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September 12, 2017

VIA HAND DELIVERY

President London Breed
c/o Angela Calvillo, Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place
City Hall, Room 244
San Francisco, CA 94102

RE: Appeal of CEQA Mitigated Negative Declaration ("MND")
Planning Case No. 2013.1383ENV
Building Permit Application Nos. 2013.12.16.4318 and 2013.12.16.4322
3516-3526 Folsom Street ("Project Site")

Dear President Breed and Honorable Members of the Board of Supervisors:

This letter supplements our prior letter to the Board of Supervisors dated September 1, 2017, on behalf of the Project Sponsors for 3516 and 3526 Folsom Street in order to address the last-minute supplemental letter filed by the Appellants on September 11, 2017.

Once again, Appellants seek to delay the Project by presenting yet more "expert" opinions challenging the adequacy of the City's CEQA review after the Planning Commission's unanimous adoption of a Mitigated Negative Declaration (the "MND") on June 15, 2017. As these "expert" opinions attempt to poke holes in the analysis contained in the March 24, 2017 Vibration Evaluation by Illingworth & Rodkin, Inc., and the MND that was published on April 19, 2017, there can be no doubt as to the motives of the Appellants in filing their letter less than 24 hours prior to the Board's hearing of their appeal. The Vibration Evaluation has been in the public record for the past five and a half months, and the MND for the past four and half months. However, these "expert" opinions by Mr. Ridings and Mr. Viani still present no substantial evidence to support a fair argument that the Project may have a significant effect on the environment. Mitigation Measure M-NO-3: Vibration Management Plan fully complies with CEQA requirements and will ensure that construction of the Project would not have a significant effect on the PG&E pipeline.

First, Mr. Ridings and Mr. Viani err by misstating factual information about the Vibration Evaluation by attempting to cast doubt on references to Caltrans criteria and making purely speculative comments on the use of inappropriate construction equipment. In fact, the vibration values cited in the Vibration Evaluation are for continuous construction equipment operation, not blasting. Furthermore, the Vibration Evaluation was accurately based on the equipment that the General Contractor and its subcontractors intend to use during the construction of the Project. Second, in response to Opinion 2 of Mr. Ridings and Mr. Viani's letter regarding compaction of the street above the PG&E pipeline, using a vibration compactor is out of the question because there are other construction methods and other uses of materials that do not require compaction, which is why it was not included in the Project Sponsors' proposed list of construction equipment. PG&E typically uses a method called "plate wacker," which would achieve 95% compaction as required by the Project. There are also other methods, like hydraulic water jet compaction or other use of materials that do not require compaction, like pouring a slurry or other similar materials. Third, Opinion 4 of Mr. Ridings and Mr. Viani's letter is purely speculative in its discussion on the depth of cover, and will not be ascertained until the Project Sponsor undergoes potholing in the street. Fourth, Mr. Ridings and Mr. Viani ignore the analysis presented in the MND and the fact that Mitigation Measure M-NO-3 adequately addresses vibration effects by providing continuous monitoring of vibration levels. Any demolition or construction work that is done within 10 feet of the PG&E pipeline must be done with on-site PG&E supervision. If vibration levels on the PG&E pipeline exceed 2 ips, then all construction must stop. The construction methods and the Project will still be reviewed and approved by PG&E engineers, and will be subject to its regulations concerning work in proximity to a pipeline. In addition, the Planning Department and the Department of Building Inspection are responsible for the enforcement of Mitigation Measure M-NO-3. Appellants still fail to present any substantial evidence that calls into question the oversight that two public agencies, completely independent from the Project Sponsors, will provide to the Project.

The opinions from Mr. Ridings and Mr. Viani do not provide substantial evidence requiring the preparation of an environmental impact report. The Project Sponsors once again respectfully request that the Board reject this appeal and uphold the Planning Department's adoption of the MND.

Sincerely,

Charles R Olson

Charles R. Olson

cc: Fabien Lannoye and Anna Limkin
James Fogarty and Patricia Fogarty
Joy Navarrete, Planning Department, Environmental Planner
Justin Horner, Planning Department, Environmental Planner

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Date: September 12, 2017

To: Fabien Lannoye
Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

From: Paul R. Donavan, Sc.D.
Illingworth & Rodkin, Inc.
1 Willowbrook Court, Suite 120
Petaluma, CA 94954

Subject: Reply to Opinions of Engineering Design & Testing Corp. Regarding the Construction Vibration Evaluation for 3516 and 3526 Folsom Street

I reviewed the opinions expressed by Mr. Ridings and Mr. Viani regarding my memo Construction Vibration Evaluation for 3516 and 3526 Folsom Street dated March 24, 2017. I have copied their specific opinions below and show my responses directly below in *italics*.

Opinion:
The vibrations were from explosives, not continuously vibrating equipment. It is understood that explosives are not planned for this project. Continuous vibrations impart cyclical loads on the pipe. The Caltrans documents suggest that acceptable PPV values for continuous vibrations are half of acceptable values for surface blasting.

Response: The vibration values reported in Table 2 of the March 24, 2017 Illingworth and Rodkin, Inc. (I&R) memo are for continuous operations for construction equipment, not blasting. The Caltrans criteria cited are for continuous construction equipment operation.

Opinion:
In the Caltrans report referenced in the Vibration Evaluation where no damage was observed when blasting vibration levels were at certain levels, there is no description as to the type of damage that was not observed or how it was determined that there was no damage. Was the pipe dug up and examined to see whether the pipe had bent? Was the determination of no damage made because no leaks were observed? Steel pipe can be damaged, compromising its strength, without immediately detectable leakage. No correlation is shown between the types of damages that were not observed in the referenced reports on the one hand, and the type of damage to LI 09 that may expected with elevated vibration levels on the other hand. Because a comparison of what constitutes damage was not made, the Caltrans report data is not a valid reference.

Response: The Caltrans "report" is actually a Vibration Guidance Manual which is a compilation of information from many sources shown on Page 76 in Table 22. The table includes a statement of "effect" for various applications which give details such as "radial cracks develop in concrete" and "shafts misaligned", etc. For the two cases that pertain to explosions near buried pipe, the observation is simply "no damage". This taken mean that no damage occurred of any kind.

Opinion:
The operating conditions, commodity and pipe specifications were not listed in the Caltrans report. Ll 09 at the Project location is a 26-inch diameter steel pipe with a maximum operating pressure (MAOP) of 150 psig and at MAOP is at a 19.8% of the pipe's specified minimum yield strength. A higher stressed pipe will become damaged at a lower value PPV than a lower stressed pipe. There was no mention of operating stress levels of the pipes in the Caltrans report. Because a correlation between the operating stress levels in the Caltrans report pipes and LI09 was not made, the Caltrans report data again is not a valid reference.

Response: See above. Again the Caltrans document is not a report but rather a State of California Guidance Document. PG&E stated that 150 psig is the maximum allowable operating pressure and that it would take a pressure of at least 750 psig to cause the steel pipe to deform. This implies that line 109 is not a "higher stressed" pipe.

Opinion:
The Spectra project involved surface explosions, different operating stress levels in the pipe than Ll09, and because the Spectra project involved the installation of new pipe, the physical condition of the pipe was known. Although PG&E may have inspection documents that show the physical condition of portions of Ll 09 in the Project and adjoining area, this information was not used in the Vibration Evaluation. This section of L109 was installed in 1981 and the slope of the hill is steep. The slope in the project area is reported to be 28%. The slope of the hill from the north end of the project to Bernal Heights Road visually appears to be even steeper. Slippage of the pipe, localized corrosion, or impact damage may have taken place since 1981 and increased the stress levels in the pipe. It cannot be assumed that what was acceptable to the pipe in the Spectra project is acceptable for L109. As with the Caltrans reports, a correlation was not made between stress levels in the pipe. Further, the Spectra project involved installation of new pipe in what appears to be a nearly horizontal street. The Vibration Evaluation did not take into consideration the physical condition ofL109 or bending stresses that may exist with the changes in grade.

The Spectra analysis is inapplicable to the Project, and it is an inadequate basis for designing Project mitigation measures that will reduce Project impacts to a level of insignificance.

Response: The West Roxbury project was for explosions, not construction vibration. This citation was used a point of reference and not intended to be a criteria for the Folsom Street project. The calculated velocities are based on established ground vibration values for various type of construction equipment and these are at or below the criterion for industrial buildings. From the PG&E testing routinely done on gas transmission lines, there appears to be no special concerns for L190.

Opinion:
Based on the above, the Vibration Evaluation is not complete nor is it representative of this project and is not appropriate to use as a basis for determining safe levels of vibration to LI09.

Since the Vibration Evaluation is not complete or representative, it cannot be used as a reference or comparison to validate PG&E's maximum vibration level of 2 ips. PG&E did not provide a basis for their PPV value of 2 ips and it does not appear that they were they asked to provide one. As a result, there is no basis for any of the maximum vibration levels in the Vibration Evaluation and MND.

Response: Construction Vibration Evaluation for 3516 and 3526 Folsom Street is complete and representative of the project based on the equipment listed by the applicant and the accepted vibration levels associated with them. There is no reference to PG&E maximum vibration limit of 2 in/s. A PPV value of 2 in/s was cited based on that for industrial buildings.

Opinion:
For example, compaction of the street above L109. PG&E's March 30, 2017 letter to the San Francisco Planning Department states that the depth of cover over L109 could be as shallow as 24 inches. Per the Grading Plan prepared by David Franco dated 9/21/16 indicates that roadway excavation is estimated to be 12-inches. Placement and compaction of subgrade and/or base rock will require the use of compaction equipment. For example, using the Vibration Evaluation value of 0.21 ips at 25 feet for a vibratory compactor from the Illingsworth March 24, 2017 report titled "Construction Vibration Evaluation for 3516 and 3526 Folsom Street", with the compactor 3.3 feet away from the pipe, the PPV at the pipe is calculated to be 4.3 ips. With the compactor 1 foot above the pipe, the PPV is calculated to be 26.26 ips. This PPV level is significantly higher than the 2.0 ips that PG&E has said is acceptable. Although the basis for PG&E' s level has not been made known, it is reasonable to believe that significantly higher levels, such as 26.26 ips will damage L109, which may result in a catastrophic release of natural gas from L109.

Response: The use of a vibratory compactor is not planned for this project. As the street extension will be constructed from portland cement concrete.

Paul R. Donavan

Paul R, Donavan, Sc.D.
Principal
Illingworth & Rodkin, Inc.

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September 11, 2017

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(Note: Pursuant to California Government Code, Section 65009(b)(2), information received at, or prior to, the public hearing will be included as part of the official file.)

VIA HAND DELIVERY AND EMAIL

President London Breed
c/o Angela Calvillo, Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place
City Hall, Room 244
San Francisco, CA 94102

Re: Appeal of CEQA Mitigated Negative Declaration
Planning Case No. 2013.1383ENV
Building Permit Application Nos. 2013.12.16.4318 and 2013.12.16.4322
3516 and 3526 Folsom Street ("Project Site")

Dear President Breed and Honorable Members of the Board of Supervisors:

Please find the following document enclosed:

Exhibit

O. Independent Evaluation of the San Francisco Planning Department Mitigated Negative Declaration, prepared by Engineering Design & Testing Corp. (Kenneth Ridings, P.E. and Steve Viani, P.E.), Sept. 11, 2017

The reviewing engineers conclude:

> As a result of these deficiencies in the MND, a significant possibility of a catastrophic release of natural gas from L109 during construction of the Project still exists. . . . **Based on our review and analysis, it is our expert opinion that there still exists a high risk that has not been mitigated based on our review of the MND. It is our opinion the failure to mitigate the risks are significant and a potential for damage and explosion of PG&E's gas transmission pipeline L109 still exists.** (Report, pp. 4, 10.)

Without question, this report constitutes substantial evidence requiring the preparation of an environmental impact report (EIR). A mitigated negative declaration cannot be adopted unless "there is **no substantial evidence** in light of the whole record before the public agency that the project, as revised, **may** have a significant effect on the environment." (Pub. Resources Code, § 21064.5 (emphasis added).)

"If the administrative record before the agency contains substantial evidence that the project may have a significant effect on the environment, **it cannot adopt a negative declaration**; it must go to on the third stage of the CEQA process: preparation and certification of an EIR." (Gentry v. City of Murrieta (1995) 36 Cal.App.4th 1359, 1372, as modified on denial of reh'g (Aug. 17, 1995) (emphasis added), citing Pub. Resources Code §§ 21100, 21151; Guidelines, §§ 15002, subd. (k)(3), 15063, subd. (b)(1), 15064, subds. (a)(1), (g)(1), 15362.))

Very truly yours,

ZACKS, FREEDMAN & PATTERSON, PC

Ryan J. Patterson
Attorneys for Herb Felsenfeld and Gail Newman

EXHIBIT O

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September 11, 2017

SF Board of Superviors
San Francisco City Hall
1 Dr, Carlton B Goodlett Pl. #244
San Francisco, CA 94102

REFERENCE: 3516 and 3526 Folsom Street, San Francisco, CA
SF Planning Department Case No. 2013.1383ENV
ED&T File Number: OAK2319-61292

Dear President Breed and Honorable Members of the Board of Supervisors,

This letter is in response to a request for Engineering Design & Testing (ED&T) to conduct an independent evaluation of the San Francisco Planning Department Mitigated Negative Declaration (MND) for the 3516 & 3526 Folsom Street project (Project) as it pertains to Pacific Gas & Electric Company's (PG&E) natural gas transmission pipeline L109. Mr. Steven Viani, P.E. and Mr. Kenneth Ridings, P.E. reviewed the following documents in the evaluation, which are sufficient to analyze the Project's MND:

- The MND with a focus on Impact NO-3 and referenced footnote documents, Figures 1-12 and Mitigation Measures
- MND Appeal dated September 5, 2017
- Spectra Energy Partners - Algonquin Incremental Market Project – Analysis of the West Roxbury Crushed Stone Operations on Construction and Operation of the West Roxbury Lateral dated March 31, 2014
- Letter from Lubin Olson to President London Breed dated September 1, 2017 regarding Appeal of MND
- Reported email from Austin Sharp with PG&E (date understood to be mid-2014) to Debra Gerson and Herb Felsenfeld (nearby neighbors to the project) and Fabien Lannoye (Bluorange Designs) contained as Appendix A in letter from Lubin Olson to President London Breed dated September 1, 2017
- 49 Code of Federal Regulations Part 192 – Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

- ASME B31.8S-2016 Managing System Integrity of Gas Pipelines
- U.S. Department of Transportation - Pipeline and Hazardous Materials Administration – Reportable Incident Data
- Foot note 3: John Dolcini, Pipeline Engineer-Gas Transmission, Pacific Gas and Electric Company, Letter Re: 3516/3526 Folsom Street, March 30, 2017
- Foot note 20: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment, May 2006, pp. 8-1 to 8-3, Table 8-1.
- Foot note 30: US Department of Transportation, Federal Highway Administration, Construction Noise Handbook, Table 9.1, July 2011.
- Foot note 31: Illingworth and Rodkin, Inc., Construction Vibration Evaluation for 3516 and 3526 Folsom Street, March 24, 2017.
- Illingsworth & Rodkin Inc., Memo: Ground Characteristics and Effect on Predicted Vibration, April 14, 2017.
- California Department of Transportation, Transportation and Construction Vibration Guidance Manual, September 2013.
- PG&E Gas Transmission Pipeline Services—Integrity Management, 3516/26 Folsom Street, March 30, 2017.
- H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3516 Folsom Street, San Francisco, California, August 3, 2013. H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3526 Folsom Street, San Francisco, California, August 3, 2013.
- Geotechnical Report Update, Proposed Residence at 3516 & 3526 Folsom Street San Francisco, California by H. Allen Gruen,11/29/16
- Geotechnical Responses to Project Review Letter, Proposed Residence at 3516 & 3526 Folsom Street San Francisco, California by H. Allen Gruen, 1/24/17
- Review of Proposed Pipeline Impacts 3516 & 3526 Folsom Street, San Francisco, California, Storesund Consulting, June 14, 2017
- Mitigated Negative Declaration Appeal, 3516 & 3526 Folsom Street September 5, 2017, San Francisco Planning Department
- David J. Franco PE, 3516 & 3526 Folsom Street Grading Plan, 9/21/16
- Planned Street and Utility Improvements at 3516 & 3526 Folsom Street San Francisco, California by H. Allen Gruen, 7/6/17

Please note that the preceding is based on information available at the time of this writing. It is conceivable that additional information may be forthcoming which bears on stated observations and opinions. The right is reserved, therefore, to review and modify all observations and opinions at any future point in time should, in fact, additional information become available.

Mr. Ridings is a licensed Professional Mechanical Engineer in California and other states. I worked in the "gas department" at PG&E for 25 years beginning in 1979 and have worked at ED&T since 2005.

While at PG&E, I worked in field operations (gas distribution and transmission) for 9 years and in corporate staff support departments for 16 years. While in field operations I supervised multi-disciplined work groups responsible for the engineering, design, operations and maintenance of 2700 miles of distribution and transmission pipelines, including locating and marking underground pipes, investigated gas incidents and damage caused by third party dig-ins and reviewed street construction plans for conflicts with gas facilities.

While in corporate staff support at PG&E, I investigated the cause of and emergency response to gas distribution and transmission incidents; interpreted regulatory code requirements; developed certain engineering, construction, and operations and maintenance standards for gas distribution facilities; oversaw the development and implementation of certain construction, engineering, operations and maintenance standards, procedures for gas distribution piping systems including the locating and marking of underground pipes; and oversaw staff that provided training and technical support to field operations.

Currently at ED&T I conduct engineering investigations to determine the cause of damage to or from fuel gas piping systems and facilities; infrastructure utilities and piping systems; HVAC and refrigeration systems; fire suppression systems; cranes/heavy equipment, machinery and equipment.

Mr. Viani has over 40 years professional experience planning, designing and constructing, civil, environmental and geotechnical projects. I am a registered civil engineer in California and two other states. In addition, I am a licensed engineering (A) and building (B) contractor with a hazardous waste removal endorsement. Throughout my career, I have been involved with the CEQA process for a variety of projects including wastewater treatment, environmental remediation and environmental protection. During my tenure with ED&T, I have been involved with numerous related assignments involving the identification and assessment of vibration from construction equipment and blast related vibration damage.

The above qualifies us to evaluate the MND as it pertains to PG&E's gas transmission pipeline L109.

Our Curriculum Vitaes are attached.

Based on our review of the Project and the aforementioned documents, ED&T's findings and expert opinions of the MND are:

1. The Construction Vibration Evaluation (Vibration Evaluation) performed by Illingworth and Rodkin, Inc. on behalf of Bluorange is not complete and does not accurately determine what vibration level is safe for L109.
2. The Vibration Evaluation does not adequately address the types of equipment that may be used and the vibration levels imparted on L109 by said equipment.
3. Impact NO-3 was not adequately analyzed and mitigated.
4. The height of soil (cover) on top of L109 in the Project area has not been determined. The cover must be determined prior to issuance of a mitigated negative declaration because the following steps cannot be taken without this information:
   a. Determination of whether the pipeline risk will increase, decrease or remain the same following construction of the project.
   b. Determination of whether the soil cover over the pipe is too shallow and what mitigation measures need to be imposed.
   c. Determination of safe designs and specifications for the Project to ensure that the Project remains stable, rather than being significantly changed during construction as a result of observed physical conditions of L109 and depth of cover.
5. That a PG&E inspector, or an independent, qualified third party inspector, be present for the entire project.
6. That every project employee be trained in PG&E's requirements and restrictions for working in the vicinity gas transmission pipelines and requirements that are specific to the Project.

As a result of these deficiencies in the MND, a significant possibility of a catastrophic release of natural gas from L109 during construction of the Project still exists.

Opinion 1: The Vibration Evaluation for the proposed project references a Caltrans report where a Peak Particle Velocity (PPV) value of 25 inches/second (ips) associated with explosives near buried pipe resulted in no damage to the pipe, as did values for explosives near buried pipe of 50-150 ips. PPV is the speed of a particle in a medium as it transmits a wave. It is a measurement of vibration. These vibrations can cause damage to any structure.

The MND states that the Vibration Evaluation utilized a "conservative" 12 ips, a value that was in the Spectra Energy report, as the criterion for potential damage to L109. The Spectra project involved determining the impacts of blasting at a rock quarry on a proposed natural gas transmission pipeline in Massachusetts.

Problems with the Vibration Evaluation and MND include:

- The vibrations were from explosives, not continuously vibrating equipment. It is understood that explosives are not planned for this project. Continuous vibrations impart cyclical loads on the pipe. The Caltrans documents suggest that acceptable PPV values for continuous vibrations are half of acceptable values for surface blasting.

- In the Caltrans report referenced in the Vibration Evaluation where no damage was observed when blasting vibration levels were at certain levels, there is no description as to the type of damage that was not observed or how it was determined that there was no damage. Was the pipe dug up and examined to see whether the pipe had bent? Was the determination of no damage made because no leaks were observed? Steel pipe can be damaged, compromising its strength, without immediately detectable leakage. No correlation is shown between the types of damages that were not observed in the referenced reports on the one hand, and the type of damage to L109 that may expected with elevated vibration levels on the other hand. Because a comparison of what constitutes damage was not made, the Caltrans report data is not a valid reference.

- The operating conditions, commodity and pipe specifications were not listed in the Caltrans report. L109 at the Project location is a 26-inch diameter steel pipe with a maximum operating pressure (MAOP) of 150 psig and at MAOP is at a 19.8% of the pipe's specified minimum yield strength. A higher stressed pipe will become damaged at a lower value PPV than a lower stressed pipe. There was no mention of operating stress levels of the pipes in the Caltrans report. Because a correlation between the operating stress levels in the Caltrans report pipes and L109 was not made, the Caltrans report data again is not a valid reference.

- The Spectra project involved surface explosions, different operating stress levels in the pipe than L109, and because the Spectra project involved the installation of new pipe, the physical condition of the pipe was known. Although PG&E may have inspection documents that show the physical condition of portions of L109 in the Project and adjoining area, this information was not used in the Vibration Evaluation. This section of L109 was installed in 1981 and the slope of the hill is steep. The slope in the project area is reported to be 28%. The slope of the hill from the north end of the project to Bernal Heights Road visually appears to be even steeper. Slippage of the pipe, localized corrosion, or impact damage may have taken place since 1981 and increased the stress levels in the pipe. It cannot be assumed that what was acceptable to the pipe in the Spectra project is acceptable for L109. As with the Caltrans reports, a correlation was not made between stress levels in the pipe. Further, the Spectra project involved installation of new pipe in what appears to be a nearly horizontal street. The Vibration Evaluation did not take into consideration the physical condition of L109 or bending stresses that may exist with the changes in grade.

  The Spectra analysis is inapplicable to the Project, and it is an inadequate basis for designing Project mitigation measures that will reduce Project impacts to a level of insignificance.

- The 2014 email from PG&E states that there are three federally-approved methods to complete a transmission pipeline integrity management baseline assessment:
  - In-Line Inspections (ILI) – An ILI involves a tool (commonly known as a "pig") being inserted into the pipeline to identify any areas of concern such as a potential metal loss (corrosion) or geometric abnormalities (dents) in the pipeline.

- External Corrosion Direct Assessment (ECDA) – Involves an indirect, above-ground electrical survey to detect coating defects and the level of cathodic protection. Excavations are performed to do a direct examination of the pipe in areas of concern as required by federal regulations.
- Pressure Testing (PT) – PT is a strength test normally conducted using water, which is also referred to as a hydrostatic test.

PG&E performed an ECDA of L190 in this area in 2009 and another one was scheduled in 2015. No issues were found in 2009.

Based on the above, the Vibration Evaluation is not complete nor is it representative of this project and is not appropriate to use as a basis for determining safe levels of vibration to L109.

Since the Vibration Evaluation is not complete or representative, it cannot be used as a reference or comparison to validate PG&E's maximum vibration level of 2 ips. PG&E did not provide a basis for their PPV value of 2 ips and it does not appear that they were they asked to provide one. As a result, there is no basis for any of the maximum vibration levels in the Vibration Evaluation and MND.

Opinion 2: The Vibration Evaluation does not include types of equipment for some construction scenarios that are likely to occur such as excavation of the Chert bedrock, shoring and compaction of the street.

For example, compaction of the street above L109. PG&E's March 30, 2017 letter to the San Francisco Planning Department states that the depth of cover over L109 could be as shallow as 24 inches. Per the Grading Plan prepared by David Franco dated 9/21/16 indicates that roadway excavation is estimated to be 12-inches. Placement and compaction of subgrade and/or base rock will require the use of compaction equipment. For example, using the Vibration Evaluation value of 0.21 ips at 25 feet for a vibratory compactor from the Illingsworth March 24, 2017 report titled "Construction Vibration Evaluation for 3516 and 3526 Folsom Street", with the compactor 3.3 feet away from the pipe, the PPV at the pipe is calculated to be 4.3 ips. With the compactor 1 foot above the pipe, the PPV is calculated to be 26.26 ips. This PPV level is significantly higher than the 2.0 ips that PG&E has said is acceptable. Although the basis for PG&E's level has not been made known, it is reasonable to believe that significantly higher levels, such as 26.26 ips will damage L109, which may result in a catastrophic release of natural gas from L109.

Opinion 3: Based on Opinions 1 and 2, Impact NO-3 has not been adequately analyzed and mitigated.

Opinion 4: PG&E requires a minimum of 3 feet of soil cover over gas lines and a maximum of 7 feet. PG&E stated that the soil cover over L109 may be as low as 24-inches. PG&E did not address what corrective action is needed if the cover is less than required nor did they mention the risk impact if the cover is less than required.

Depth of cover may be a component of PG&E's Gas Transmission Pipeline Integrity Management program, a federal regulatory requirement of natural gas transmission system owners and operators such as PG&E. A less than required cover may impact the risk of that segment and mitigation measures may need to be taken. Mitigation measures are not included in the MND regarding the pipeline cover.

The impacts of less than required cover was not analyzed in the MND nor were mitigation measured addressed.

Any grading or excavation within 2 feet of L109 must be done by hand. Potholing and exposing the top portion of the pipe is required to determine which sections above the pipe can be graded or trenched by equipment. Potholing will expose the top portion of the pipe.

Grade cuts for street construction above L109 is 12-inches according to the Franco Grading Plan dated 9/2/16. Grade cuts of 12-inches would leave 12-inches above the pipeline where existing cover is 24-inches. Because of vibration and/or wheel loading restrictions, the equipment mentioned in the MND may not be safe to be used in shallow sections.

The design prepared for the extension of Folsom St. shown in the Grading Plan requires use of a full sized roller for compaction and the required level of aggregate base compaction is 95%, in 6 inch lifts. Compaction to 95% requires an increased number of passes over the more typical compaction level of 95% Modified Proctor testing. As noted above in Opinion 2, the PPV of a vibratory compactor 1 foot above the pipe is calculated to be 26.26 ips, which exceeds the maximum threshold of 2.0 set by PG&E.

Hand digging over L109 is required for all new utility crossings (water, sewer, electric, gas, communications) so there may be more locations where L109 will be potholed.

Exposing the pipeline before detailed design or construction begins also provides visual information regarding the physical condition of the pipe which can be used in performing the vibration analysis and PG&E's risk assessment of this section.

Given that:

- Some potholing and exposing L109 is required, and
- the information gained from potholing will yield information used in determining safe vibration levels, and
- the information from potholing will limit the types of construction equipment and activity in the vicinity of L109, and
- mitigation measures may be needed to correct less than required cover over L109,

exploratory potholing of L109 should have been completed prior to issuance of the MND.

Opinion 5: From January 2010 through September 8, 2017, excavation damage was the leading cause of unintended gas releases from transmission pipelines in California. PG&E is not under contract with the Project's general and sub-contractors/developer. Nor are the Project's general and sub-contractors/developer under contract with PG&E. There are many PG&E requirements/restrictions of the contractor when working within 10 feet of the pipeline, which is an approximate 3 feet from the front wall of the planned residences. Having an on-site inspector at all times would facilitate scheduling changes by the contractor and eliminate lack of communications and reduce the risk of damage to L109, but this was not required as a Mitigation Measure.

Opinion 6: Every Project employee should be trained in PG&E's requirements and restrictions for working in the vicinity of gas transmission pipelines. Given the significant risks posed by the Project, this should have been required as a Mitigation Measure.

Please note that the preceding is based on information available at the time of this writing. It is conceivable that additional information may be forthcoming which bears on stated observations and opinions. The right is reserved, therefore, to review and modify all observations and opinions at any future point in time should, in fact, additional information become available.

Based on our review and analysis, it is our expert opinion that there still exists a high risk that has not been mitigated based on our review of the MND. It is our opinion the failure to mitigate the risks are significant and a potential for damage and explosion of PG&E's gas transmission pipeline L109 still exists.

Regards,

P.E.

Kenneth R. Ridings, P.E.

P.E.

Steven P. Viani, P.E.

Attachments

REGISTERED PROFESSIONAL ENGINEER
KENNETH R. RIDINGS
27526
EXP. 6/30/19
MECHANICAL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
STEVEN VIANI
No. C60965
3/31/18
CIVIL
STATE OF CALIFORNIA

Please note that the preceding is based on information available at the time of this writing. It is conceivable that additional information may be forthcoming which bears on stated observations and opinions. The right is reserved, therefore, to review and modify all observations and opinions at any future point in time should, in fact, additional information become available.

ENGINEER: MECHANICAL
PROCESS
UTILITIES

KENNETH R. RIDINGS, P.E.
Engineering Manager
Engineering Design and Testing Corp.
Post Office Box 5126
Concord, California 94524
(925) 674-8014
kenridings@edtengineers.com

EDUCATION

August, 1979	Bachelor of Science, Mechanical Engineering, University of Utah, Salt Lake City, Utah

PROFESSIONAL EXPERIENCE:

2005 to present	**Engineering Design and Testing Corp., Oakland, California** Assistant Vice President, District Engineering Manager and Consulting Engineer - Investigation of incidents involving natural gas piping systems and facilities; moisture intrusion and damage in residential and commercial buildings and industrial facilities; infrastructure utilities and piping systems; HVAC and refrigeration systems; fire suppression systems; cranes/heavy equipment, machinery and equipment. Services provided include failure analysis and causation identification, scope of damage evaluations, estimate repair/replacement costs, claims analysis, standards and codes interpretation, fire origin and cause, and construction monitoring and timeline scheduling.
1998 - 2004	**Pacific Gas & Electric Company, San Francisco, California** Manager – Conducted investigations of major gas incidents. Responsible for development and implementation of construction, engineering, operations and maintenance standards, procedures for gas distribution piping systems. Prepared expert testimony and testified in California Courts on behalf of PG&E's gas distribution capital and expense investments for the 1999 regulatory funding proceedings.
1993 – 1998	**Pacific Gas & Electric Company, San Francisco, California** Senior Distribution Engineer – Investigated cause and emergency response of gas distribution and transmission incidents. Interpreted regulatory code requirements. Developed engineering, construction, and operations and maintenance standards for pipe rehabilitation, valves, fittings, pressure control facilities and substructure enclosures. Investigated system operations, material, equipment, and facility failures.
1989 – 1993; 1984 – 1988	**Pacific Gas & Electric Company, Fresno, California** Division Engineer – Supervised multi-disciplined work groups responsible for the engineering, design, operations and maintenance of transmission and

	distribution systems, including cathodic protection. Investigated gas incidents including fires and explosions and damage caused by third party dig-ins.
1988 – 1989	**Pacific Gas & Electric Company, Fresno, California** Transmission and Regulation Supervisor – Supervised technical workgroup responsible for operations and maintenance on 2700 miles of pipeline and 165 pressure control stations. Scheduled work, prepared and directed system sequence of operations changes, and diagnosed system operations.
1984	**Pacific Gas & Electric Company, Antioch, California** Area Engineer - Responsible for cathodic protection, facility records management, design and cost estimate preparation, engineering of gas transmission pipelines and associated facilities.
1979 – 1984	**Pacific Gas & Electric Company, Walnut Creek, California** Engineer - Designed and engineered gas transmission pipe line, metering, and compressor station facilities. Specified water treatment and heat exchanger operations and maintenance at compressor stations. Performed pipe loading and stress analysis, and hydraulic capacity and system planning analysis.
1978-1979	**Northwest Pipe Line Company, Salt Lake City, Utah** Engineering Intern – Facility engineering, perform cathodic protection analysis and prepare recommendations.

PROFESSIONAL ORGANIZATIONS:

ASM International (ASM)
American Society of Mechanical Engineers (ASME)
California Conference of Arson Investigators (CCAI)
East Bay Claims Association – Vice President 2012-13
National Association of Fire Investigators (NAFI)
National Fire Protection Association (NFPA)
National Society of Professional Engineers (NSPE)
National Association of Subrogation Professionals (NASP)

September 2015

PROFESSIONAL REGISTRATIONS:

Registered Professional Engineer – Arizona (#44546)
Registered Professional Engineer – California (#M27526)
Registered Professional Engineer – Idaho (#14379)
Registered Professional Engineer – Hawaii (#14923)
Registered Professional Engineer – Montana (#19897)
Registered Professional Engineer – Nevada (#021117)
Registered Professional Engineer – Oregon (#78334PE)
Registered Professional Engineer – Utah (#180944-2202)
Registered Professional Engineer – Washington (#42731)
National Council of Examiners for Engineering and Surveying (#28431)

CONTINUING EDUCATION:

2010 Fire Pump Seminar
National Fire Protection Association
Reno, Nevada

2007 Investigation of Gas & Electric Appliance Fires
Western Michigan University
Kalamazoo, Michigan

2006 Fire and Explosion Investigation
National Association of Fire Investigators
Sarasota, Florida

2006 Mechanical and Electrical Estimating
RS Means
Las Vegas, Nevada

EXPERIENCE – ENGINEERING INVESTIGATIONS (partial listing)

Natural Gas Pipeline and Facilities

Damage to Pipelines Caused by Third Party Dig-Ins – Multiple Locations, California
Examine damaged pipe and site location, review utility locate and mark records, review "call before you dig" records, review third party records, and determine cause of dig-in. Evaluate scope of damage, emergency response and repair activities. Review utility repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Compressor Station Fire – Gillette, Wyoming
Examine station and equipment, review operating records and other documents and determine cause of fire.

Gas Explosions and Fires – Multiple Locations, California
Investigate and determine whether natural gas fueled explosions and fires were caused by natural gas utility facilities and/or operations.

Underwater River Crossings – Calgary, Canada
Examine three separate pipeline crossings underneath flooded rivers, review inspection records, conduct underwater survey, and determine scope of damage of pipelines. Evaluate the repair/replacement scope of work and estimated costs.

Overpressurization of Low Pressure Distribution System – Alameda, California
Lead investigation and determine cause of overpressurization of a low pressure system and evaluate gas utility emergency response. Examine pressure control station equipment and maintenance records, system operation records, emergency response sequence of events.

Pressure Regulator Stations – Multiple Locations, California
Determine cause of pressure regulator valve failures at multiple regulator stations and metering facilities.

Commercial and Residential (Single and Multi-Story)

Moisture/Water Intrusion – Multiple Locations
Investigation of 200+ incidents involving water supply, irrigation, HVAC, waste, drainage, and fire sprinkler system piping and associated fittings, connector hoses, and equipment; water heaters and boilers; restroom and kitchen faucets and appliances; washing machines.

Heat and Smoke Damaged Generator Ductwork – Mesa, Arizona

Review of drawings, fire damage reports, repair costs, business interruption estimates and other documents to determine scope of damage. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Leaking Chiller Tubes at Medical Center – Bakersfield, California

Examine chiller system and evaporator, review manufacturer drawings and equipment specifications, review operating records. Determine cause and scope of damage. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Dry Cleaning Equipment – Chandler, Arizona

Examine equipment, review equipment specifications, service records and other documents, determine cause of leaks in equipment steam chamber.

Collapsed Car Lift – San Francisco, California

Examine steel member framed, hydraulic powered car lift, review manufacturer specifications, drawings and other documents, determine cause of collapse.

Hail Damaged Roof Top HVAC Condensers – Scottsdale, Arizona

Examine condensers, identify impact damage caused by hail and determine reparability. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Leaking Hydraulic Elevator Casing – Multiple Locations

Examine elevator equipment, service records and other documents and determine cause of leak.

Water Damage to Elevator Components (multiple) – Multiple Locations

Examine elevator system components, identify water contacted components, and determine scope of damage, if any, to water contacted components. Evaluate repair cost proposals as to appropriateness of repair and associated costs.

Construction

Crane Tipover – San Ramon, California

Examine crane and highway construction site, review crane specifications, operator log and other documents and determine cause of tipover. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Mechanical Lift Tipover – Groveland, California
Examine lift and residence construction site, review lift specifications and determine cause of tipover.

Crawler Crane Tipover – West Olive, Michigan
Examine crane at generation plant, determine scope of damage from tipover and cost to repair. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Leaking Toilets in Condominiums Building – San Jose, California
Examine toilet installations, review manufacturer specifications and instructions, review test reports and determine cause of leaks.

Leaking Water Supply Valves in Multi-Unit Residential Buildings – Walnut Creek, California
Examine valves and installation, review manufacturer specifications and literature, determine cause of fractures in valve bodies.

Fire Investigations

Equipment and Appliances – Multiple Locations
Investigation of fires involving furnaces, water heaters, cooking and other appliances.

Industrial

Moisture/Water Intrusion – Multiple Locations
Investigation of incidents involving water supply, HVAC, boilers and water heater equipment, piping, and associated fittings.

Imploded Milk Storage Tank – Hanford, California
Examine tank, tank service and dairy operating records, manufacturer drawings and specifications and determine cause of implosion.

Imploded Fermentation Tank – Ukiah, California
Examine tank and process equipment at brewery, review operating records, drawings, sequence of operations, manufacturer specifications and other documents and determine cause of implosion. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Imploded Storage Tank at Ethanol Plant – Cambridge, Nebraska
Examine plant and tank, review operating records and system design, coordinate testing of valve, and determine cause of collapse.

Single-Axis Solar Panel Tracker System Detachment – McCarran, Nevada
Examine tracker system and panels, review operating records and design documents, review snowfall and other weather records, and determine cause of detachment.

Ammonia Release at Cold Storage Facility – Phoenix, Arizona
Examine refrigeration equipment, review manufacturer specifications, review maintenance records, test components, and determine cause of ammonia release.

Utilities Service Interruption – Harahan, Louisiana
Review documents and determine duration and cause of service interruptions to a cold storage facility

Shiploader Tipover– Vancouver, Washington
Examine shiploader and bearing assembly, review design drawings and operating records, review video of incident, supervise other discipline engineers, and determine cause of tipover.

Damaged Retort MIG Thermometer – Corning, California
Examine retort, thermometer, and process equipment at olive processing facility, review operating records, FDA requirements, sequence of operations, manufacturer specifications and other documents and determine cause of damage to thermometer.

Logging Vehicle Fire Suppression System – Burns Lake, British Columbia, Canada
Examine fire damaged logging vehicle and fire suppression system, review multiple documents and determine why suppression system did not discharge.

Controlled Atmosphere Room at Cold Storage Facility – Multiple Locations, Washington
Examine facility Atmosphere Control System and refrigeration system, review test reports and facility records, and with a fruit harvest specialist, determine if damage to stored fruit was the result of a malfunction in the systems.

Chiller Coil Tube Leaks at Cold Storage Facility – Reedley, California
Examine facility and chiller tubes, review facility operations, review test reports and other documents and determine cause of leaks.

Fire Damaged Distillation Column at Ethanol Plant - Clinton, Iowa
Examine plant and column and review plant drawings and records. Determine scope of damage, cost of repairs and work schedule to facilitate repairs.

Digester Overpressure, Water Treatment Plant – Delano, California
Examine digester and associated equipment, review facility drawings, operating records and determine cause of overpressure.

Damaged PVC Piping System Containing CO2 Gas – Corning, California

Examine Carbon dioxide vaporizer and overhead PVC piping system in olive processing facility, review drawings, service records, weather records, operating and other documents and determine cause of damage.

Water Well Contamination – Live Oak, California

Examine well, review well inspection videos, water quality reports and other documents, and determine cause of contamination.

Water Well Collapse (2) – Corcoran, California

Examine well head and inspection videos, review drilling logs well test records and other operating documents and determine cause of collapse. Review repair documents as to appropriateness of repairs and reasonableness of costs.

Water Pumping Plant – Walnut Creek, California

Examine plant, review manufacturer specifications, design drawings and other documents, and determine cause of coupling detachment. Supervise other engineering disciplines to evaluate scope of water damage to building components, and electrical and mechanical equipment. Review repair documents as to appropriateness of repairs and reasonableness of costs.

Water Treatment Plant – Livermore, California

Examine damaged clarifier equipment, review construction, maintenance and test records, and determine cause of damage. Review repair documents as to appropriateness of repairs and reasonableness of costs.

Whirlybird Type Crane Tipover – Seattle, Washington

Examine crane, determine scope of damage, conduct research on used crane prices, and determine value of damage.

Fire Damaged Conveyor, Recycling Power Generation Plant – Oroville, California

Examine conveyor and associated electrical and mechanical equipment. Review construction drawings, operating records, repair cost estimates and other documents. Engage other engineering disciplines to determine scope of damage and reparability. Review repair documents as to appropriateness of repairs and reasonableness of costs.

Ammonia Refrigeration System – Coalinga, California

Examine refrigeration system, review facility and system drawings, service records and other documents and determine cause of ammonia release.

Corroded At-Grade Water Storage Tank – San Luis Obispo, California

Examine tank and attached piping, review cathodic protection system installation and service records, review other records, test insulation points, and determine cause. Determine scope of damage. Review repair documents as to appropriateness of repairs and reasonableness of costs. Monitor repair schedule.

Leaking At-Grade Gasoline Storage Tank – Las Vegas, Nevada

Examine tank, associated equipment, and tank farm cathodic protections system. Review tank and cathodic protection system drawings, operating records, manufacturer instructions, test records and other documents. Determine cause of leaks.

Marine

Ship Container Fire – Pacific Ocean

Examine ship containers and contents at Port of Seattle, review ship drawings and records, review manufacturer specification of container contents, and determine cause of fire.

Water Damaged Motors – Fairfield, California

Examine motors and packaging, review transport records and historical weather records, conduct laboratory tests, and determine if source of moisture was during transit or after motors were off-loaded from truck.

Pontoon Boat Lift Separation – Discovery Bay, California

Examine lift and documents and determine cause of separation.

Other

Hiker Fall – Muir Woods, California

Review documents, examine fall location, and determine if the involved trail had been maintained in accordance with regulatory requirements and to determine if the conditions of the incident location were dangerous and hazardous.

Roller Blader Fall – Ixtapa, Mexico

Conduct elevation survey and coefficient-of-friction tests on concrete trail.

Mobile Paper Shredder Truck – Fresno, California

Examine truck and paper shredder, review design drawings and determine cause of mechanical damage to shredder.

LEGAL CONSULTATION – PEER REVIEW (partial list)

Natural Gas Explosion – Seattle, Washington

Review gas utility maintenance and emergency response records, review Washington State regulatory requirements, review regulatory agency reports, review expert and testing agency reports and other documents and provide opinion as to the cause of the explosion.

Natural Gas Explosion – Sublette, Kansas

Review gas utility maintenance standards, maintenance and operating records, Kansas State regulatory requirements and other documents. Provide opinion as to cause of explosion.

Moisture Intrusion – Multiple

Review manufacturer, engineering, and investigation reports regarding separated piping system components. Provide opinions as to cause of separated components.

Steven P. Viani, P.E
spviani@aol.com
(916-952-8503)

Education and Specialized Training

BS Civil Engineering, California State University, Sacramento
Graduate courses in Geotechnical Engineering
Continuing education classes in claims avoidance, negotiations and project management
OSHA 40 hour training
USACOE Construction Quality Management Certification

Professional Registrations

Registered Civil Engineer in California, Arizona and Washington
Licensed A, B & Haz. Contractor (RMO Alvia Services Inc)

Employment History

State Water Resources Control Board (2-year assignment with Army Corps of Engineers)-Associate Engineer	(1977-1982)
Kellogg Corporation-Senior Engineer	(1982-1983)
Department of Health Services-Senior Engineer	(1984-1987)
Roy F. Weston, Inc.-Project Director	(1987-1990)
Canonie Environmental Services, Inc.-Western Regional Manager	(1990-1994)
Geo Con Inc.-Western Regional Manager	(1994-1998)
Layne-Christensen Co.-Western Regional Manager	(1998-1999)
BCN Company-Vice President of Operations	(1999-2001)
Donald B. Murphy Contractors Inc.-Regional Manager	(2001-2003)
Private Consulting/Alvia Services Inc	(2003-Present)

Representative Experience

Over the past 40 years, has held senior level positions in construction, consulting and governmental entities. Have managed, directed or performed projects ranging from $3000 Phase 1 Preliminary Site Assessments to $20 Million site remediations, including many large and significant environmental and geotechnical construction projects as a direct hire contractor. Have 25 plus years experience in managing business units and design departments with total P+L responsibility and staff management up to 35 people. Have worked nationwide and internationally in Asia and Europe.

Legal, Claims and Defect Oriented Experience

- Developed a remediation plan for the removal of construction debris in Malibu, CA. Project involved the determination of quantity, permitting, construction oversight and closure parcel containing illegally disposed debris. Los Angeles County and Coastal Commission involvement.
- Provided expert review of shoring/scaffolding failure at mid-rise residential/commercial building in San Francisco that was overloaded.
- Provided expert services for water damage and intrusion for single family housing, multi-family housing and businesses involving stucco, windows, roofs, siding from wind-driven rain, expansive soils and mechanical damage.
- Provide expert services for a fatal accident involving improperly secured construction equipment on a construction site in Northern California.

- Provided expert services, including accident reconstruction of a major fall injury case involving truck loading at an active wastewater treatment facility in the San Francisco area.
- Provided expert witness services for issues related to a subsiding rock retaining wall causing damage to an adjacent dwelling in San Francisco, CA.
- Provided inspection/evaluation of 50+ residential and commercial damaged by a refinery explosion in Utah.
- Provided expert engineering review of construction defects and standard of care associated with sewer lines, water lines, moisture intrusion, land movement, drainage systems, land development, soils testing, residential construction and other civil engineering defects.
- Provided expert witness services for cost and schedule claim by County of Monterey against CM and Prime Contractor involving asbestos containing materials and affected by mold.
- Provide expert witness service for pile driving operations affecting defectively designed and constructed stucco clad public library in LA area.
- Provided expert witness services and court testimony for construction defect case involving expansive soils, construction impacts and water damage to a house foundation in Irvine, CA.
- Provided expert services for construction dispute involving an environmental remediation groundwater collection and storage system constructed at a large refinery facility in New Jersey.
- Provided expert witness services for accident involving multi-party commercial construction site in Auburn, CA involving rolling scaffolding.
- Reviewed remedial measures for condo building in Sacramento affected by water intrusion through roofs, walls and walkways that resulted in mold.
- Provided expert witness testimony for contractual dispute involving adequacy of geotechnical report, differing site conditions and cost to repair for sewer line in Las Vegas, NV.
- Provided expert witness services for issues related to a subsiding rock retaining wall causing damage to an adjacent dwelling in San Francisco, CA.
- Provide expert services to insurance group for major excavation support failure in San Francisco to determine cause and cost to repair caused by differing soil conditions.
- Provide contract review and claims support for steel water reservoir project in Honouliuli, HI affected by delays, changes and differing site soil conditions.
- Provided contract review and cost to complete for a 900 unit military family housing project in Honolulu, HI. Project encountered with numerous changes that required renegotiation of unit prices, payment for acceleration and additional time related overhead.
- Successfully negotiated a $ 6 million termination for convenience claim for a Superfund site. Developed an estimate of contractor costs and negotiated a fair and reasonable settlement while representing a state government entity. Project required negotiation of an acceleration claim for previous contractor, expert testimony at various court proceedings and presentations to media.
- Prepared and negotiated a changed site conditions, acceleration, directed change, constructive change and defective and deficient contract document change order with the US Army Corps of Engineers for a slurry wall project.
- Developed and negotiated large change orders for quantity increases and changes for design/build environmental remediation projects.
- Developed claim document for high rise hotel in downtown Los Angeles involving directed changes, constructive changes, defective and deficient contract documents, acceleration and significant contractual issues.

Construction Oriented Experience

- Oversaw construction of large wastewater treatment plants, pump stations, earth-pressure balance and open road header tunnels and box sewers for Federal Government construction program in San Francisco. 12 foot diameter tunnel was 1 mile open face cut using road header and steel sets and wood lagging prior to permanent liner. Tunnel was constructed using Earth-pressure balance method with steel liner plate prior to permanent concrete liner was then cast.

- Designed and constructed micropile foundation system for elevated transit structure for BART.
- Designed and constructed a micropile supported foundation for Hotel Berry in Sacramento, CA.
- Constructed Administration, Switchyard and Electrical Control steel framed buildings consisting of about 50,000 square feet for a combined–cycle gas fired power plant.
- Designed/built a pre-engineered steel framed maintenance building for major northern California public utility at a wind energy facility.
- Designed and constructed a micropile foundation for a community college administration building in Alameda, CA.
- Designed and built a micropile project for a new state building in Sacramento.
- Designed and constructed micropile foundation system for elevated transit structure for BART.
- Designed and constructed a micropile supported foundation for Hotel Berry in Sacramento, CA.
- Designed and built a micropile slope stabilization project for the emergency support of a sewer main sliding into a creek in Thousand Oaks.
- Constructed slope stabilization for a hydro-electric powerhouse in the Sierra Nevada Mountains involving rock anchors, soil nails, drains and shotcrete.
- Constructed projects using ground anchors, tiebacks, compaction grouting, chemical grouting, jet grouting, soil mixing, shotcrete, micropiles, driven piles and sheet piles, often under design/build contracts.
- Constructed soil nail, soldier pile and wood lagged excavation support projects for building excavations and soil removal projects.
- Constructed numerous slurry wall projects for seepage control using soil-bentonite, soil-cement-bentonite, soil-cement-bentonite-fly ash and soil-attapulgite for groundwater control on civil and environmental projects. Size of barrier walls ranged from 100,000 sf to 350,000 sf.
- Constructed ADA upgrade and remodel for US Coast Guard Pacific Strike Force Facility in Novato.
- Investigated, designed and oversaw abatement of asbestos affected state buildings after Loma Prieta earthquake in 1989.
- Managed lead abatement, asbestos abatement, structural repairs and painting for 1400 military housing units at Beale Air Force base.
- Designed and managed asbestos abatement activities for 500,000 square feet of office space for TRW buildings in El Segundo.
- Performed ground improvement projects involving dynamic compaction and vibro compaction/vibro-replacement.

<u>Consulting Oriented Experience</u>

- On contract to provide soils investigation and consulting services to pool contractors in N. Calif.
- Provide consulting and design services for residential and commercial structures affected by fire, wind, structural design deficiencies, impacts, earthquakes and other factors.
- Planning and conceptual design for construction of a multi-waste stream processing center for an industrial waste recycling center in San Diego County, CA.
- Developed geotechnical reports for new housing, including stick-built and manufactured housing throughout California.
- Evaluation of AST's and treatment ponds at oil collection facility in Santa Maria, CA.
- Performed forensic investigations for wastewater treatment plants, schools, commercial buildings and houses for water intrusion damage, expansive soils, presence of mold and construction defects.
- Designed and oversaw abatement of numerous asbestos abatement projects in California.
- Planned and permitted high tech chemical storage and fabrication facilities internationally.
- Developed large scale Phase 1 property transfer program for major renovation of prime San Francisco real estate.

- Performed numerous Phase 1 Preliminary Site Assessments, Remedial Investigations, Feasibility Studies and Corrective Measures Studies using a variety of technologies.
- Assistant author on document concerning repairs and lining UST's.

Remediation and Environmental Experience

- Expert services related to evaluation and removal of UST and AST systems on California.
- Developed a Remedial Investigation /Feasibility Study for the Purity Oil Sales Superfund site in Malaga, CA. Site was former oil processor that had filled onsite ponds and AST's with construction debris containing oil, PCB, lead and asbestos that impacted soil, surface water and groundwater. RI/FS included on-site and off-site investigation, surface water sampling, development of remedial objectives and interim remedial measures.
- Developed a Remedial Investigation/Feasibility Study/Remedial Design for the removal of PCB's and PAH's from a site in Norwalk, CA. Documents were submitted to LAFD and City of Norwalk for approval prior to initiating cleanup. Clean closure granted.
- As part of a construction claim on a 4-story parking structure at San Francisco International Airport, evaluated an earthwork claim concerning the presence of hazardous waste, rock, trash and unsuitable materials and their effect on the project schedule. Further analysis of environmental requirements on illegal filling of wetlands in San Francisco Bay.
- Completed the remediation of the Capri Pumping Services site in East Los Angeles, CA. Site was contaminated with lead, copper, cadmium, solvents and petroleum hydrocarbons. Remediation of this State Superfund site included preparation of a health risk assessment for lead exposure to the surrounding community.
- Oversaw the remediation of the Jibboom Superfund Site in Sacramento, CA. Site was a former scrap yard that had impacted the area with lead, PCB, and hydrocarbons. Extensive air monitoring of the perimeter was performed to limit migration of contaminants. Later designed remediation of inside surfaces at remaining building involving PCB, lead and asbestos.
- Site manager for the McColl Superfund site in Fullerton, CA. Involvement included site sampling of surface and subsurface runoff, construction of site facilities and management of remedial contractors.
- Project manager for the Kyocera facility in Sorrento Valley, CA. Project involved leaking UST solvent tank that impacted groundwater and adjacent wetlands and ponds. Project included on-site and off-site investigation, development of remedial alternatives, permitting and monitoring.
- Remediated a PCP impacted groundwater plume using funnel-gate technology at a wood treating facility. Project involved innovative concept using activated carbon in a passive treatment system.
- Designed and remediated 2500 CY TCA impacted soil inside an existing manufacturing structure in Southern California.
- Designed, permitted and remediated 70,000 CY of TPH impacted soil removal for the closure of the Lockheed C plant in Burbank, California. Clean closure granted.
- Oversaw the design and construction of a groundwater treatment facility for pesticide contaminated soils in Fresno, California as well as excavation of 10,000 CY of pesticide impacted soils.
- Remediated a TCE/TCA impacted groundwater plume using a Deep Soil Mix (DSM) wall that was 65 feet deep and had a surface area of 50,000 SF at an active rail yard.
- Remediated soil impacted with solvents using vapor extraction at the Xerox site in Santa Ana. California. Project included permitting, monitoring and maintenance.
- Constructed a gasoline extraction trench using biopolymer slurry and an HDPE membrane at the port of Los Angeles.
- Developed environmental analysis for portion of former Superfund site that would be removed from Superfund designation to assess impacts on new owners of that piece of property.

L. B. Karp to the C&CSF Board of Supervisors, Tuesday September 12, 2017

Good afternoon. I am Lawrence Karp, engineer. I am here about the significant potential environmental impacts of the proposed Bernal Heights project. I am here as a public service without fee or compensation. My report is about the proposed Mitigated Negative Declaration where City Planning has failed to properly answer twelve CEQA questions. I have provided evidence that the answers should have been yes, significant potential environmental impacts may result from the project.

This is a truly awful project. If implemented, it will be disaster waiting to happen. It is intended to build a concrete structure upon PG&E's 26 inch near surface pipeline. City Planning states a 10 inch thick concrete street will be required for the project without any indication of how that slab will be supported or any recognition that this will interfere with leak detection and corrosion inspections of the longitudinally welded pipeline and maintenance of the cathodic protection system.

City Planning, as they did in their CatEx attempt, has stated without substantiation the slope is 28%. Less than a week ago they slipped in 32%, but still unsubstantiated. They are wrong; according to the developer's licensed land surveyor's topographic survey the contours show a minimum gradient of 40.3%. Department of Public Works limits City streets to 17%. The extremely steep concrete slab, if built, will require foundations excavated into rock which construction will initially produce vibrations that will affect the brittle metal around the welds and later, when the concrete is exercised in service by automobile and truck trips, will produce daily vibrations into the pipeline. Though all this the pipeline will be concealed from inspections and service, which is not allowed by PG&E; contrary to what City Planning has written, PG&E has not evaluated and approved the project. The regulatory restrictions could be argued against if the the Board of Supervisors denys the appeal. The aforementioned hazards with the gas line and the landslides in the area are all significant potential environmental impacts, which at this stage, require an order for an Environmental Impact Report.

I will be glad to answer any questions.

Lawrence B. Karp
California Geotechnical
Engineer #0452
renewable
12/31/18

FILE No. 170859

UNACCEPTABLE EXTENSION
FOLSOM STREET, PROTRACTED IN 1861
STRUCTURE ON 40.3% GRADIENT SLOPE
UPON LARGE GAS LINE IN LANDSLIDE AREA
BERNAL HEIGHTS, SAN FRANCISCO
ENVIRONMENTAL IMPACT REPORT REQUIRED

LAWRENCE B. KARP *CONSULTING ENGINEER*

LAWRENCE B. KARP
CONSULTING GEOTECHNICAL ENGINEER

FOUNDATIONS, WALLS, PILES
UNDERPINNING, TIEBACKS
DEEP RETAINED EXCAVATIONS
SHORING & BULKHEADS
EARTHWORK & SLOPES
CAISSONS, COFFERDAMS
COASTAL & MARINE STRUCTURES

SOIL MECHANICS, GEOLOGY
GROUNDWATER HYDROLOGY
CONCRETE TECHNOLOGY

September 12, 2017

London Breed, President
C&CSF Board of Supervisors
City Hall, Room 244
San Francisco, CA 94102

Subject: Unacceptable Extension of 1861 Protracted Folsom Street, Bernal Heights Structure on 40.3% Gradient Slope Upon Large Gas Pipeline in Landslide Area
Environmental Impact Report Required

Dear President Breed and Members of the Board:

This report presents facts and a summary evaluation of them and results of field observations and civil engineering with review of documents that have been submitted to the Board pro and con for appeal of the Planning Department's (SFPD) proposed Mitigated Negative Declaration of Environmental Impact (MND) of 6/8/17. As this document is essentially the same as SFPD's CatEx Determination on 7/8/16 deciding to grant a CEQA Categorical Exemption (14 Cal Code Regs §15315) to the sponsor of the subject project, this report incorporates discussion and evidence of the same deficiencies and potential environmental impact that appeared in the CatEx Determination which cannot be remedied by the proposed meager mitigation.

I. Introduction

SFPD's defense of the community's appeal of the CatEx Determination was scrapped by SFPD on 1/24/17, minutes before the most recent rescheduled hearing. As with the CatEx Determination, there has been virtually no relevant and competent technical analysis, engineering, or environmental data submitted for the proposed installation of a permanent concrete structure that will be exercised producing daily vibrations to service six (6) building sites on top of and over an aging major gas pipeline (26 inch diameter) to create a street on a slope with a gradient of 40.3%, contrary to the SFPD's determination, unsubstantiated, at page 1 paragraph 1, of a 28% slope gradient and repeated, again unsubstantiated, at page 1 paragraph 1 of the MND. Very recently, without explanation, SFPD changed the slope to 32%. (SFPD 2017*b*) which is still incorrect. With good reason, this segment of Folsom Street, paper since 1861, has never been developed.

The project area, which includes the pipeline, is also below a mapped landslide area which existence has been denied by the Planning Department even though the map they publish as a guide for CatEx Determinations shows landsliding in Bernal Heights. A field trip by staff could not have missed the steep failing slope along Bernal Heights Boulevard directly above the project site, which project includes excavation, grading, and construction of a concrete roadway 145 feet long by 25 feet wide by 10 inches thick over the 26 year old longitudinally welded steel gas pipeline where the Planning Department has never required the developer to provide geotechnical data for existing bedding under and backfill around the pipe.

This report is based on evidence contained in the records of San Francisco's City Planning Department that has been either ignored, misinterpreted, or misunderstood. The record, considered in its entirety, contains substantial evidence to support a fair argument that the project may have a significant effect on the environment that has not been avoided or will be mitigated to a less than significant level by project modifications or proposed mitigation measures.

II. The Westover Survey Has Gradient for a Developed Folsom Street Extension at 40+%

The 6/20/13 Westover survey is not on the list of references in any of the Gruen reports. Gruen's 6/28/13 logs show no elevations but instead in the box for that information a note "*ground surface" appears rather than any topographical identification, with site plan of the lots and streets shown as being level. Gruen's house report (Attachment E) is backdated to few days before 8/15/13 when SFDBI first officially published the minimum requirements for geotechnical reports (revised in 2015 and 2017). In any event, SFPD's "Determination of Categorical Exemption", on 7/8/16, which replaced an earlier Determination that was rescinded, was fatally flawed because of SFPD's failure to recognize (and properly consider) the actual steepness of the project's slope (40+% not 28%), failure to recognize (and properly consider) that absolutely no relevant geotechnical engineering information was secured for the project, and failure to recognize (and properly consider) the environmental consequences associated with the geotechnic mapping pertinent to the project site, and the street section described in the MND (SFPD 2017*a*, last Bullet, pg 56).

Coupled with the failure to secure a proper investigation of the project site, instead of causing the developer to address well known site specific data and maps produced by both the State and City/County agencies, such as California's 2001 "Seismic Mapping Act - Zones of Areas of Potential Liquefaction and Earthquake-Induced Landslides map of San Francisco (which shows the project site is located on a very steep slope below active landsliding) and San Francisco's 2008 Slope Protection Act which includes URS/Blume's map "Landslide Locations-San Francisco Seismic Safety Investigation-Geologic Evaluation"; "Figure 4", which although old, is a wall poster at the SFDBI, showing the project site in the middle of the instabilities mapped for Bernal Heights (end of Attachment F). Regardless of the dickering this year about what is supposed to be or what will be in any current slope protection map that may or may not be required to be followed, to a practicing geotechnical engineer all information must be considered so these maps are valuable as they will lead to further investigation. For those that argue that there is no official SPA in effect at this instant so no consideration of slope protection is necessary, SFDBI engineers and design professionals who work in San Francisco are aware that posted on the wall at the 2nd floor Plan Review Station of SFDBI as information for everyone are color enlargements of both the 1974 URS/Blume and the 2008 Seismic Hazard maps and they are both noted in the C&CSF "Geotechnical Report Requirements (beginning of Attachment F).

III. There is No Mitigation Possible for a 40+% Gradient Slope

SFPD adopted developer's distracting argument that house building can be mitigated to lessen transient vibrations from excavations for the houses, a minor problem compared to tons of concrete for the street, and its foundations required by the steep slope, which will generate vibrations from exercising the street by 12 daily trips according to SFPD (minimum). First, SFPD lacks the civil engineering expertise to determine that slope, normal to contour lines shown on the topographical map that was produced by the developer's land surveyor (Daniel Westover, LS 7779), is 40.3% (**Attachment A**). Second, in not recognizing the real problem of low cycle fatigue of the pipeline's weld metal at the longitudinal weld lines from constant vibrations in service transmitted to L-109 by the intended subgrade supported concrete structure (which is not allowed by PG&E), SFPD failed in their Initial Study to properly classify the potential environmental problem as significant as that determination would have led to an EIR which is what SFPD strives to avoid.

IV. Concrete Structure is Prohibited by PG&E & Street Cannot Meet SFDPW Standards

Conveniently, the developer has not submitted engineered plans to PG&E for approval and SFPD's MND conflicts with the plans (Franco 2016). The MND states "*For the street extension, top soil up to as much as 12 inches will be removed, and a cement concrete road surface with a thickness of 8 to 10 inches would be installed.*" (SFPD 2017*a*, bullet at bottom of page 56.) Grading and soil removal described in the MND would erase the "existing" cover over the pipeline thereby triggering the minimum three foot pipeline cover requirement which cannot be accomplished with existing L-109.

As the pipeline has been described by the following text: "*Current records ... depth of cover could be as shallow as 24 inches*" (PG&E 2017, Item 2), pipeline replacement would be required. There is no way to reduce the natural slope gradient without retaining walls crossing the pipeline. The gradient requires, for the street specified by City Planning to be 10 inches thick, a reinforced concrete section with foundations or keyways in Franciscan rock placed under the concrete upon the existing pipeline, which would mean hard transmission of daily vibrations to the pipeline caused by vehicles. Not discussed herein are the civil engineering plans (Franco 2016) as they specify asphalt pavement over aggregate base and show a retaining wall interfering with the pipeline. Structure over L-109 in the MND (even for the false gradient published by City Planning) is prohibited under PG&E regulations (PG&E 2017, Item 6).

The MND's emphasis is for "two residential building permit applications" dismissing the rest of the project, but a garage/off-street parking places is required for each residence. This requirement can only be satisfied by vehicular access to garages at each of the two houses (and the additional four houses if the street is approved by the Board of Supervisors by denying the appeal). The hook is that if the project is approved at this stage SFDPW will have a difficult task refusing to permit the project and it is unknown if PG&E will waive their rule about no structure within 10 feet of their pipeline as well as the total elimination of effective (but vital) inspections of leaks, corrosion, and cathodic protection by the installation of 227 tons of concrete not including foundations. Rightfully, after the 2010 San Bruno disaster, PG&E must require an EIR before waiving safety requirements.

In 1981 PG&E placed their L-109 pipeline in their right-of-way in very steep paper street protracted in 1861 because it was never expected to be an actual street as SFDPW has always disallowed this segment of Folsom Street. Nor should it be approved or accepted now by SFDPW (Order 183447, 3/24/15) as City streets are limited to 17% gradient, fire truck access is limited to 14% gradients, and dead end street widths need to be increased to 60 feet (**Attachment B**).

However, the developer, for this project, is attempting an end run around both SFDPW and PG&E by emphasizing the residences are all that matter at this time which kicks whatever PG&E and SFDPW require down the road, which is grossly improper under all of CEQA: "*All phases must be considered.*" (14 Cal Code Regs §15126). SFPD failed to submit and require for written comments from SFDPW and PG&E. This matter is environmentally sensitive to the community so unverified discussions by telephone or e-mail about intentions that only concern "*grading work*" (PG&E 2017, paragraph 1 line 1) which are not otherwise supported by approved engineering plans and specifications relevant to the MND, for the intended structures to be placed upon the pipeline, are insufficient to facilitate project approval by the Board of Supervisors. Review for compliance with PG&E Utility Standard TD-44905 "Gas Pipeline Rights-of-Way Management" would be a minimum requirement for the utility which would have to include characterizing the bedding and backfill for volume change by densification when loaded, exercised by the street, and shaking of concrete during an earthquake, and subdrainage. An EIR is necessary to properly investigate the project's environmental effects and inform the public.

V. PG&E Has Not Evaluated and Approved the Project

CEQA requires "Mitigation measures must be fully enforceable through permit conditions, agreements or other legal binding instruments (14 CCR §15126.4). In order for vehicles to access the two car garages for each house shown on the architectural plans for the buildings (SFPD 2016*b*) the vehicles would have to cross the near surface 26 inch diameter L-109 is planned to be covered with a 227 ton concrete structure not including foundations. Although the City Planning states that PG&E "has evaluated the proposed project" (SFPD 2017c) that is not true. Snippets of hearsay from the developer and purported telephone conversations by persons at the Planning Department about a single subject, vibrations due to house building, do not in any way constitute a proper evaluation of significant environmental effects for the full project which is required by Initial Study.

A list of questions were posed and answers were provided on 5/28/14 by PG&E employee Austin Sharp; however he declined to locate the pipeline and did not know its depth, and noted that regular inspections for leaks and levels of cathodic protection are regularly performed. He was not informed about the project's street construction which would eliminate the inspections he said must regularly occur. But there is no evidence that Mr. Sharp or anyone at PG&E he had consulted with knew about the steepness of the slope or anything about the project because with his e-mail he provided the questioner with a proprietary image "L109_Folsom_Street.pdf" (not in the record) as well as answers that all show a lack of significant knowledge about the project (**Attachment C**). The proprietary aerial image depicts the path of the pipeline but shows the project site (by boxing addresses 3516 and 3526 Folsom Street) far to the east and outside the path of the pipeline instead of west and over the pipeline which is the actual location of the project. The image is noted to be a PG&E's to be operated only by PG&E personnel. What this means is that neither Mr. Sharp nor apparently anyone else at PG&E knew the simple facts, steepness and location of the project and with that there is no record of site visits or review of documents which preclude proper "evaluation".

Genuine evaluation of the project would include engineering by PG&E's licensed professionals that would occur in a full investigation of the entire project including the concrete street and foundations for the concrete to be placed on a 40+% grade directly over the pipeline by PG&E, how welds and leaks and corrosion can be monitored, and how vibrations from in-service exercising of the street will affect the 26 year old pipeline. The research and investigation must culminate in a dated and signed report for the public to review and comment. Asking PG&E for such evaluation has been carefully avoided by the project sponsor and the agency, who have both to date supplied only innuendo.

VI. Vibrations: Minor Transient in MND, Major in Service for Project

Taking direction from the developer, who hired an acoustical and air quality company (not licensed architects or engineers) appropriate for remodel of a symphony hall, to opine in what have been purported to be engineering reports called "Memos", they concluded that excavations for building the residences will not produce significant vibrations that will affect the 26 inch diameter, 26 year old, welded steel gas pipeline (Illingworth & Rodkin 2017*a,b*). In California, engineering documents must be stamped and signed by licensed professional engineers (B&P Code §6735.1).

The reports use irrelevant data from New Hampshire and Hawaii to estimate the propagation of peak particle velocity (PPV) from assumed house building construction in the Franciscan formation of San Francisco and then made mathematical calculations to impress the City's Planning Department. To fit theoretical mathematical equations, the writers make compound assumptions about geotechnic conditions that have no basis in fact and simultaneously ignored the street construction specified by City Planning along with certain activity over the coming years. These types of postulations, which are prepared to make a case which the preparers are hired to make and serve no useful purpose, are known to qualified engineers as "junk science".

The Illingsworth & Rodkin memos reported an "*evaluation...of the potential for vibration levels from the residential building construction project at 3516 and 3526 Folsom Street of effecting a buried P&E gas line...*". There is nothing about the massive concrete street construction and constant use of the street for the project that will be upon L-109 which cannot be accessed for inspections and repairs. The memos concern transient motions for building houses, not vibrations generated by in service vibrations constantly generated by 12+ trips per day for vehicles to and from the ultimate 6 houses, which do not include delivery trucks. Due to difficult access from the street to the garages vehicles have to be parked in tandem, which requires for use of a vehicle that is blocked by another one, one has to be driven into the street to allow the other exit or enter. That means at least 50% more transits over the new street.

There is no indication the depth of the pipeline at any point (which PG&E's estimates is less than 24 inches which would be reduced to less than 14 inches clearance between the top of the pipe and the bottom of the concrete street after 10 inches of soil removal and concrete construction noted in the MND). There are no reasons given why the "potholing" PG&E has suggested to locate the pipe has not been performed by Gruen which could have been done if the bedding and backfill to the pipe had been evaluated, a minimum requirement to evaluate the street phase of the project. There is no acknowledgment that the only construction PG&E has written about for the project is "grading work" with no review by PG&E of engineering plans and no written approval for the project. There is no mention that the referenced "soils" report shows a level project site and the fact that the characteristics of the bedding and backfill for the pipeline, which have failed before (**Attachment D**), are deliberately unknown. There is no understanding demonstrated by City Planning that the planned 227 tons of concrete used to build the street on a 40+% gradient cannot stand alone by friction so the concrete mass must have buttressing and anchoring foundations for the street or it will slide. And what will the construction vibrations from excavating into rock for the foundations for the street have on the pipeline even before the street is put into service? And of course how can the pipeline be inspected under the concrete for cracks and leaks, and level of cathodic protection?

VII. City Planning Accepted Obviously Superficial and Defective "Soils Reports"

SFPD failed, apparently because of undue influence or ignorance, to request and secure the most fundamental technical information necessary to properly assess the geotechnical aspects of the project. Where a proper report of geotechnical engineering investigation would absolutely be required for any excavation and grading project where there will be excavations ("up to 10 feet") into a very steep slope (for obvious reasons, since 1861 no street was actually constructed) below identified landslides, SFPD first turned to an extra shoddy boilerplate "soils report" produced in duplicate by Gruen on 8/3/13 and then unbelievably gave credence to an 11/29/16 "update" where Gruen's surrogage misstated the houses as being on one lot, and then being confident in stating nothing was done concerning the [street portion] of the project ("No other project details are known at this time"). Then, more paper, incomplete and substandard, was generated (group **Attachment E**).

These "reports", written for the the proposed houses (duplicates), showed miserable site plans for non-existent level lots in a level project area, and they contain absolutely no information about the project site which has to include, as there are garages shown on the plans, the proposed extension of Folsom Street including the near-surface pipeline, intended grading, and street construction which requires foundations. The proposed improvement of Folsom Street that was before SFPD has clear potential environmental impact, which would have been obvious to qualified design professionals.

Subsequent to the original report(s) for both new houses, which do not meet minimum standards for such reports, someone using the engineer's stamp (apparently to avoid liability for the stamp holder) produced more worthless documents. On 11/29/16 the developer submitted a "Geotechnical Report Update" for the houses (3516 and 3526 Folsom Street), reports that were improperly written with several short paragraphs, and signed by a Gruen surrogate (in violation of B&P Code §6735.1). The first stated the letter presented "*....an update of my geotechnical investigation for the proposed residence [sic] at 3516 and 3526 Folsom Street ....*" and under a paragraph titled "**Proposed Project**", "*It is my understanding that the project will consist of the design and construction of a new residence* [sic] *on an undeveloped lot* [sic]. *No other project details are known at this time.*"

The City adheres to constantly revised but strict geotechnical report requirements (e.g **Attachment F**) which were ignored (the 2015 version referenced the 1974 URS/Blume map per the Slope Protection Act (SPA), C&CSF 2008); the early 2017 version references the local 2000 Seismic Hazard Zones map.

Whether or not there is an exact SPA technically in effect exactly at this time is immaterial; the intent and data exists and it is important to consider by all geotechnical engineers. In SFPD's CatEx Determination and the MND, Gruen's papers were referenced without regard to the fact that nothing serious about the project was in them but should have been because the City's report requirements stress slope and grading information (as do all versions of the SPA). Nevertheless SFPD stated in their determination and MND that the project site was investigated when it was not. It is incomprehensible why SFPD took the Gruen papers without question. First, two new houses on two level lots, and second, two houses on one lot in the update, are not legitimate geotechnical documents pertaining to the grading of a slope having 40+% gradient over and on top of a large diameter gas pipeline in a landslide area. However, in the "update" it was admitted engineering about the project was unknown, which effectively voided the CatEx. For the purpose of CEQA (here the MND) the reports are superficial and defective.

In SFPD's CatEx Determination, nobody licensed as a design professional, gave as references for the Dermination (that there was "no possibility" of environmental impact) the superficial "reports" for houses that do not approach minimum ASCE Standards for site investigations (ASCE 1976) and SFDBI's report requirements which are primarily directed to excavations and grading of slopes and foundations in slopes, and they do not meet standards set forth in the California building codes as adopted tri-annually by C&CSF.

The Gruen house reports do not comply with recognized practice and standard-of-care and competence regulations required for California engineers contained in the Business & Professions Code, and misrepresentation prohibitions for California engineers contained in the California Code of Regulations for development in steep difficult areas let alone those that have large underground natural gas pipelines. Gruen and his surrogates know very little about the project that is the subject of the present appeal. SFPD's reliance in their MND on poor writings by Gruen for two identical houses only vaguely related to the project where vehicular access via an improved Folsom Street is intended by the developer (and also expressed by other lot owners than the project applicant who intend to rely on the project completion to access and develop their lots) reveals that the "Environmental Review Officer" is not qualified in civil and geotechnical engineering.

On 1/24/17, on the day the CatEx appeal hearing was to be heard (cancelled a few minutes before it was about to begin for good reason: "*A categorical exemption cannot be used for an activity where there is a reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances.)*" [i.e. the gradient and pipeline], 14 Cal Code Regs §15300c. Gruen's surrogate produced another document stamped but not signed by Gruen referring to Gruen in the third person. Here the surrogate (no initials this time) criticized Dr. Rune Storesund, geotechnical engineer and Executive Director of the University of California Berkeley's Center for Catastrophic Risk Management who, aside from that position also happens to provide private consulting for the State of California Department of Education, a truly qualified expert and acting *pro bono* to the community, no less. Gruen's surrogate, in responding to the Storesund reports (Storesund 2016*a,b*) where Storesund questioned the missing geotechnical information concerning the pipeline in the Gruen reports, stated that the information was available for the residences or was "*beyond the scope of our work for the residential development*" and other disclaimers. Gruen's loan of his professional engineering stamp to an unlicensed person is a serious violation of Business &Professions Code §6735.1, and allowing his stamp to aid and abet the Rules of Professional Conduct for engineers (Cal Code Regs §475(c)) is also a cause for discipline by the Board.

Lastly, after SFPD issued their amended MND on 6/8/17, on 7/6/17 Gruen produced a report purportedly about his geotechnical investigation for "planned Street and Utility Improvements" at the project site. The report is yet another incompetent document which City Planning did not question although there was no information asserted that could corroborate their standard denial of there not being any potential significant impact for the project.

On 1/24/17 Gruen's surrogate wrote the portion of the project site that was outside of the houses ("beyond the scope of our work for the residential development") but now, using that excuse again but stating he performed in accordance with his agreement with his assignment by the developer, he still provides no information what his assignment was actually about and he fails completely to confirm what City Planning had written that there will be no potential environmental impact from the project. This is because there will be significant potential environmental impact to the community from the project.

Gruen's 7/6/17 report is merely a reiteration of boiler plate paragraphs immaterial to the issues of the 40+% slope inclination and the near surface gas pipeline under pressure that runs down the middle of the undeveloped, for 156 years, paper Folsom Street, where construction is intended. These are apparently "details" as the report again, as was done on 11/29/16 by a surrogate, states "*No other project details are known at this time.*" The site plan again shows a level project site, the report does not address the extreme steepness of the site, and there is nothing about L-109's depth and ground characteristics such as density and grain size for P-109's bedding or backfill. There are no recommendations for design and construction of the concrete street and its necessary foundations for the 227 tons of concrete proposed to sit on the 40+% grade such as values to be used for friction between the concrete street and the ground, groundwater and subdrainage, and the effect on the pipeline from excavating into the hillside for foundations and long term in-service vibrations transmitted from the concrete street to subgrade from the many daily trips up and down the hillside that City Planning has written about (SFPD 2017*a*) as well as shaking during earthquakes.

VIII. Geotechnic Maps Show Project in a Very Steep Area Subject to Landsliding

As the activity is in a "uniquely sensitive environment" evidenced in this case by the State of California's "Seismic Hazard Zones" map of C&CSF (**Attachment G**) which is now used as the City's standard reference and based in part on that study, no less, is SFPD's own published "CatEx Determination Layers" map showing "Seismic Hazard Zone: Landslide" and "Slopes Over 20%" (**Attachment H**) which clearly apply to the subject project regardless of SFPD's denial in their CatEx determination which ignored mapping even though it is as precise as exists anywhere; the large diameter gas pipeline buried in the steep hillside of protracted Folsom Street where backfill has failed in the past (Attachment D), potential damage covered by expert reports ignored by SFPD that will be excavated and graded; the extreme steepness (Attachment A) of the hillside below an active landslide (40.3% gradient, not the 28% basis that is incorrectly stated (without substantiation) in both SFPD's documents (page 1, paragraph 1). Of all the mapped areas of San Francisco, the most prolific are the maps adopted that regard hazards of activity in areas of steep slopes and landsliding that goes with those steep slopes (e.g. Attachments F, G, H).

The exemption for an activity specifically does not apply if the activity may have an impact on an environmental resource of "*hazardous or critical concern where designated by, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.*" 14 Cal Code Regs §15300.2(a). Full environmental review is necessary as CEQA does not allow (Practice Under CEQA §5.57A) an agency to rely on mitigation measures to conclude any project is categorically exempt so what SFPD has done to get around that regulation is to contrive a pathetically inadequate MND.

Locations below landslides are especially meaningful for geotechnical engineers (but not for SFPD) where the landsliding is above steep slopes that are proposed for excavation and grading. Engineers, but in this case planners, recognize the very real potential loss of lateral and subjacent support for land above, and accompanying change in groundwater regime, as being critical. The geotechnical maps are as precise as can exist under mapping standards in California for such engineering in lieu of an environmental review, which is the point of CEQA particularly applicable for the subject project.

IX. The 1861 Protracted Map Without Consideration of Topography Created "Junk Lots"

156 years ago the Bernal Heights area was protracted (on paper, without regard to topography) into 1783 small lots clustered around fictitious street names or extensions of existing streets. With the Subdivision Map Act, enacted by emergency legislation, the state outlawed subdivision by protraction. The paper subdivision, titled "Gift Map 3" (**Attachment I**), included Butler Street now known as Folsom Street. To illustrate the map's actual (never intended) use, the protraction showed 20 lots on the west side of Folsom (Butler) from "Powhatan" northward to "California Street" which indicated paper Folsom Street was to run up over and down the cliffs in Bernal Heights Park!

As the area developed, protracted lots were combined or abandoned leaving only 3 lots developed on the west side of Folsom north of Powhattan up to the end of developed Folsom Street where it turns into Chapman Street. Many of the individual protracted lots were ever built upon with houses nor were they ever intended to be, individually they were often judged near worthless. For instance, years after the assessors map was created, Lots 11 and 12 sold for $4,000 each to the City and Lot 13 (now known as 3516 Folsom, vacant) sold for $4.83. The proposed project, the development of Folsom, is north of the intersection with Chapman.

X. CEQA Prohibits "Piecemeal" Projects Resulting in Cumulative Effects

SFPD's Determination circumvents cumulative and compound evidence of requirements for an environmental review for this project, and presentation of the project (and handling by SFPD) which is obviously a CEQA prohibited "piecemeal" approach, 14 Cal Code §15303(a), to a project that will shortly service six steep hillside lots (admittedly, the record shows that other lot owners have indicated they will develop lots if Folsom Street is constructed) which, after the State's Subdivision Map Act and the SFDPW Subdivision Regulations, could not have been created. SFPD has no qualified staff to opine on the engineering aspects of the project (there are no licensed engineers or even other licensed design professionals such as architects and land surveyors on staff). Licensure, not a fancy in-house title to supplement wages, is evidence of qualification under California's Business & Professions Code.

XI. City Planning Failed to Recognize SFDPW's Need to Protect City's Slope

The lots immediately between the project site (Folsom paper Street) and Bernal Heights Boulevard, which is also directly below the landsliding shown on SFPD's CatEx (and other) maps, are shown in relative detail on the "Property Information Map" issued to the public as property information. For the Gift Map 3 lots combined over the end of Folsom Street, the annotated maps (**Attachment J**) show that all the lots above the project site (not the private lots to the east) are under "SFDPW jurisdiction" and they are noted as having "Slope Protection".

From a civil/geotechnical engineering, and community standpoint, it is imperative that the project is subjected to full environmental review (EIR) to properly inform the public below and lateral to the proposed project concerning the significant potential environmental impacts of the project.

XII. Planning Department Publishes the Map "CatEx Determination Layers"

Furthermore, and demonstrative of their questionable motives which bears repeating, SFPD has amazingly ignored their own detailed map which they generated and titled "CatEx Determination Layers, Printed May 17, 2015 [by] San Francisco Planning Department" (Attachment H). City Planning's own map shows two "Layers" that are allocated to "Seismic Hazard Zones" and "Slopes Over 20%" with the project site located on both steepness and hazard layers (the gradient of the site is 40+% which is double the map's threshold) and the slope's earthquake hazard is mapped directly overhead of the project site.

Incredibly, the SFPD reviewers failed to review their own map which they even made into a poster as noted on the map (and other maps that show "sensitive environment" were also not reviewed or if they were in some degree they were not understood). Even if they did not recognize the environmental hazards associated with excavating below an active landslide or chose to treat the hazards, without technical support, as being insignificant, City Planning's CatEx Determination, now replaced with a Mitigated Negative Declaraton to avoid environmental review is tantamount to making CEQA a nullity.

XIII. Planning Department's Initial Study for MND is Grossly Defective

The finding in City Planning's proposed Mitigated Negative Declaration "The project could not have a significant effect on the environment" (SFPD 2017*a*, (page ii)" is not based on substantial evidence and there is substantial evidence to the contrary in the record. And, the statement "In the independent judgment of the Planning Department, there is no substantial evidence that the project could have a significant effect on the environment", signed by someone for Lisa Gibson on 7/11/17, only means that the Planning Department does not have qualified persons on staff and has not performed a proper Initial Study.

In the Planning Department's "Summary of Environmental Effects" and "Evaluation of Environmental Effects", the following are false answers in the proposed Mitigated Negative Declaration:

Impact 1b (page 25)	Conflicts with PG&E and SFDPW regulations[1] (IV, V above). Box should have been checked for "Potentially Significant Impact"
Impact 4e (page 35)	Creates dead end on 40+% substandard width street w/o turn-around (IV above). Box should have been checked for "Potentially Significant Impact".
Impact 5b (page 44)	Vibrations affecting loading of pipeline[2] (I, III, VI, V above). Box should have been checked for "Potentially Significant Impact".
Impact 13a.ii (page 94)	Seismic shaking of concrete street/fdns will affect pipeline (IV, VII, VIII above) Box should have been checked for "Potentially Significant Impact".
Impact 13a.iv (page 94)	Project is in the vicinity of a landslide area (I, II, VI, VIII, XI, XII above). Box should have been checked for "Potentially Significant Impact".
Impact 13c (page 94)	Project is in the vicinity of off-site landsliding[3] (I, II, VI, VII, VIII, XI, XII above). Box should have been checked for "Potentially Significant Impact".

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[1]True: "The proposed project includes the improvement of a currently unimproved 'paper' street segment of Folsom Street" (MND, page 25).

[2]Vibrations from excavating into the hillside for foundations for a concrete street on 40+% grade, loading on pipeline from concrete, and vibrations in service of street from automobile and truck trips will affect large diameter gas pipeline.

[3]False: "The project site and vicinity do not include any hills or cut slopes that could cause or be subject to a landslide." (MND, page 97).

Impact 15a (page 104)	Alteration of ground regime around large gas pipeline (I, II, III, IV, VII above). Box should have been checked for "Potentially Significant Impact".
Impact 15b (page 104)	Concrete structure will block leak/corrosion detection (I, III, IV, V, VI, VII above). Box should have been checked for "Potentially Significant Impact".
Impact 15h (page 104)	Conceal detection of corrosion/leaks may result in fires (I, III, IV, V, VI, VII above). Box should have been checked for "Potentially Significant Impact".
Impact 16c (page 104)	Conceal detection of corrosion/leaks may result in waste (I, III, IV, V, VI, VII above).. Box should have been checked for "Potentially Significant Impact".
Impact 18b (page 112)	Impacts 1b⇒16c have cumulative potential significant impacts on the environment. Mandatory: Box should have been checked for "Potentially Significant Impact".
Impact 18c (page 112)	Impacts 1b⇒16c have cumulative potential significant impacts on the environment. Mandatory: Box should have been checked for "Potentially Significant Impact".

XIV. Summary

In my professional opinion, earned by over 50 years involvement in geotechnical (soil and foundation) engineering in San Francisco, if the subject project is implemented without a proper and complete environmental review, which only an independent EIR under CEQA can provide, there is a potential for significant environmental impact to result from the project which is cumulative.

The potential exists not only during construction of house foundations which City Planning has taken the liberty to emphasize while ignoring the street construction phase of the project, but the cumulative impacts of constructing the street and the impacts of the street in service due over a near surface large diameter natural gas pipeline as well as the contribution of additional development of more buildings and use of a concrete structure and its foundations over the pipeline facilitated by the project which in turn is will be block inspections of leaks, weld fatigue, corrosion, and inspection and replacement of anodes for the cathodic protection, and is also likely to impair lateral and subjacent support in the landslide area in and above where the project is situated.

XV. Conclusion

My credentials include an earned doctorate and other degrees as well as a post-doctoral certificate in earthquake engineering from the University of California, Berkeley. As a public service, I have provided this report as assistance to the Bernal Heights neighborhood without fees or any other compensation. I will be present at the appeal hearing to answer any questions from Board Members.

Yours truly,

Lawrence B. Karp

REGISTERED PROFESSIONAL ENGINEER LAWRENCE B. KARP No. 25389 CIVIL STATE OF CALIFORNIA

LICENSED ARCHITECT LAWRENCE B. KARP No. 10130 STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER LAWRENCE B. KARP No. 452 GEOTECHNICAL STATE OF CALIFORNIA

References

American Society of Civil Engineers [ASCE], 1976; "Subsurface Investigation for Design and Construction of Foundations of Buildings", Geotechnical Engineering Division, American Society of Civil Engineers, New York, 62 pgs.

Bailey, Edgar H., Irwin, William P., & Jones, David L., 1964; "Franciscan and Related Rocks, and their Significance in the Geology of Western California", California Division of Mines and Geology, Bulletin 183, 177 pages.

California, State of - Division of Mines and Geology [CDM&G], November 17, 2000*a*; "Seismic Hazard Zones - City and County of San Francisco Official Map" [Seismic Mapping Act - Zones of Areas of Potential Liquefaction and Earthquake-Induced Landslides], map, Scale 1:24,000 (1" = 2,000'), 1 sheet. (and Report 043, 52 pages).

California, State of - Division of Mines and Geology [CDM&G], 2000*b*; "Seismic Hazard Zone Report for the City and County of San Francisco, California", Report 043, 52 pages.

City & County of San Francisco, Amended October 20, 2008, "Slope Protection Act", Ordinance 258-08 (includes reference to URS/Blume's 1974 map "Landslide Locations") [reference pertinent to successor text and maps and their intent], 12 pages.

City & County of San Francisco, Department of Building Inspection, August 15, 2013; "Information Sheet - Geotechnical Report Requirements", 3 pages.

City & County of San Francisco, Planning Department (SFPD), printed May 17, 2015; "CatEx Determination Layers", map, Scale 1:46,220 (1" = 3,718'), 1 sheet

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City & County of San Francisco, Planning Department (SFPD), October 4, 2016*b*; "Discretionary Review - Full Analysis", 903 pages.

City & County of San Francisco, Planning Department (SFPD), December 5, 2016*c*; "Categorical Exemption Appeal, 3516-3526 Folsom Street", 14 pages.

City & County of San Francisco, Planning Department (SFPD), April 19, 2017, Amended June 8, 2017*a*; "Mitigated Negative Declaration", [For only two building sites, not access to them and four other building sites from the street therefore incomplete for the actual project: *"The project site the Block bounded by Bernal Heights Boulevard to the north, Gates Street to the west, Powhattan Avenue ot the south and Folsom Street to the east. The project site is located along the west side of an approximately 145-foot-long unimproved segment of Folsom Street, north of Chapman Street, that ends at the Bernal Heights Community Garden*".]

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DeLisle, M. D., 1993; "Map Showing Generalized Contours on the Groundwater Surface on a Portion of the San Francisco North 7.5' Quadrangle", map prepared for the California Division of Mines and Geology, unpublished, Scale 1:24,000 (1" = 2,000'), 1 sheet.

Figures, Sandy, July/August 2017; "Guidelines for Construction Vibrations", Geostrata, Geo-Institute and ASCE, pages32-36.

Franco, David J. - Civil Engineer, August 2016; "3516 & 3526 Folsom Street, Street & Improvement Plan, San Francisco, California", plans and specifications, 4 sheets.

Gruen, H. Allen - Geotechnical Engineer, August 3, 2013; "Report Geotechnical Investigation, Planned Residence at 3516 Folsom Street, San Francisco, California" document prepared for Mr. James Fogarty - Blue Orange Designs, 26 pages. (A duplicate report was produced for 3526 Folsom Street.) [Project's site plan is shown level but proposed Folsom Street extension needed to access the residences not shown as being included in the project, document stamped and signed by H. Allen Gruen].

Gruen, H. Allen dba Earth Mechanics Consulting Engineers - Geotechnical Engineering, November 29, 2016; "Geotechnical Report Update, Proposed Residence [sic] at 3516 & 3526 Folsom Street, San Francisco, California" letter prepared for Mr. James Fogarty - Blue Orange Designs, 2 pages. ["*It is my understanding that the project will consist of the design and construction of a new residence on an undeveloped lot* [sic]. *No other project details are known at this time.*"; document stamped but NOT signed by H. Allen Gruen per B&P Code §6735.1].

Gruen, H. Allen - Geotechnical Engineer, January 24, 2017*a*; "Geotechnical Responses to Project Review Letter, 3516 and 3526 Folsom Street, San Francisco, California" letter prepared for Mr. James Fogarty - Blue Orange Designs, 2 pages. [Bedrock is below bedrock, other questions beyond scope of work for residential development; document stamped and but NOT signed by H. Allen Gruen per B&P Code §6735.1].

Gruen, H. Allen - Geotechnical Engineer, July 6, 2017*b*; "Report Geotechnical Investigation, Planned Street amd Utility Improvements at 3516 and 3526 Folsom Street, San Francisco, California" document prepared for Mr. Fabien Lannoye, 21 pages. [Project's site plan is shown level, no data for pipeline bedding and backfill or street; report is incomplete and defective, document stamped and signed by H. Allen Gruen].

Illingworth & Rodkin, Inc., March 24, 2017*a* "Construction Vibration Evaluation for 3516 and 3526 Folsom Street", memo prepared for Bluorange Designs, 6 pages.

Illingworth & Rodkin, Inc., April 14, 2017*b* "Ground Characteristics and Effect on Predicted Vibrtation", memo prepared for Bluorange Designs, 2 pages.

Lappin, Todd (Bernalwood), October 12, 2011; "A Safety Update from PG&E About That Anxiety-Generating Gas Pipeline in Bernal Heights".

PG&E, May 28, 2014; questions and answers by Austin Sharp with an aerial image illustrating that the writer of the answers knew not the project, had not visited the site, and did not have adequate information about the project for 3516 and 3526 Folsom Street to evaluate or opine on the project [portions of this document, without the image, have been used.

Pacific Gas & Electric Company (PG&E Gas Transmission Pipeline Services - Integrity Management), by John Dolcini), March 30, 2017, 2 pages [concerning "...grading work near PG&E gas transmission pipeline located near 3516 and 3526 Folsom Street."]

Schlocker, Julius, 1964; "Bedrock-Surface Map of the San Francisco North Quadrangle, California", U. S. Geological Survey, Miscellaneous Field Studies Map MF-334, Scale 1:31,680 (1" = 2,640'), 1 sheet.

Schlocker, Julius, 1974; "Geology of the San Francisco North Quadrangle, Calif." (includes Plate [1] "Geologic Map...", Scale 1:24,000 (1" = 2,000'); Plate [2] "Composition and Grain Size of Surficial Deposits....", and Plate [3] "Map Showing Areas of Exposed Bedrock, Contours on Bedrock Surface, and Landslides....", Scale 1:24,000 (1" = 2,000'), USGS Paper 782, 109 pgs.

Storesund Consulting, December 1, 2016*a*; "Independent Project Review, 3516 & 3526 Folsom Street, San Francisco, California", report prepared for the SF Board of Supervisors, 10 page report plus 30 page Professional Resume..

Storesund Consulting, December 11, 2016*b*; "Impact to PG&E Transmission Line 109, 3516 & 3526 Folsom Street, San Francisco, California", report prepared for the SF Board of Supervisors, 3 pages,

U. S. Geological Survey, 1956 (Photorevised 1980); "San Francisco South Quadrangle California, 7.5 Minute Series (Topographic)", map, Scale 1:24,000 (1" = 2,000'), 1 sheet.

List of Attachments

A. Westover Surveying topographical survey map (contours annotated) & Thomas Bros map

B. DPW street steepness limit 17%, fire truck access limit 14%, 60 foot width for dead end street

C. PG&E e-mail 5/28/14 of proprietary image of different project with answers to questions

D. Photos of PG&E gas pipeline backfill restoration after failure in paper Folsom Street

E. Gruen and surrogate reports and letters 8/3/13, 11/29/16, 1/24/17, 4/14/17, 7/6/17.

F. C&CSF Geotechnical Report Requirements w/referenced landslide map

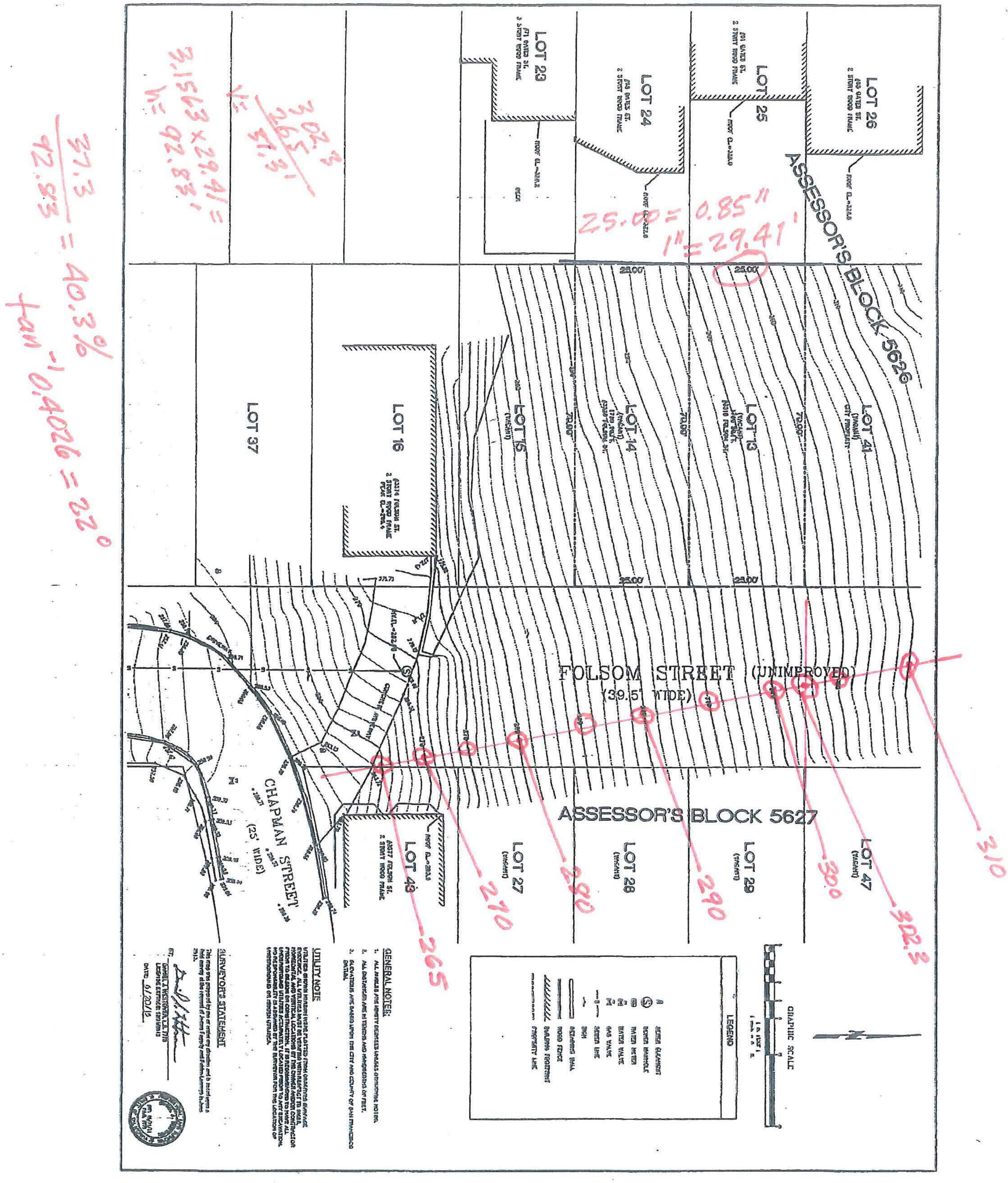
G. California Seismic Hazard Map for C&CSF, annotated enlargement of site, SP117 cover

H. City Planning's CatEx Layer Map & enlargements of site with legend

I. 1841 Gift Map 3, C&CSF assessors map of Block 5626, annotated & sale records for 3 lots

J. Aerial image & DPW slope protection maps, paper Folsom St. south of Bernal Heights Blvd

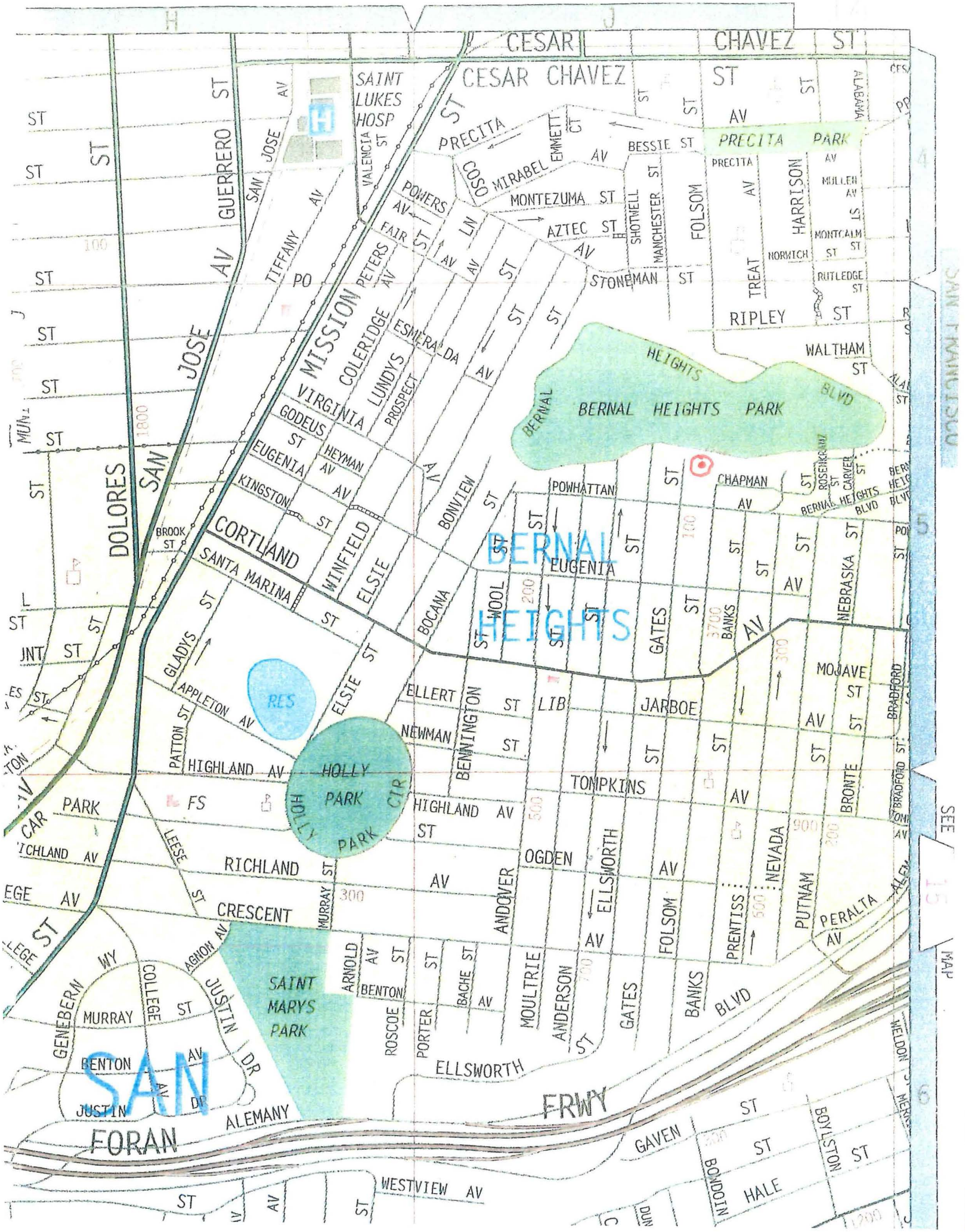
Attachment A



SHEET 1 OF 1

SITE SURVEY	SURVEY DATE: 6/20/2016	NO.	DATE	COMMENTS	JOB NO.
3616 and 3620 FOLSOM STREET LOTS 13 AND 14 OF ASSESSOR'S BLOCK 5627 SAN FRANCISCO, CALIFORNIA	DRAWN BY: D.JW				13029
	CHECKED BY: D.JW				
	SCALE: 1"=5'				

WS WESTOVER SURVEYING


H
J
CESAR CHAVEZ ST
CESAR CHAVEZ ST
SAINT LUKES HOSP
H
SAN JOSE AV
GUERRERO ST
VALENCIA ST
MISSION ST
PRECITA AV
PRECITA PARK
EMMETT CT
BESSIE ST
MIRABEL AV
COSO
MONTEZUMA ST
AZTEC ST
SHOTWELL
MANCHESTER ST
FOLSOM
HARRISON
MULLEN AV
MONTCALM ST
NORWICH ST
TREAT
RUTLEDGE ST
ALABAMA
POWERS AV
FAIR AV
LN
TIFFANY AV
PO
PETERS AV
COLERIDGE
ESMERALDA AV
LUNDYS
PROSPECT
STONEMAN ST
RIPLEY ST
WALTHAM ST
BERNAL HEIGHTS BLVD
BERNAL HEIGHTS PARK
VIRGINIA AV
GODEUS ST
HEYMAN AV
EUGENIA AV
KINGSTON ST
BONVIEW
POWHATTAN
CHAPMAN AV
ROSENKRANZ ST
CARVER
BERNAL HEIGHTS BLVD
DOLORES
SAN JOSE
BROOK ST
CORTLAND
SANTA MARINA ST
WINFIELD
ELSIE
BERNAL HEIGHTS
EUGENIA
BOCANA
WOOL ST
GATES ST
BANKS
NEBRASKA ST
GLADYS ST
APPLETON AV
RES
ELLERT ST
LIB
JARBOE AV
MOJAVE ST
BRADFORD ST
NEWMAN ST
BENNINGTON
PATTON ST
HIGHLAND AV
HOLLY PARK CIR
TOMPKINS AV
BRONTE
FS
HIGHLAND AV
ST
LEESE ST
RICHLAND AV
OGDEN AV
ELLSWORTH
NEVADA
PUTNAM
PRENTISS
PERALTA AV
MURRAY ST
ANDOVER
CRESCENT AV
MOULTRIE
ANDERSON ST
FOLSOM
AGNON AV
SAINT MARYS PARK
ARNOLD AV
BENTON AV
BACHE ST
PORTER ST
ROSCOE
GATES
BANKS
BLVD
GENEBERN WY
COLLEGE
MURRAY ST
JUSTIN DR
BENTON AV
JUSTIN DR
SAN
ELLSWORTH
FRWY
ALEMANY
FORAN
GAVEN ST
BOYLSTON ST
BOWDOIN
HALE
WESTVIEW AV
WELDON
SAN FRANCISCO
SEE MAP 15
14
4
5
6
100
1800
200
300
500
700
900
3700

Attachment B

SUBDIVISION REGULATIONS

2015

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF SAN FRANCISCO

Adopted by Department of Public Works Order No. 183447

Approved March 24, 2015

Mohammed Nuru, Director of Public Works

Fuad Sweiss, City Engineer

Bruce Storrs, City and County Surveyor

PROFESSIONAL LAND SURVEYOR
BRUCE R. STORRS
No. 6914
STATE OF CALIFORNIA

C. STREET GUIDELINES

1. Alignment

All streets shall, as far as practicable, align with existing streets. The Subdivider shall justify any deviations based on written environmental and design objectives.

2. Intersecting Streets

Intersecting streets shall meet at right angles or as nearly so as practicable.

3. Naming

Streets of a proposed subdivision which are in alignment with existing streets shall bear the names of the existing streets. The Department of Public Works shall approve names for all new streets.

4. Street Grades

DPW shall not approve street grades in excess of 17% except as an exception and under unusual conditions.

Streets having grades in excess of 14% shall require separate consultation with the Fire Department prior to use for fire access purposes.

No gutter grade shall be less than 0.5%. The Subdivider shall provide concrete on any pavement grade less than 1.0%.

The Subdivider shall connect all changes in street grades, the algebraic sum of which exceeds 1.5%, with vertical curves of DPW-approved length sufficient to provide safe stopping sight distances and good riding quality. All changes in street grades shall have an absolute value of the algebraic difference in grades which does not exceed fifteen percent (15%), regardless of any vertical curves.

The Director with the consent of the SFFD may approve of any design modification to this standard on a case-by-case basis.

5. Surface Drainage

a. Subdivider shall grade streets to provide a continuous downhill path.

b. At low end cul-de-sacs and sumps, in addition to sewer drainage facilities, Subdivider shall provide surface drainage channels in dedicated easements as relief of overflow to prevent flooding of adjoining property.

c. Subdivider shall design street and drainage channel cross-sections to provide a transport channel for overland or surface flow in excess of the 5-years storm capacity of the sewer system. The channel capacity shall be the difference between the sewer capacity and the quantity of runoff generated by a 100-year storm as defined by the NOAA National Weather Service or by City-furnished data, applied over the tributary area involved.

d. Subdivider shall round street curb intersections by a curve generally having a radius equivalent to the width of the sidewalk and the design shall be in accordance with the Better Streets Plan. While allowing vehicle movements for emergency vehicles, the Subdivider shall use the smallest possible radius.

D. PRIVATE STREETS

Private streets shall have a minimum right-of-way width of 40 feet for through streets. Dead-end private streets shall have a minimum right-of-way width of 60 feet. The Subdivider shall consult with the Fire Department and Department of Building Inspection for all designs that might result in less than the minimum width.

E. BLOCKS

Attachment C

Pipeline Location is Not Exact
Call 811 before you dig

PG&E Pipeline Information
Facilities to be operated by PG&E personnel only

Subject: Fw: Fwd: Development on Upper Folsom Street Follow-Up Request
From: barbara underberg <bjunderberg@yahoo.com>
Date: Sun, 10 Sep 2017 18:23:03 +0000 (UTC)
To: "L. B. Karp" <lbk@lbkarp.com>

----- Forwarded Message -----
From: Herb Felsenfeld <herbfelsenfeld@gmail.com>
To: Deborah Gerson <dgerson646@gmail.com>; "bjunderberg@yahoo.com" <bjunderberg@yahoo.com>
Cc: Gail Newman <g-newman@comcast.net>
Sent: Saturday, September 9, 2017 5:31 PM
Subject: Fwd: Development on Upper Folsom Street Follow-Up Request

Barbara - I believe this is the e-mail you wanted.
Deborah - Thank You!!
Herb

---------- Forwarded message ---------
From: Deborah Gerson <dgerson646@gmail.com>
Date: Sat, Sep 9, 2017 at 5:06 PM
Subject: Fwd: Development on Upper Folsom Street Follow-Up Request
To: Herb Felsenfeld <herbfelsenfeld@gmail.com>

Here's the message from Austin Sharp that you wanted.
The date is 5/28/2014
---------- Forwarded message ----------
From: **Sharp, Austin** <AWSd@pge.com>
Date: Wed, May 28, 2014 at 4:57 PM
Subject: RE: Development on Upper Folsom Street Follow-Up Request
To: Herbert Felsenfeld <herbfelsenfeld@gmail.com>
Cc: Deborah Gerson <dgerson646@gmail.com>, "Fabien Lannoye (fabien@bluorange.com)" <fabien@bluorange.com>

Hi Deborah, Herb, and Fabien,

Please see below for the response to the questions that Deborah submitted to me. Herb, I will have the additional questions sometime next week. I will also be attending your design review board meeting tonight, so if you have any PG&E related questions I will be available to answer them. Look forward to seeing you there.

Background: Lot 13 and Lot 14, Block 5626; 3516 Folsom St.; 3526 Folsom St. Concerned neighbors require explicit information about Pipeline 109. Thus we are sending the following request for information to the developer and to you as a representative of PG&E. As the owner of the above listed lots, in the vicinity of Pipeline #109 in Bernal Heights, we, concerned neighbors, are asking you to provide the following information:

QUESTION(S) 1: Where exactly is pipeline 109?; identify the longitude and latitude coordinates.
RESPONSE(S) 1: Please see attachment "*L109_Folsom_Street.pdf*" for the location of Line 109 near 3516 and 3526 Folsom Street, San Francisco. PG&E does not provide latitude and longitude of natural

gas pipelines to outside parties (other than its regulators) for security reasons. To have PG&E identify the location of the gas lines in your street, please call USA, the Underground Service Alert, at 811.

QUESTION(S) 2: How deeply is #109 buried?
RESPONSE(S) 2: Gas transmission pipelines are typically installed with 36 to 48 inches of cover. However, the depth may vary as cover over the lines may increase or decrease over time due to land leveling and construction. Without digging and exposing the line, it is not possible to determine the exact depth.

QUESTION(S) 3: What is Pipeline #109 composed of?
RESPONSE(S) 3: Line 109 is a steel pipeline. In your neighborhood, this pipeline has a maximum allowable operating pressure (MAOP) of 150 pounds per square inch gage (psig), which is 19.8% of the pipe's specified minimum yield strength (SMYS). This provides a considerable margin of safety, since it would take a pressure of at least 750 psig to cause the steel in the pipe to begin to deform.

QUESTION(S) 4: How old is Pipeline #109?
RESPONSE(S) 4: Line 109 in this area was installed in 1981 and was strength tested at the time of installation.

QUESTION(S) 5: How big in diameter is Pipeline #109? What is the composition of the pipeline?
RESPONSE(S) 5: Line 109 in your vicinity is a 26-inch diameter steel pipeline.

QUESTION(S) 6: How/with what are the pipe seams welded?
RESPONSE(S) 6: Line 109 near 3516 and 3526 Folsom Street is constructed of API 5L-Grade B steel pipe, and has a double submerged arc weld along the longitudinal seam.

QUESTION(S) 7: How much gas runs through Pipeline #109?
RESPONSE(S) 7: Line 109 has a variable flow rate that is dependent on system operations and San Francisco area gas customer consumption. As points of reference, however, Line 109 observed flow rates of 1.55 – 2.375 million standard cubic feet per hour (MMSCFH) through the flow meter at Sullivan Avenue in Daly City on May 27, 2014.

QUESTION(S) 8: When were the last 3 inspections? Would you produce the documentation for these inspections.
RESPONSE(S) 8: PG&E has a comprehensive inspection and monitoring program to ensure the safety of its natural gas transmission pipeline system. PG&E regularly conducts patrols, leak surveys, and cathodic protection (corrosion protection) system inspections for its natural gas pipelines. Any issues identified as a threat to public safety are addressed immediately. PG&E also performs integrity assessments of certain gas transmission pipelines in urban and suburban areas.

Patrols: PG&E patrols its gas transmission pipelines at least quarterly to look for indications of missing pipeline markers, construction activity and other factors that may threaten the pipeline. Line 109 through the neighborhood was last patrolled in May 2014 and everything was found to be normal.

Leak Surveys: PG&E conducts leak surveys at least annually of its natural gas transmission pipelines. Leak surveys are generally conducted by a leak surveyor walking above the pipeline with leak detection instruments. Line 109 was last leak surveyed in April 2014 and no leaks were found.

Cathodic Protection System Inspections: PG&E utilizes an active cathodic protection (CP) system on its gas transmission and steel distribution pipelines to protect them against corrosion. PG&E inspects its CP systems every two months to ensure they are operating correctly. The CP systems on Line 109 in your area were last inspected in May 2014 and were found to be operating correctly.

Integrity Assessments: There are three federally-approved methods to complete a transmission pipeline integrity management baseline assessment: In-Line Inspections (ILI), External Corrosion Direct Assessment (ECDA) and Pressure Testing. An In-Line Inspection involves a tool (commonly known as a "pig") being inserted into the pipeline to identify any areas of concern such as potential metal loss (corrosion) or geometric abnormalities (dents) in the pipeline. An ECDA involves an indirect, above-ground electrical survey to detect coating defects and the level of cathodic protection. Excavations are performed to do a direct examination of the pipe in areas of concern as required by federal regulations. Pressure testing is a strength test normally conducted using water, which is also referred to as a hydrostatic test.

PG&E performed an ECDA on Line 109 in this area in 2009 and no issues were found. PG&E plans to perform the next ECDA on L-109 in this area in 2015. PG&E also performed an ICDA (Internal Corrosion Direct Assessment) on L-109 near 3516 and 3526 Folsom Street in 2012, and no issues were found.

Unfortunately, PG&E cannot provide the documentation from these inspections because they contain confidential information that PG&E only provides to its regulators.

QUESTION(S) 9: Is this pipeline equivalent in type to the exploded pipeline in San Bruno?
RESPONSE(S) 9: Line 109 near 3516 and 3526 Folsom Street is not equivalent to the pipe in San Bruno that failed. The pipeline in San Bruno that failed was PG&E natural gas transmission pipeline L-132, which had a diameter of 30 inches, was installed in 1956, and had an MAOP of 400 psig. As described in the responses above, L-109 in your area is a 26-inch diameter pipeline, was installed in 1981, and operates at an MAOP of 150 psig.

Thanks,

Austin

Austin Sharp I Expert Customer Impact Specialist
Pacific Gas and Electric Company
Phone: 650.598.7321
Cell: 650.730.4168
Email: awsd@pge.com

From: Herbert Felsenfeld [mailto:herbfelsenfeld@gmail.com]
Sent: Thursday, May 22, 2014 6:00 PM
To: Sharp, Austin
Cc: Deborah Gerson
Subject: Re: Development on Upper Folsom Street Follow-Up Request

I look forward to hearing from you, Austin by COB 05/28 with answers to Dr. Deborah Gerson's questions, and, I similarly look forward to hearing from with answers to my additional questions by COB 06/04.

Thank you kindly for your attention to our requests, as well for your timely and informative reply.

Sincerely,
Herb

On Thu, May 22, 2014 at 4:37 PM, Sharp, Austin <AWSd@pge.com> wrote:
Hi Herb,

I expect the responses for the questions sent over by Deborah mid next week, and then the additional responses from your questions in the letter most likely the week after. Please let me know if you have any questions. Thanks, Austin

Austin Sharp I Expert Customer Impact Specialist
Pacific Gas and Electric Company
Phone: 650.598.7321
Cell: 650.730.4168
Email: awsd@pge.com

From: Herbert Felsenfeld [mailto:herbfelsenfeld@gmail.com]
Sent: Saturday, May 17, 2014 3:26 PM
To: Sharp, Austin
Subject: Development on Upper Folsom Street Follow-Up Request

May 17, 2014

Thank you for talking with me on Friday, May 16, 2014, Mr. Sharp. Attached is a copy of a letter that will also be sent by US Mail. Hard copies will also be sent to Mr. Nick Bruno and Mr. Nick Stavropoulos.
Thank you for your response to the questions within one weeks time.

Yours truly,
Herb Felsenfeld

PG&E is committed to protecting our customers' privacy.
To learn more, please visit http://www.pge.com/about/company/privacy/customer/

L109_Folsom_Street.pdf	**Content-Type:** application/pdf **Content-Encoding:** base64

Attachment D

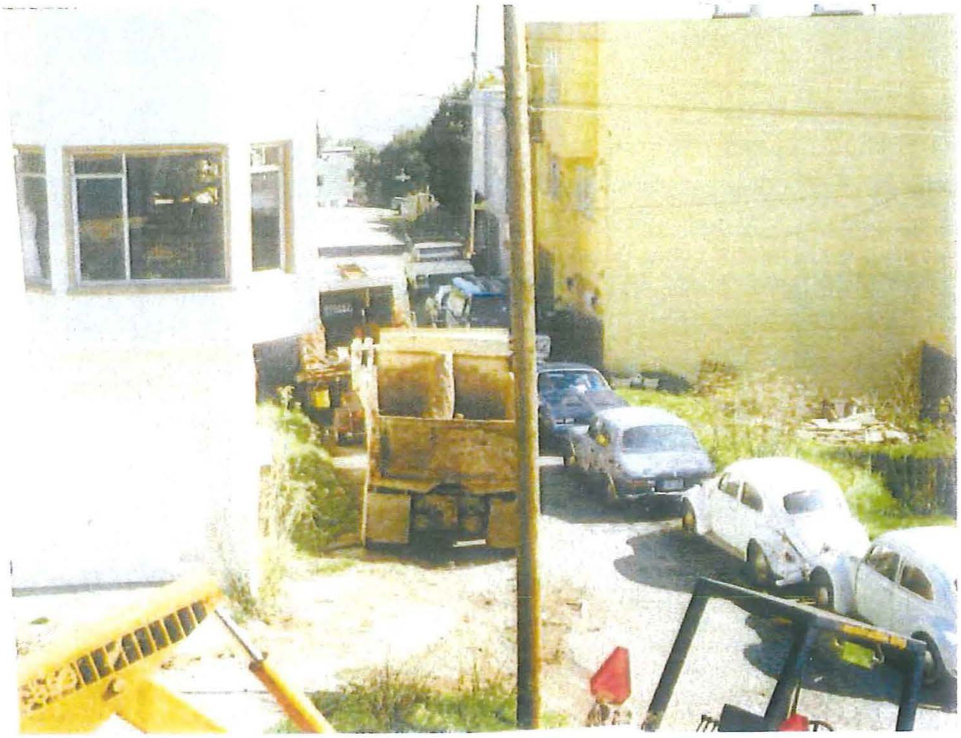

case


229 ZWC


229 ZWC
case


W20
case
case


W20



Attachment E

REPORT
GEOTECHNICAL INVESTIGATION
Planned Residence At
3516 Folsom Street
San Francisco, California

Prepared for:

Mr. Fabien Lannoye
Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

Prepared by:

H. Allen Gruen
Geotechnical Engineer
360 Grand Avenue, # 262
Oakland, California 94610
(510) 839-0765

Project Number: 13-4060

REGISTERED PROFESSIONAL ENGINEER
H ALLEN GRUEN
GE. 2147
Exp. 12/31/2013
GEOTECHNICAL
STATE OF CALIFORNIA

H. Allen Gruen

H. Allen Gruen, C.E., G.E.
Registered Geotechnical Engineer No. 2147

August 3, 2013

TABLE OF CONTENTS, CONTINUED

FINDINGS

Site Description

As shown on the Boring Location Map, Plate 1, the project site is located northwest of the intersection of Folsom and Chapman Streets in San Francisco, California. The topography in the vicinity of the site slopes downward toward the south at an average inclination of about 3-½:1 (horizontal:vertical). At the time of our investigation, the subject site was undeveloped.

Geologic Conditions

The site is within the Coast Ranges Geomorphic Province, which includes the San Francisco Bay and the northwest-trending mountains that parallel the coast of California. Tectonic forces resulting in extensive folding and faulting of the area formed these features. The oldest rocks in the area include sedimentary, volcanic, and metamorphic rocks of the Franciscan Complex. This unit is Jurassic to Cretaceous in age and forms the basement rocks in the region.

Locally, the site is in the San Francisco South Quadrangle (1993). A published geologic map of the area (Bonilla, 1998) shows the area southwest of the site is underlain by colluvial deposits (slope debris and ravine fill) consisting of stony silty to sandy clay and the area northeast of the site is underlain by chert bedrock.

Earth Materials

Our borings at the subject site encountered about 3 to 4 feet of soil overlying chert bedrock. Boring 1 encountered about 4 feet of very stiff, lean clay with varying amounts of sand overlying the chert bedrock. Boring 2 penetrated about 2 feet of very stiff, silty clayey sand overlying hard, sandy lean clay that was underlain at a depth of about 3 feet by chert bedrock. Detailed descriptions of the materials encountered as well as test results are shown on the Boring Logs, Plates 2 and 3.

Groundwater

Free groundwater was not encountered in our borings to the maximum depth explored of 5 feet. It is our opinion that the free groundwater table will be below the planned site excavations. We anticipate that the depth to the free water table will vary with time and that zones of seepage may be encountered near the ground surface following rain or irrigation upslope of the subject site.

Earthquake Shaking

Earthquake shaking results from the sudden release of seismic energy during displacement along a fault. During an earthquake, the intensity of ground shaking at a particular location will depend on a number of factors including the earthquake magnitude, the distance to the zone of energy release, and local geologic conditions. We expect that the site will be exposed to strong earthquake shaking during the life of the improvements. The recommendations contained in the applicable Building Code should be followed for reducing potential damage to the improvements from earthquake shaking.

Liquefaction

Liquefaction results in a loss of shear strength and potential volume reduction in saturated granular soils below the groundwater level from earthquake shaking. The occurrence of this phenomenon is dependent on many factors, including the intensity and duration of ground shaking, soil density and particle size distribution, and position of the groundwater table (Seed and Idriss, 1982). The site does not lie within a liquefaction potential zone as mapped by the California Division of Mines and Geology for the City and County of San Francisco (CDMG, 2000). In addition, the earth materials encountered on our borings have a low potential for liquefaction. Therefore, it is our opinion that there is a low potential for damage to the planned improvements from liquefaction.

Lateral Spreading

Lateral spreading or lurching is generally caused by liquefaction of marginally stable soils underlying gentle slopes. In these cases, the surficial soils move toward an unsupported face, such as an incised channel, river, or body of water. Because the site has a low potential for liquefaction, we judge that there is a low risk for damage of the improvements from seismically-induced lateral spreading.

Densification

Densification can occur in clean, loose granular soils during earthquake shaking, resulting in seismic settlement and differential compaction. It is our opinion that earth materials subject to seismic densification do not exist beneath the site in sufficient thickness to adversely impact the planned improvements.

Excavations

Bedrock was encountered in our borings at a depth of about 3 to 4 feet below the ground surface. We anticipate that excavations in the upper portions of bedrock at the site can be conducted with conventional equipment, although localized ripping may be required. Excavations extending deeper into the bedrock may require extra effort, such as heavy ripping, hoe-rams, or jack-hammering. We anticipate that the bedrock will become harder and more massive with increasing depth.

Overexcavation

Loose, porous soils and topsoil, if encountered, should be overexcavated in areas designated for placement of future engineered fill or support of improvements. Difficulty in achieving the recommended minimum degree of compaction described below should be used as a field criterion by the geotechnical engineer to identify areas of weak soils that should be removed and replaced as engineered fill. The depth and extent of excavation should be approved in the field by the geotechnical engineer prior to placement of fill or improvements.

Subgrade Preparation

Exposed soils designated to receive engineered fill should be cut to form a level bench, scarified to a minimum depth of 6 inches, brought to at least optimum moisture content, and compacted to at least 90 percent relative compaction, in accordance with ASTM test designation D 1557.

Material for Fill

It is anticipated that the on-site soil will be suitable for reuse as fill provided that lumps greater than 6 inches in largest dimension and perishable materials are removed, and that the fill materials are approved by the geotechnical engineer prior to use.

Fill materials brought onto the site should be free of vegetative mater and deleterious debris, and should be primarily granular. The geotechnical engineer should approve fill material prior to trucking it to the site.

Compaction of Fill

Fill should be placed in level lifts not exceeding 8 inches in loose thickness. Each lift should be brought to at least the optimum moisture content and compacted to at least 90 percent relative compaction, in accordance with ASTM test designation D 1557.

Foundations

General

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for foundations in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if during construction, soil is observed more than 4 feet below the ground surface at foundation levels, the foundations will need to be deepened to bear in rock, or the foundations will need to be redesigned using the soil values.

It is our opinion that the planned improvements may be supported on a conventional spread footing foundation bearing in competent earth materials. If the spread footings would cover a substantial portion of the building area, a mat foundation may be used as an alternative to reduce forming and steel bending costs. The Structural Engineer may also choose to use drilled piers to support improvements, or for shoring and underpinning, if required. Design criteria for each foundation type are presented below.

Spread Footings

Spread footings should extend at least 24 inches below lowest adjacent exterior grade, or 18 inches below lowest adjacent interior grade, whichever is lower. If soft or unstable soil areas are encountered at the bottom of the footings, localized deepening of the footing excavation will be necessary. Footing depths may be reduced if competent bedrock is exposed in footing excavations. Footings should be stepped to produce level tops and bottoms and should be deepened as necessary to provide at least 7 feet of horizontal clearance between the portions of footings designed to impose passive pressures and the face of the nearest slope or retaining wall.

Spread footings bottomed in soil can be designed to impose dead plus code live load bearing pressures and total design load bearing pressures of 2,000 and 3,000 psf, respectively. If foundations are bottomed in bedrock, the footings may be designed for maximum allowable rock contact pressures of 3,500 pounds per square foot (psf) for dead plus sustained live loads, and 5,000 psf for total loads, including wind or seismic forces.

Mat Foundation

A mat foundation may be used to support the planned improvements. The mat can be designed for an average allowable bearing pressure in soil over the entire mat of 2,000 psf for combined dead plus sustained live loads, and 3,000 psf for total loads including wind or seismic forces. The weight of the mat extending below current site grade may be neglected in computing bearing loads. Localized increases in bearing pressures of up to 4,000 psf may be utilized. If the mat is bottomed in bedrock, the mat may be designed for maximum allowable rock contact pressures of 3,500 pounds per square foot (psf) for dead plus sustained live loads, and 5,000 psf for total loads, including wind or seismic forces, with localized increases up to 8,000 psf. For elastic design, a modulus of subgrade reaction for soil of 50 kips per cubic foot and for rock of 200 kips per cubic foot may be used.

Resistance to lateral pressures can be obtained from passive earth pressures against the face of the mat and soil friction along the base of the mat foundation. We recommend that an allowable passive equivalent fluid pressure in soil of 250 pcf and a friction factor of 0.3 times the net vertical dead load be used for design. In bedrock, a uniform pressure of 3000 psf and a friction factor of 0.4 times the net vertical dead load may be used for design to resist lateral forces and sliding. Passive pressures should be disregarded in areas with less than 7 feet of horizontal soil confinement and for the uppermost 1-foot of foundation depth unless confined by concrete slabs or pavements.

Retaining Walls

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for retaining walls in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if more than 2 feet of soil than what was anticipated from the borings is being retaining by subsurface walls, the portions of walls supporting the additional soil will need to be designed using the lateral earth pressures for soil conditions.

Retaining walls should be fully backdrained. The backdrains should consist of at least a 3-inch-diameter, rigid perforated pipe, or equivalent such as a "high profile drain", surrounded by a drainage blanket. The pipe should be sloped to drain by gravity to appropriate outlets. Accessible subdrain cleanouts should be provided and maintained on a routine basis. The drainage blanket should consist of clean, free-draining crushed rock or gravel, wrapped in a filter fabric such as Mirafi 140N. The aggregate drainage blanket should be at least 1 foot in width and extend to within 1 foot of the surface. The uppermost 1-foot should be backfilled with compacted native soil to exclude surface water. Alternatively, the drainage blanket could consist of Caltrans Class 2 "Permeable Material" or a prefabricated drainage structure such as Mirafi Miradrain. The backdrain should extend down at least 8 inches below lowest adjacent grade.

Rigid retaining walls constrained against such movement could be subjected to "at-rest" lateral earth pressures equivalent to those exerted by the fluid pressures listed above plus a uniform load of 6•H pounds per square foot in soil and of 4•H pounds per square foot in rock, where H is the height of the backfill above footing level. Where an imaginary 1:1 (H:V) plane projected downward from the outermost edge of a surcharge load intersects a lower retaining wall, that portion of the constrained wall below the intersection should be designed for an additional horizontal thrust from a uniform pressure equivalent to one-half the maximum anticipated surcharge pressure in soil and one-third the maximum anticipated surcharge pressure in rock. In some cases, this value yields a conservative estimate of the actual lateral pressure imposed. We should be contacted if a more precise estimate of lateral loading on the retaining wall from surcharge pressures is desired.

A seismic pressure increment equivalent to a rectangular pressure distribution of 5H in psf may be used, where H is the height of the soil retained in feet.

Wall backfill should consist of soil that is spread in level lifts not exceeding 8 inches in thickness. Each lift should be brought to at least optimum moisture content and compacted to not less than 90 percent relative compaction, per ASTM test designation D 1557. Retaining walls may yield slightly during backfilling. Therefore, walls should be properly braced during the backfilling operations.

Where migration of moisture through retaining walls would be detrimental or undesirable, retaining walls should be waterproofed as specified by the project architect or structural engineer.

Retaining walls should be supported on footings designed in accordance with the recommendations presented above. A minimum factor of safety of 1.5 against overturning and sliding should be used in the design of retaining walls.

Slab-on-Grade Floors

The subgrade soil in slab and flatwork areas should be proof rolled to provide a firm, non-yielding surface. If moisture penetration through the slab would be objectionable, slabs should be underlain by a capillary moisture break consisting of at least 4 inches of clean, free-draining crushed rock or gravel graded such that 100 percent will pass the 1-inch sieve and none will pass the No. 4 sieve. Further protection against slab moisture penetration can be provided by means of a moisture vapor barrier membrane, placed between the drain rock and the slab. The membrane may be covered with 2 inches of damp, clean sand to protect it during construction.

LIMITATIONS

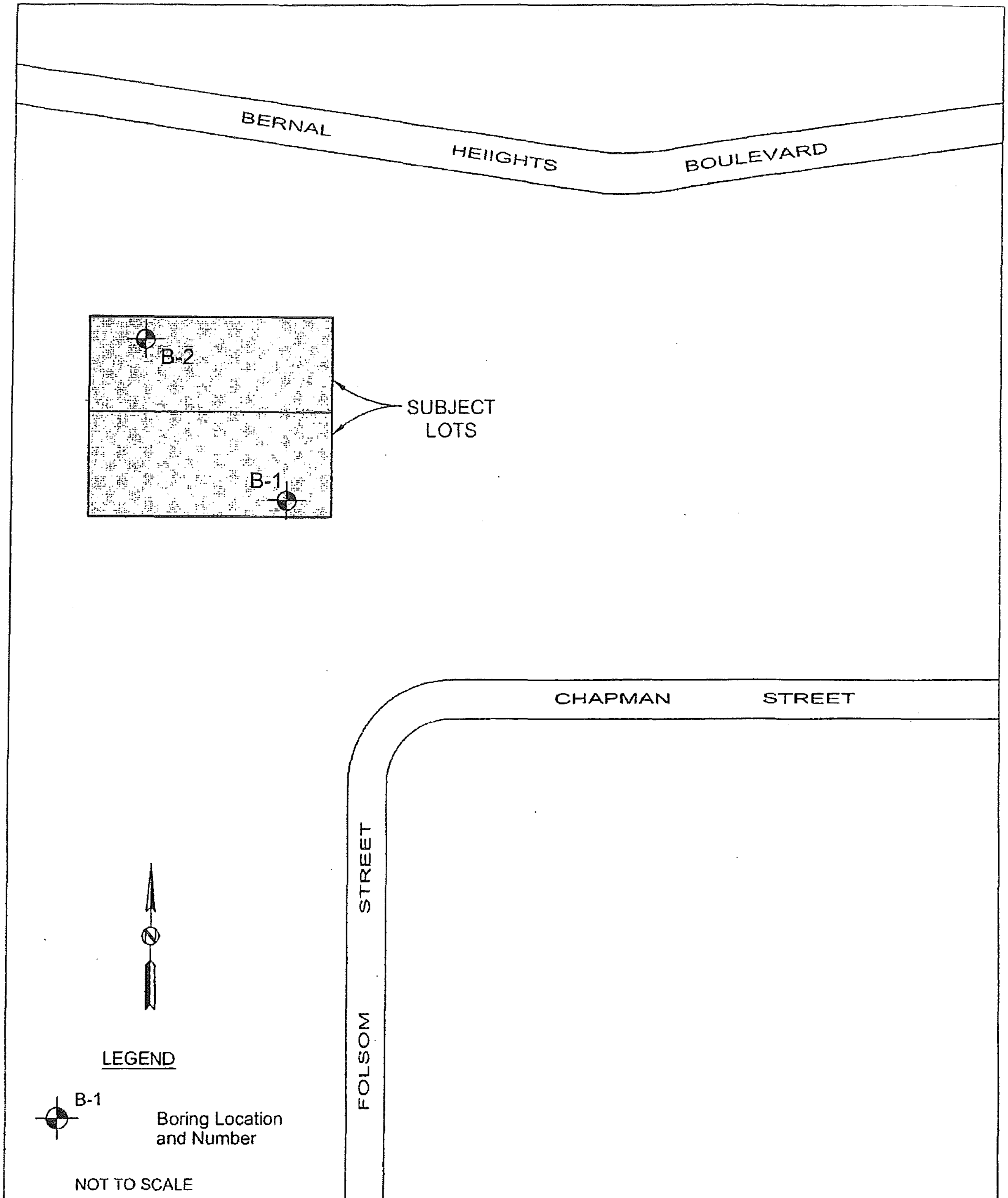
This report has been prepared for the exclusive use of Bluorange Designs and their consultants for the proposed project described in this report.

Our services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. We provide no other warranty, either expressed or implied. Our conclusions and recommendations are based on the information provided us regarding the proposed construction, the results of our field exploration and laboratory testing programs, and professional judgment. Verification of our conclusions and recommendations is subject to our review of the project plans and specifications, and our observation of construction.

The test boring logs represent subsurface conditions at the locations and on the date indicated. It is not warranted that they are representative of such conditions elsewhere or at other times. Site conditions and cultural features described in the text of this report are those existing at the time of our field exploration, conducted on June 28, 2013, and may not necessarily be the same or comparable at other times.

The locations of the test borings were established in the field by reference to existing features and should be considered approximate only.

The scope of our services did not include an environmental assessment or an investigation of the presence or absence of hazardous, toxic, or corrosive materials in the soil, surface water, groundwater or air, on or below, or around the site, nor did it include an evaluation or investigation of the presence or absence of wetlands.



Earth Mechanics Consulting Engineers	Job. No: 13-4060 Appr: Drwn: LPDD Date: 7/1/13	BORING LOCATION MAP 3516 & 3526 Folsom Street San Francisco, California	PLATE 1

EQUIPMENT: Continuous Sampling
ELEVATION: *
LOGGED BY: A.K.
START DATE: 6-28-13
FINISH DATE: 6-28-13

Other Laboratory Tests	Pocket Penetrometer (ksf)	Moisture Content (%)	Dry Density (pcf)	% Passing #200 sieve	Blows/Foot	DEPTH (FEET)	Description
					58	0	Brown Silty Clayey Sand (CL-ML), moist, very stiff, with roots
						1	
		18.3		73			
					86	2	Light Mottled Brown Sandy Lean Clay (CL), moist, hard
		20.9		63			
		2.7		27	50/6"	3	Reddish-Brown Chert, firm, friable, moderately weathered

Bottom of Boring = 3.5'
No Free Water Encountered

* Existing ground surface.

Earth Mechanics
Consulting Engineers

Job No: 13-4060
Appr:
Drwn: LPDD
Date: JUL 2013

LOG OF BORING 2

3516 & 3526 Folsom Street

San Francisco, California

PLATE 3

ROCK SYMBOLS

SHALE OR CLAYSTONE	CHERT	SERPENTINITE
SILTSTONE	PYROCLASTIC	METAMORPHIC ROCKS
SANDSTONE	VOLCANIC	DIATOMITE
CONGLOMERATE	PLUTONIC	SHEARED ROCKS

LAYERING

MASSIVE	Greater than 6 feet
THICKLY BEDDED	2 to 6 feet
MEDIUM BEDDED	8 to 24 inches
THINNLY BEDDED	2-1/2 to 8 inches
VERY THINNLY BEDDED	3/4 to 2-1/2 inches
CLOSELY LAMINATED	1/4 to 3/4 inches
VERY CLOSELY LAMINATED	Less than 1/4 inch

JOINT, FRACTURE, OR SHEAR SPACING

VERY WIDELY SPACED	Greater than 6 feet
WIDELY SPACED	2 to 6 feet
MODERATELY SPACED	8 to 24 inches
CLOSELY SPACED	2-1/2 to 8 inches
VERY CLOSELY SPACED	3/4 to 2-1/2 inches
EXTREMELY CLOSELY SPACED	Less than 3/4 inch

HARDNESS

SOFT - Pliable; can be dug by hand

FIRM - Can be gouged deeply or carved with a pocket knife

MODERATELY HARD - Can be readily scrached by a knife blade; scratch leaves heavy trace of dust and is readily visable after the powder has been blown away

HARD - Can be scratched with difficulty; scratch produces little powder and is often faintly visable

VERY HARD - Cannot be scratched with pocket knife; leaves a metallic streak

STRENGTH

PLASTIC - Capable of being molded by hand

FRIABLE - Crumbles by rubbing with fingers

WEAK - An unfractured specimen of such material will crumble under light hammer blows

MODERATELY STRONG - Specimen will withstand a few heavy hammer blows before breaking

STRONG - Specimem will withstand a few heavy ringing hammer blows and usually yields large fragments

VERY STRONG - Rock will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments

DEGREE OF WEATHERING

HIGHLY WEATHERED - Abundant fractures coated with oxides, carbonates, sulphates, mud, etc., thourough discoloration, rock disintegration, mineral decomposition

MODERATELY WEATHERED - Some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition

SLIGHTLY WEATHERED - A few stained fractures, slight discoloration, little or no effect on cementation, no mineral decomposition

FRESH - Unaffected by weathering agents, no appreciable change with depth

APPENDIX C

Field Exploration

Our field exploration consisted of a geologic reconnaissance and subsurface exploration by means of two test borings logged by our Engineer on June 28, 2013. The test borings were drilled with a hand carried, portable drill rig utilizing continuous flight, 4-inch-diameter augers. The borings were drilled at the approximate locations shown on Plate 1.

The logs of the test borings are displayed on Plates 2 and 3. Representative undisturbed samples of the earth materials were obtained from the test borings at selected depth intervals with a 1.4-inch inside diameter, split-barrel Standard Penetration Test (SPT) sampler, a 2-inch inside diameter, split-barrel sampler, and a 2.5-inch inside diameter, modified California sampler.

Penetration resistance blow counts were obtained by dropping a 70-pound hammer through a 30-inch free fall. The sampler was driven 24 inches or less and the number of blows was recorded for each 6 inches of penetration. The blows per foot recorded on the Boring Logs represent the accumulated number of blows that were required to drive the sampler the last 12 inches or fraction thereof.

The soil classifications are shown on the Boring Logs and referenced on Plate 4. Bedrock is described in accordance with the engineering geology rock terms presented on Plate 5.

Laboratory Testing

Natural water contents and percentages of gravel, sand, and fines were determined on selected soil samples recovered from the test borings. The data are recorded at the appropriate sample depths on the Boring Logs.

EARTH MECHANICS CONSULTING ENGINEERS

Geotechnical Engineering

360 Grand Avenue • Suite 262
Oakland, CA 94610
Phone (510) 839-0765
Fax (510) 839-0716

November 29, 2016
Project Number: 13-4060

Mr. James Fogarty
Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

Subject: Geotechnical Report Update
Proposed Residence at
3516 & 3526 Folsom Street
San Francisco, California

Dear Mr. Fogarty:

This letter presents an update of my geotechnical investigation report for the proposed residence at 3516 and 3526 Folsom Street in San Francisco, California. H. Allen Gruen, Geotechnical Engineer performed a geotechnical investigation for the project and presented results in the report dated August 3, 2013.

Proposed Project

It is my understanding that the project will consist of the design and construction of a new residence on an undeveloped lot. No other project details are known at this time.

Report Update

It is my opinion that, the findings, conclusions, and recommendations presented in our geotechnical investigation report dated August 3, 2013, are still valid and applicable for the proposed development.

H. ALLEN GRUEN

Geotechnical Engineer

360 Grand Avenue, # 262
Oakland, CA 94610
Phone (510) 839-0765
H.Allen.Gruen@gmail.com

January 24, 2017
Project Number: 13-4060c

Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

Subject: Geotechnical Responses to Project Review Letter
3516 and 3526 Folsom Street
San Francisco, California

Dear Ladies and Gentlemen:

This letter presents my geotechnical responses to the project review letter by Storesund Consulting, dated December 1, 2016, for the proposed residences at 3516 and 3526 Folsom Street in San Francisco, California. H. Allen Gruen, Geotechnical Engineer performed a geotechnical investigation for the project and presented results in the report dated August 3, 2013.

- The reviewer notes that geotechnical borings do not extend to the proposed depth of excavations (about 6 feet deep). Our borings encountered chert bedrock at depths about 2 to 4 feet. Practical drilling refusal was encountered at the maximum depth explored of 5 feet. We anticipate that bedrock will extend for a significant depth below the subject site.

- Estimating induced ground vibrations caused by rock excavations causing potential degradation of the transmission line integrity was beyond our scope of work for the residential development.

- Determining negative impacts of construction traffic to the transmission line integrity was beyond our scope of work for the residential development.

- The construction operations for the subject residential development adjacent to the transmission pipeline are not expected to have a significant detrimental impact to the transmission pipeline.

H. ALLEN GRUEN

Geotechnical Engineer

360 Grand Avenue, # 262
Oakland, CA 94610
Phone (510) 839-0765
H.Allen.Gruen@gmail.com

April 14, 2017
Project Number: 13-4060d

Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

Subject: Geotechnical Consultation
3516 and 3526 Folsom Street
San Francisco, California

Dear Ladies and Gentlemen:

This letter presents my geotechnical consultation for the proposed residences at 3516 and 3526 Folsom Street in San Francisco, California. H. Allen Gruen, Geotechnical Engineer performed a geotechnical investigation for the project and presented results in the report dated August 3, 2013.

- The house foundations will require about 298 cubic yards of excavation for 3516 Folsom and 253 cubic yards for 3526 Folsom. I would estimate about 50 cubic yards of top soil, with the rest being chert. The deepest excavation (15'-0" maximum at rear of proposed foundation) will happen in chert.

- The chert bedrock at the subject site is firm and friable (with the definitions provided on Plate 5 of the geotechnical report.)

I appreciate the opportunity to be of continued service to you on this project. If you have any questions, please call me at (510) 839-0765.

Sincerely,

H. Allen Gruen, C.E., G.E.
Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
H. ALLEN GRUEN
GE2147
EXP. 12-31-2017
GEOTECHNICAL
STATE OF CALIFORNIA

REPORT
GEOTECHNICAL INVESTIGATION
Planned Street and Utility Improvements At
3516 and 3526 Folsom Street
San Francisco, California

Prepared for:

Mr. Fabien Lannoye
241 Amber Drive
San Francisco, CA 94131

Prepared by:

H. Allen Gruen
Geotechnical Engineer
360 Grand Avenue, # 262
Oakland, California 94610
(510) 839-0765

Project Number: 17-4702

REGISTERED PROFESSIONAL ENGINEER
H. ALLEN GRUEN
GE2147
EXP. 12-31-2017
GEOTECHNICAL
STATE OF CALIFORNIA

H. Allen Gruen

H. Allen Gruen, C.E., G.E.
Registered Geotechnical Engineer No. 2147

July 6, 2017

TABLE OF CONTENTS, CONTINUED

FINDINGS

Site Description

As shown on the Boring Location Map, Plate 1, the project site is located north of the intersection of Folsom and Chapman Streets in San Francisco, California. The topography in the vicinity of the site slopes downward toward the south at an average inclination of about 3-½:1 (horizontal:vertical). At the time of my investigation, the subject site was undeveloped.

Geologic Conditions

The site is within the Coast Ranges Geomorphic Province, which includes the San Francisco Bay and the northwest-trending mountains that parallel the coast of California. Tectonic forces resulting in extensive folding and faulting of the area formed these features. The oldest rocks in the area include sedimentary, volcanic, and metamorphic rocks of the Franciscan Complex. This unit is Jurassic to Cretaceous in age and forms the basement rocks in the region.

Locally, the site is in the San Francisco South Quadrangle (1993). A published geologic map of the area (Bonilla, 1998) shows the area southwest of the site is underlain by colluvial deposits (slope debris and ravine fill) consisting of stony silty to sandy clay and the area northeast of the site is underlain by chert bedrock.

Earth Materials

My boring at the subject site encountered sandy lean clay with gravel from the ground surface to practical refusal at a depth of 6-½ feet. The clay was firm near the ground surface and became stiff to hard with increasing depth. Detailed descriptions of the materials encountered as well as test results are shown on the Boring Log, Plate 2.

Groundwater

Free groundwater was not encountered in my boring to the maximum depth explored of 6-½ feet. It is my opinion that the free groundwater table will be below the planned site excavations. I anticipate that the depth to the free water table will vary with time and that zones of seepage may be encountered near the ground surface following rain or irrigation upslope of the subject site.

Liquefaction

Liquefaction results in a loss of shear strength and potential volume reduction in saturated granular soils below the groundwater level from earthquake shaking. The occurrence of this phenomenon is dependent on many factors, including the intensity and duration of ground shaking, soil density and particle size distribution, and position of the groundwater table (Seed and Idriss, 1982). The site does not lie within a liquefaction potential zone as mapped by the California Division of Mines and Geology for the City and County of San Francisco (CDMG, 2000). In addition, the earth materials encountered in my boring have a low potential for liquefaction. Therefore, it is my opinion that there is a low potential for damage to the planned improvements from liquefaction.

Lateral Spreading

Lateral spreading or lurching is generally caused by liquefaction of marginally stable soils underlying gentle slopes. In these cases, the surficial soils move toward an unsupported face, such as an incised channel, river, or body of water. Because the site has a low potential for liquefaction, I judge that there is a low risk for damage of the improvements from seismically-induced lateral spreading.

Densification

Densification can occur in clean, loose granular soils during earthquake shaking, resulting in seismic settlement and differential compaction. It is my opinion that earth materials subject to seismic densification do not exist beneath the site in sufficient thickness to adversely impact the planned improvements.

Landsliding

The site is mapped within an area of potential landslide hazard by URS/John A. Blume & Associates (1974). Qualifying projects may be subject to the Slope Protection Act (San Francisco Building Code 106A.4.1.4). The San Francisco Building Code (106A.4.1.4.3) states construction work that is subject to these requirements includes the construction of new buildings or structures having over 1000 square feet of new projected roof area and horizontal or vertical additions having over 1000 square feet of new projected roof area. In addition, these requirements apply to the following activity or activities, if, in the opinion of the Director, the proposed work may have a substantial impact on the slope stability of any property: shoring, underpinning, excavation or retaining wall work; grading, including excavation or fill, of over 50 cubic yards of earth materials; or any other construction activity.

Excavations

Bedrock was encountered in boring drilled adjacent to the subject site at depths of about 3 to 4 feet below the ground surface. I anticipate that excavations in the upper portions of bedrock at the site can be conducted with conventional equipment, although localized ripping may be required. Excavations extending deeper into the bedrock may require extra effort, such as heavy ripping, hoe-rams, or jack-hammering. I anticipate that the bedrock will become harder and more massive with increasing depth.

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Where migration of moisture through retaining walls would be detrimental or undesirable, retaining walls should be waterproofed as specified by the project architect or structural engineer.

Retaining walls should be supported on footings designed in accordance with the recommendations presented above. A minimum factor of safety of 1.5 against overturning and sliding should be used in the design of retaining walls.

Slab-on-Grade Floors

The subgrade soil in slab and flatwork areas should be proof rolled to provide a firm, non-yielding surface. If moisture penetration through the slab would be objectionable, slabs should be underlain by a capillary moisture break consisting of at least 4 inches of clean, free-draining crushed rock or gravel graded such that 100 percent will pass the 1-inch sieve and none will pass the No. 4 sieve. Further protection against slab moisture penetration can be provided by means of a moisture vapor barrier membrane, placed between the drain rock and the slab. The membrane may be covered with 2 inches of damp, clean sand to protect it during construction.

LIMITATIONS

This report has been prepared for the exclusive use of Fabien Lannoye and James Fogarty and their consultants for the proposed project described in this report.

My services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. I provide no other warranty, either expressed or implied. My conclusions and recommendations are based on the information provided us regarding the proposed construction, the results of my field exploration and laboratory testing programs, and professional judgment. Verification of my conclusions and recommendations is subject to my review of the project plans and specifications, and my observation of construction.

The test boring log represents subsurface conditions at the location and on the date indicated. It is not warranted that it is representative of such conditions elsewhere or at other times. Site conditions and cultural features described in the text of this report are those existing at the time of my field exploration, conducted on May 10, 2017, and may not necessarily be the same or comparable at other times.

The location of the test boring was established in the field by reference to existing features and should be considered approximate only.

The scope of my services did not include an environmental assessment or an investigation of the presence or absence of hazardous, toxic, or corrosive materials in the soil, surface water, groundwater or air, on or below, or around the site, nor did it include an evaluation or investigation of the presence or absence of wetlands.

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL SAND CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

			Confining Pressure, psf / Shear Strength, psf	
Consol	Consolidation	Tx	2630 (240)	Unconsolidated Undrained Triaxial
LL	Liquid Limit (in %)	Tx sat	2100 (575)	Unconsolidated Undrained Triaxial, saturated prior to test
PL	Plastic Limit (in %)	DS	3740 (960)	Unconsolidated Undrained Direct Shear
PI	Plasticity Index	TV	1320	Torvane Shear
Gs	Specific Gravity	UC	4200	Unconfined Compression
SA	Sieve Analysis	LVS	500	Laboratory Vane Shear
■	Undisturbed Sample (2.5-inch ID)	FS	Free Swell	
◪	2-inch-ID Sample	EI	Expansion Index	
◩	Standard Penetration Test	Perm	Permeability	
⊠	Bulk Sample	SE	Sand Equivalent	

KEY TO TEST DATA

H. Allen Gruen Geotechnical Engineer	Appr: Drwn: LPDD Date:	SOIL CLASSIFICATION CHART AND KEY TO TEST DATA 3516 and 3526 Folsom Street San Francisco, California	PLATE 3

APPENDIX C

Field Exploration

My field exploration consisted of a geologic reconnaissance and subsurface exploration by means of one test boring that was logged by my Engineer on May 10, 2017. The test boring was drilled with a hand carried, portable drill rig utilizing continuous flight, 4-inch-diameter augers. The boring was drilled at the approximate location shown on Plate 1.

The log of the test boring is displayed on Plate 2. Representative undisturbed samples of the earth materials were obtained from the test boring at selected depth intervals with a 1.4-inch inside diameter, split-barrel Standard Penetration Test (SPT) sampler, a 2-inch inside diameter, split-barrel sampler, and a 2.5-inch inside diameter, modified California sampler.

Penetration resistance blow counts were obtained by dropping a 140-pound hammer through a 30-inch free fall. The sampler was driven 24 inches or less and the number of blows was recorded for each 6 inches of penetration. The blows per foot recorded on the Boring Log represent the accumulated number of blows that were required to drive the sampler the last 12 inches or fraction thereof.

The soil classifications are shown on the Boring Log and referenced on Plate 3.

Laboratory Testing

Natural water contents and percentages of gravel, sand, and fines were determined on selected soil samples recovered from the test boring. The data are recorded at the appropriate sample depths on the Boring Log.

6734.2. Practice of mechanical engineering

Any person practices mechanical engineering when he professes to be a mechanical engineer or is in responsible charge of mechanical engineering work.

6735. Preparation, signing, and sealing of civil engineering documents

(a) All civil (including structural and geotechnical) engineering plans, calculations, specifications, and reports (hereinafter referred to as "documents") shall be prepared by, or under the responsible charge of, a licensed civil engineer and shall include his or her name and license number. Interim documents shall include a notation as to the intended purpose of the document, such as "preliminary," "not for construction," "for plan check only," or "for review only." All civil engineering plans and specifications that are permitted or that are to be released for construction shall bear the signature and seal or stamp of the licensee and the date of signing and sealing or stamping. All final civil engineering calculations and reports shall bear the signature and seal or stamp of the licensee, and the date of signing and sealing or stamping. If civil engineering plans are required to be signed and sealed or stamped and have multiple sheets, the signature, seal or stamp, and date of signing and sealing or stamping, shall appear on each sheet of the plans. If civil engineering specifications, calculations, and reports are required to be signed and sealed or stamped and have multiple pages, the signature, seal or stamp, and date of signing and sealing or stamping shall appear at a minimum on the title sheet, cover sheet, or signature sheet.

(b) Notwithstanding subdivision (a), a licensed civil engineer who signs civil engineering documents shall not be responsible for damage caused by subsequent changes to or uses of those documents, if the subsequent changes or uses, including changes or uses made by state or local governmental agencies, are not authorized or approved by the licensed civil engineer who originally signed the documents, provided that the engineering service rendered by the civil engineer who signed the documents was not also a proximate cause of the damage.

6735.1. Construction supervision; legal duty

The signing of civil engineering plans, specifications, reports, or documents which relate to the design of fixed works shall not impose a legal duty or responsibility upon the person signing the plans, specifications, reports, or documents to supervise the construction of engineering structures or the construction of the fixed works which are the subject of the plans, specifications, reports, or documents. However, nothing in this section shall preclude a civil engineer and a client from entering into a contractual agreement which includes a mutually acceptable arrangement for the provision of construction supervision services. Nothing contained in this subdivision shall modify the liability of a civil engineer who undertakes, contractually or otherwise, the provision of construction supervision services for rendering those services.

6735.3. Signing and sealing of electrical engineering documents

(a) All electrical engineering plans, specifications, calculations, and reports (hereinafter referred to as "documents") prepared by, or under the responsible charge of, a licensed electrical engineer shall include his or her name and license number. Interim documents shall include a notation as to the intended purpose of the document, such as "preliminary," "not for construction," "for plan check only," or "for review only." All electrical engineering plans and specifications that are permitted or that are to be released for construction shall bear the signature

Attachment F

City and County of San Francisco
Department of Building Inspection

Edwin M. Lee, Mayor
Tom C. Hui, S.E., C.B.O., Director

INFORMATION SHEET

NO. S-05

DATE : May 20, 2015

CATEGORY : Structural

SUBJECT : **Geotechnical Report Requirements**

PURPOSE : The purpose of this Information Sheet is to establish the permit work scope which will require the submittal of a geotechnical report.

REFERENCE : San Francisco Building Code (SFBC)
State of California Department of Conservation Division of Mines and Geology (CDMG) Seismic Hazard Zones Map for San Francisco, released November 17, 2000. [Note: Map is posted near 1660 Mission St. 2nd Floor Counter. "Liquefaction zones" are colored "Green," or Seismic Hazard Zones Map Indices listing property street addresses and/or blocks and lots which are in the potential landslide and liquefaction zones (see Attachments 1&2)]
Figure 4 of the San Francisco Seismic Safety Investigation report prepared by URS/John A. Blume & Associates, Engineers, June 1974. (Note: Map is posted near 1660 Mission St. 2nd Floor Counter. "Landslide Hazard Areas" are colored "Red")

DISCUSSION :

(A) Permit requiring geotechnical report

The following permit application submittal will require a geotechnical report:

1. New Building (with the exception of one-story storage or utility occupancy, including storage shed and garage)
2. Horizontal Additions if the footprint area increases more than 50% of the existing square footage
3. Horizontal and Vertical Additions increase more than 1000 square feet of projected roof area within the Landslide Hazard Areas (see Reference) per SFBC Section 106A.4.1.4.3 and per SFBC Section 106A.4.1.4.4.

   [See SECTION (C) page 3]

Technical Services Division
1660 Mission Street – San Francisco CA 94103
Office (415) 558-6205 – FAX (415) 558-6401 – www.sfdbi.org

4. Any of the following grading (per SFBC Section J104.3):
    a) Cut section is greater than 10 feet in vertical height.
    b) Cut slope is steeper than 2 horizontal to 1 vertical.
    c) The tops of cut banks are separated from any structure or major improvement by a distance, measured horizontally, less than the height of the bank.
    d) More than 5000 cubic yards are involved in grading.
    e) Grading performed at a site located within Earthquake Fault Zones, Seismic Hazard Zones, Landslide Zones (see Attachment 1), or Liquefaction Zones (see Attachment 2) as shown in the most recently published maps from California Geological Survey.

5. Slope of fill is steeper than two units horizontal to one unit vertical (50 percent slope) specified per SFBC Section J107.6, or deviate from the stipulated provisions in SFBC Section J107 Fills.

6. Any footings on/or adjacent to slopes steeper than one unit vertical in three units horizontal without clearances as indicated per SFBC Section 1808.7 and Figure 1808.7.1.

7. The design soil lateral loads are less than the minimum design requirements specified in Section 1610 Soil Lateral Loads.

8. The design load bearing value used exceeds values stipulated for Class 4 or 5 soil materials in SFBC Table 1806.2 Presumptive Load-Bearing Values.

9. Special foundation including but not limited to piles, piers, base isolation and any design not covered by code, excluding piers supporting a fence, sign or isolated post.

10. As required per Building Code:
    a) Expansive soil per SFBC Section 1803.5.3.
    b) Drainage system as an alternative to the requirements per SFBC Section J109 Drainage and Terracing.
    c) Water Table per SFBC Section 1803.5.4 to determine whether the existing ground-water table is above or within 5 feet below the elevation of the lowest floor level where such floor is located below the finished ground level adjacent to the foundation, unless waterproofing is provided in accordance with SFBC Section 1805.
    d) Ground improvement, including soil mix grouting and chemical soil grouting.
    e) Where shallow foundations will bear on controlled low-strength material (CLSM), a geotechnical investigation shall be conducted per SFBC Section 1803.5.9 Controlled low-strength material.
    f) Where geological investigation is deemed necessary per SFBC Section 1803 Geotechnical Investigations.

11. Permit scope subject to mandatory structural advisory review under SFBC Section 106A.4.1.2 Edgehill Slope Protection Area, Section 106A.4.1.3 Northwest Mt. Sutro Slope Protection Area.

12. All structures utilizing Modal Response Spectrum Analysis in accordance with ASCE 7-10 Section 12.9 Modal Response Spectrum Analysis.

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(B) Submittal requirements for geotechnical report (if required)

GEOTECHNICAL:

1. Provide original letter wet signed by geotechnical consultant, who is a licensed civil or geotechnical engineer, stating that they have reviewed and approved final structural plans.
{Note: In addition to the licensed geotechnical or civil engineer, a licensed geologist is also required for properties subject to the Slope Protection Act [See SECTION (C) BELOW]}.

2. Provide two (2) sets of original geotechnical reports and one (1) CD-ROM:
SOILS REPORTS: Effective November 1, 2011, DBI will no longer accept soils reports solely in "hard" copy format. Two (2) "hard" copies and one (1) copy on a CD-ROM in Adobe 'PDF' format are required. After DBI review, one "hard" copy will be returned to the applicant with a 'Received' stamp. DBI will retain its copy, and the CD-ROM will be sent to the State Department of Conservation, as required by state law.

3. Geotechnical report shall be in accordance with SFBC Section 1803.2 through Section 1803.6 and Section J104.3.

4. Civil engineers experienced in geotechnical engineering are authorized to practice geotechnical engineering. This includes preparing or reviewing soils reports.

(C) Projects subject to the Slope Protection Act (SFBC Section 106A.4.1.4)

Scope. Properties are subject to these requirements where any portion of the property lies within the areas of "Earthquake-Induced Landslide" in the Seismic Hazard Zone Map, released by California Department of Conservation, Division of Mines and Geology, dated November 17, 2000 (see Attachment 1), or amendments thereto; or within the "Landslide Hazard Areas" mapped as "Landslide Locations" in Figure 4 of the San Francisco Seismic Safety Investigation report prepared by URS/John A. Blume & Associates, Engineers, June 1974; or any successor map thereto. (see Reference)

Sites that are deemed stable by the geologist and where the geologist has mapped the site underlain by bedrock at depth shallower than the proposed depth of excavation are not required to be explored to depths specified in Section 1803.5.6.

Proposed construction work that is subject to these requirements includes the construction of new buildings or structures having over 1000 square feet of new projected roof area, and horizontal or vertical additions having over 1000 square feet projected roof area of newly constructed addition. In addition, these requirements shall apply to the following activity or activities, if determined by the plan reviewer that the proposed work may have a substantial impact on the slope stability of any property, such as: shoring, underpinning, excavation or retaining wall work; grading, including excavation or fill, of over fifty (50) cubic yards of earth materials; or any other construction activity. Such determination by plan reviewer shall be verified by supervisor or manager.

If required as above, permit applications submitted to the Department of Building Inspection for construction shall include report(s) prepared and signed by both a licensed geologist and a licensed geotechnical or civil engineer identifying areas of potential slope instability, defining potential risks of development due to geological and geotechnical factors, and drawing conclusions and making recommendations regarding the proposed development. These reports shall undergo design review by a licensed geotechnical or civil engineer. Such design review shall verify that appropriate geological and geotechnical issues have been considered and that appropriate slope instability mitigation strategies, including drainage plans if required, have been proposed.

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Procedure to request for Structural Advisory Committee (SAC). After reviewing all submitted information pursuant to Section 106A.4.1.4.4, the plan reviewer may request that the permit application be subject to review by a Structural Advisory Committee (SAC), as defined by Building Code Section 105A.6. Such request will be reviewed by Supervisor or Manager and needs to be approved by Deputy Director.

Site Permit Processing. For projects that may be subject to the Slope Protection Act, plan reviewer should request design professional to stipulate on plan the acknowledgement that: Addendum plan review may determine the project is subjecting to compliance with the Slope Protection Act that requires submittal of Geological and Geotechnical report(s) per SFBC Section 106A.4.1.4.4. Two (2) hard copies and one (1) CD_ROM of the report(s) shall be submitted to DBI upon request, prior to issuance of the structural or foundation addenda.

Tom C. Hui 5/20/15

Tom C. Hui, S.E., C.B.O. Date
Director
Department of Building Inspection

Attachments: Seismic Hazard Zones Map Indices

1. Addresses in LANDSLIDE ZONES
   www.sfdbi.org/IS_S05_Addresses_Landslide_Zones_Attachment01
2. Addresses in LIQUEFACTION ZONES
   www.sfdbi.org/IS_S05_Addresses_Liquefaction_Zones_Attachment02

This Information Sheet is subject to modification at any time. For the most current version, visit our website at http://www.sfdbi.org

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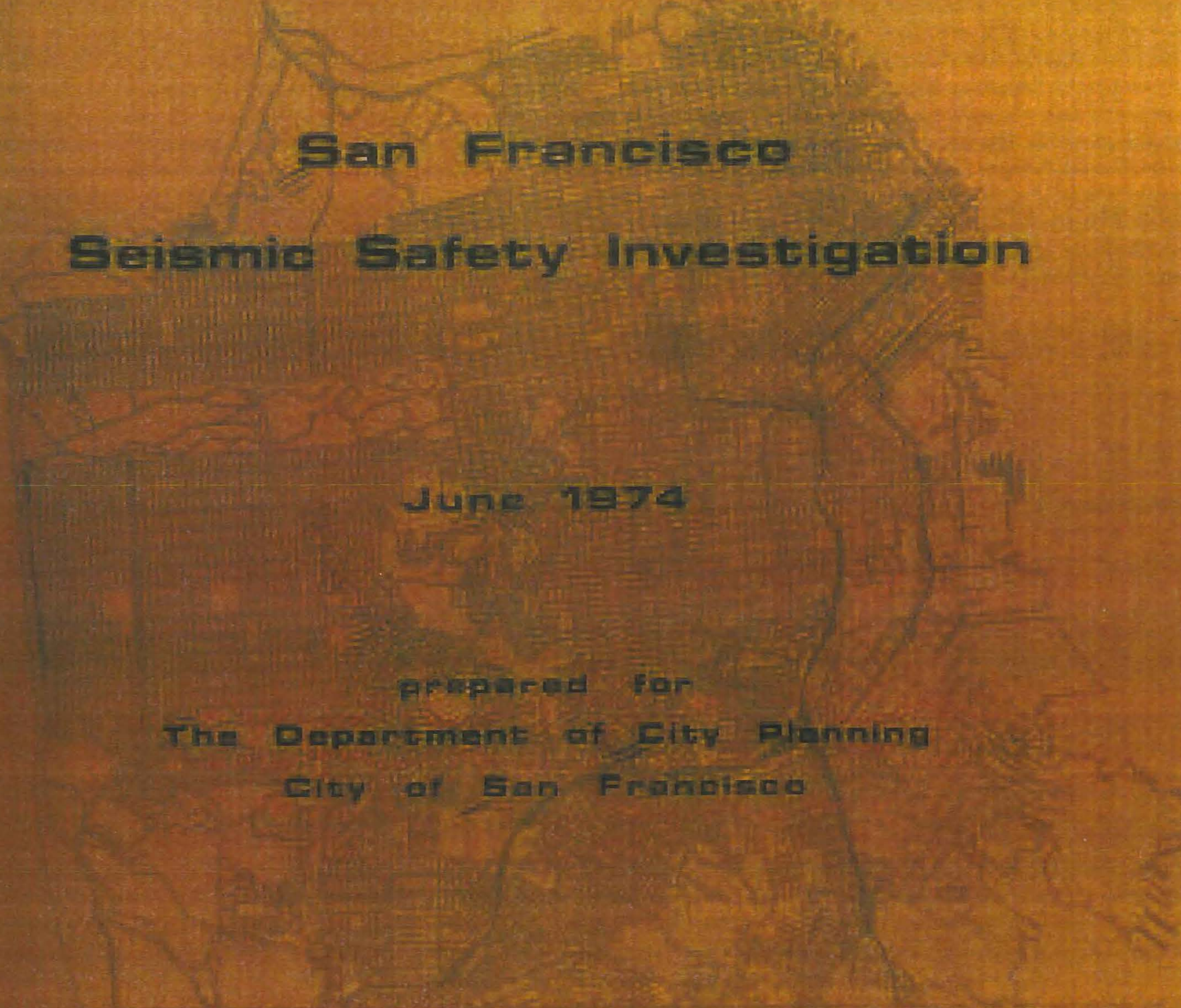


San Francisco Seismic Safety Investigation

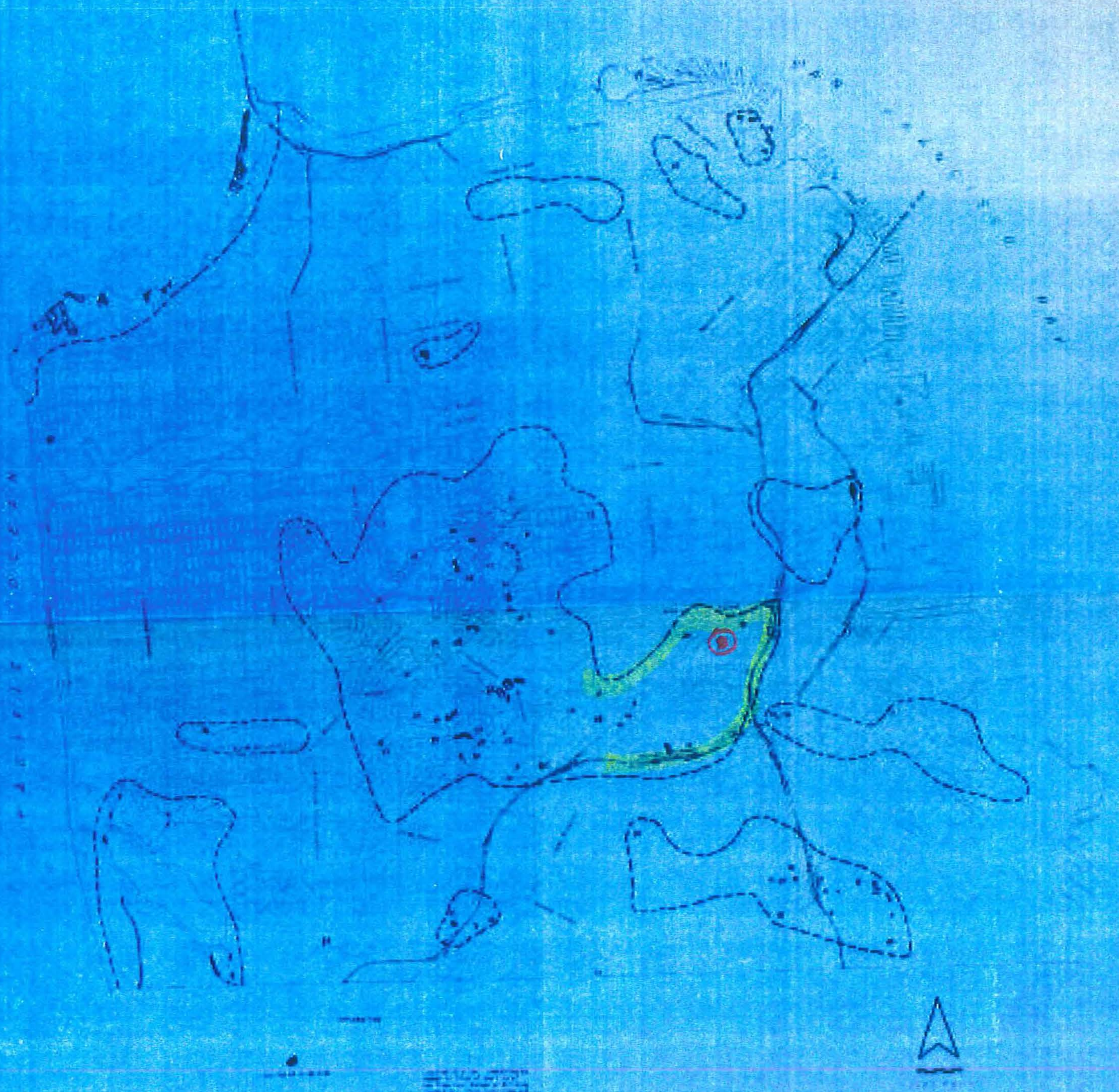
June 1974

prepared for
The Department of City Planning
City of San Francisco

URS **John A. Blume & Associates, Engineers**

San Francisco

A Member of URS Corporation



LANDSLIDE LOCATIONS

SAN FRANCISCO SEISMIC SAFETY INVESTIGATION
GEOLOGIC EVALUATION

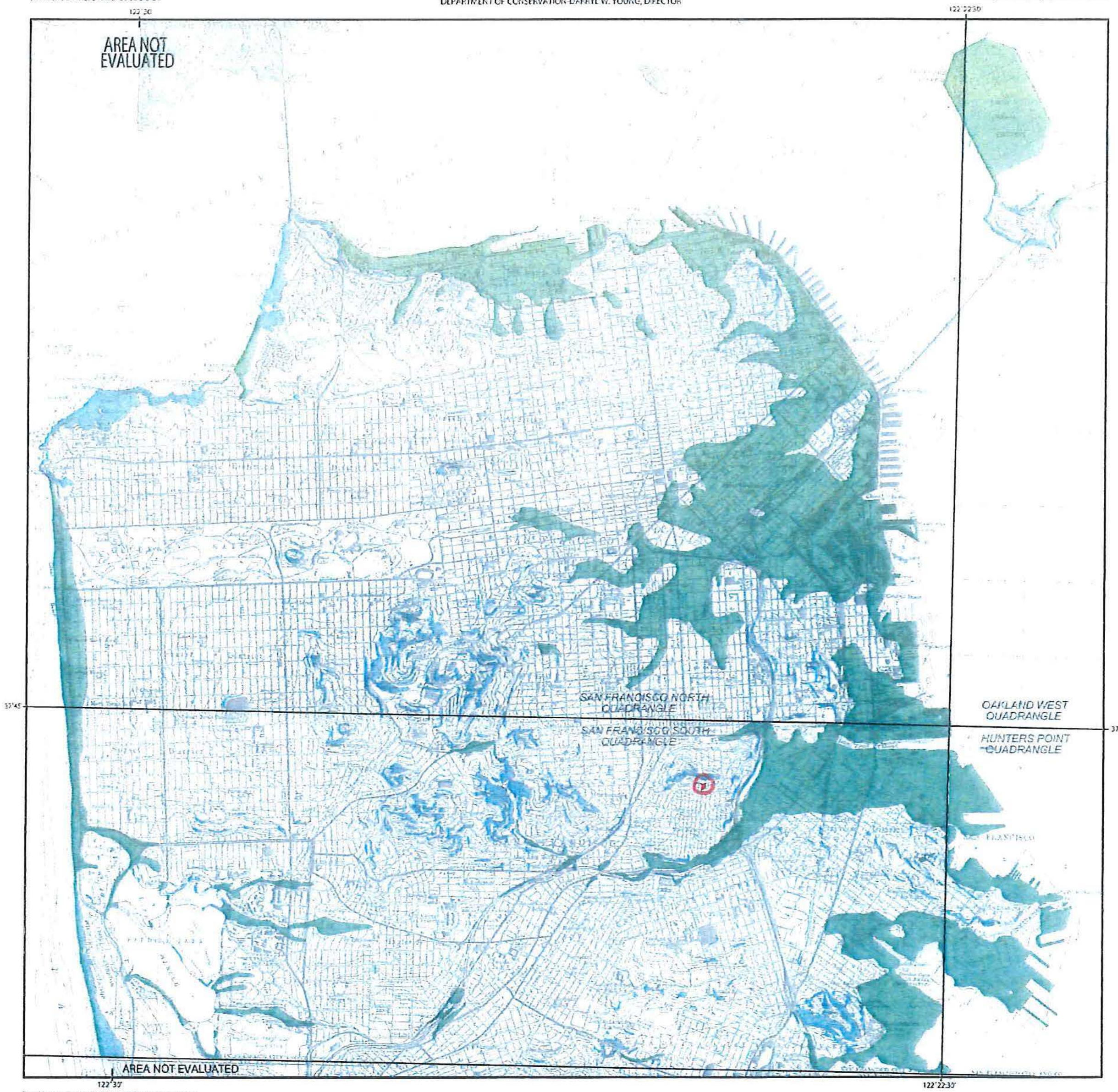
FIGURE 1

Attachment G

DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA-GRAY DAVIS, GOVERNOR
THE RESOURCES AGENCY-MARY D. NICHOLS, SECRETARY
DEPARTMENT OF CONSERVATION-DARRYL W. YOUNG, DIRECTOR

SEISMIC HAZARD ZONES
City and County of San Francisco



Base Map prepared by U.S. Geological Survey, various dates

PURPOSE OF MAP

This map will assist cities and counties in fulfilling their responsibilities for protecting the public safety from the effects of earthquake-triggered ground failure as required by the Seismic Hazards Mapping Act (Public Resources Code Sections 2690-2699.6).

For information regarding the scope and recommended methods to be used in conducting the required site investigations, see DMG Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California.

For a general description of the Seismic Hazards Mapping Program, the Seismic Hazards Mapping Act and regulations, and related information, please refer to www.conservation.ca.gov/dmg.

Production of this map was funded by the Federal Emergency Management Agency's Hazard Mitigation Program and the Department of Conservation in cooperation with the Governor's Office of Emergency Services.

IMPORTANT - PLEASE NOTE

1) This map may not show all areas that have the potential for liquefaction, landsliding, strong earthquake ground shaking or other earthquake and geologic hazards. Also, a single earthquake capable of causing liquefaction or triggering landslide failure will not uniformly affect the entire area zoned.

2) Liquefaction zones may also contain areas susceptible to the effects of earthquake-induced landslides. This situation typically exists at or near the toe of existing landslides, downslope from rockfall or debris flow source areas, or adjacent to steep stream banks.

3) This map does not show Alquist-Priolo earthquake fault zones, if any, that may exist in this area. Please refer to the latest official map of earthquake fault zones for disclosures and other actions that are required by the Alquist-Priolo Earthquake Fault Zoning Act. For more information on this subject and an index to available maps, see DMG Special Publication 42.

4) Landslide zones on this map were determined, in part, by adapting methods originally developed by the U.S. Geological Survey (USGS). Landslide hazard maps prepared by the USGS typically use experimental approaches to assess earthquake-induced and other types of landslide hazards. Although aspects of these new methodologies may be incorporated in future CDMG seismic hazard zone maps, USGS maps should not be used as substitutes Official SEISMIC HAZARD ZONES maps.

5) U.S. Geological Survey base map standards provide that 90 percent of cultural features be located within 40 feet (horizontal accuracy) at the scale of this map. The identification and location of liquefaction and earthquake-induced landslide zones are based on available data. However, the quality of data used is varied. The zone boundaries depicted have been drawn as accurately as possible at this scale. Zone boundaries reflect digital topographic data that may differ slightly from the shorelines shown on the base map.

6) Information on this map is not sufficient to serve as a substitute for the geologic and geotechnical site investigations required under Chapters 7.5 and 7.8 of Division 2 of the Public Resources Code.

7) DISCLAIMER: The State of California and the Department of Conservation make no representations or warranties regarding the accuracy of the data from which these maps were derived. Neither the State nor the Department shall be liable under any circumstances for any direct, indirect, special, incidental or consequential damages with respect to any claim by any user or any third party on account of or arising from the use of this map.

STATE OF CALIFORNIA

SEISMIC HAZARD ZONES

Delineated in compliance with
Chapter 7.8, Division 2 of the California Public Resources Code
(Seismic Hazards Mapping Act)

CITY AND COUNTY OF SAN FRANCISCO

OFFICIAL MAP

Released: November 17, 2000

STATE GEOLOGIST

MAP EXPLANATION

Zones of Required Investigation:

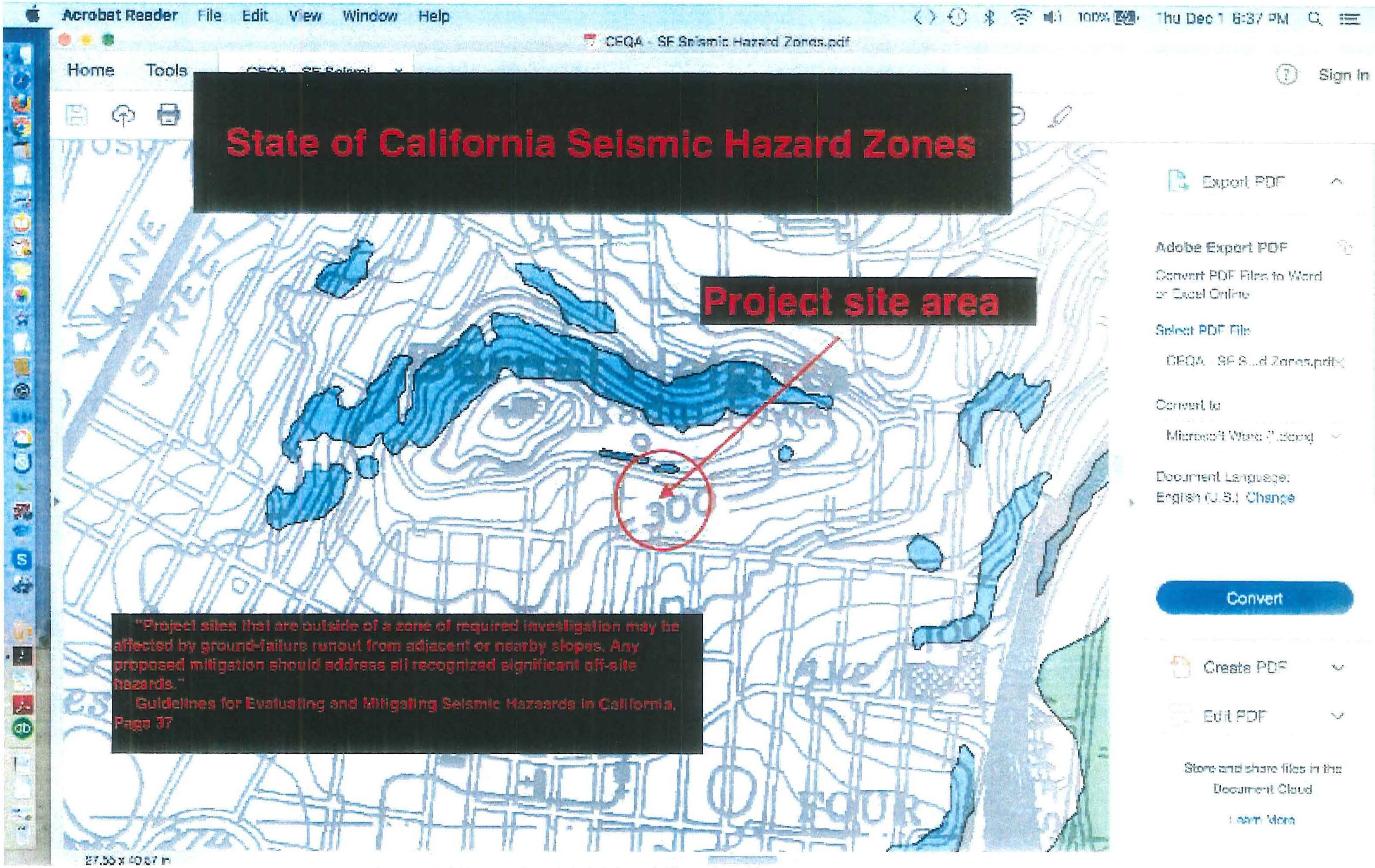
Liquefaction
Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslides
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

DATA AND METHODOLOGY USED TO DEVELOP THIS MAP ARE PRESENTED IN THE FOLLOWING:

Seismic Hazard Evaluation of the City and County of San Francisco, California. California Division of Mines and Geology, Open File Report 2000-009.

For additional information on seismic hazards in this map area, the rationale used for zoning, and additional references consulted, refer to www.conservation.ca.gov/dmg.


Acrobat Reader File Edit View Window Help
Thu Dec 1 6:37 PM
CEQA - SF Seismic Hazard Zones.pdf
Home Tools
Sign In
State of California Seismic Hazard Zones
Project site area
"Project sites that are outside of a zone of required investigation may be affected by ground-failure runout from adjacent or nearby slopes. Any proposed mitigation should address all recognized significant off-site hazards."
Guidelines for Evaluating and Mitigating Seismic Hazards in California, Page 37
LANE STREET
300
Export PDF
Adobe Export PDF
Convert PDF Files to Word or Excel Online
Select PDF File
Convert to
Microsoft Word (*.docx)
Document Language:
English (U.S.) Change
Convert
Create PDF
Edit PDF
Store and share files in the Document Cloud
Learn More

SPECIAL PUBLICATION 117

GUIDELINES FOR EVALUATING AND MITIGATING SEISMIC HAZARDS IN CALIFORNIA

Adopted March 13, 1997 by the State Mining and Geology Board in Accordance with the Seismic Hazards Mapping Act of 1990

Copies of these Guidelines, California's Seismic Hazards Mapping Act, and other related information are available on the World Wide Web at
Copies also are available for purchase from the Public Information Offices of the California Geological Survey.

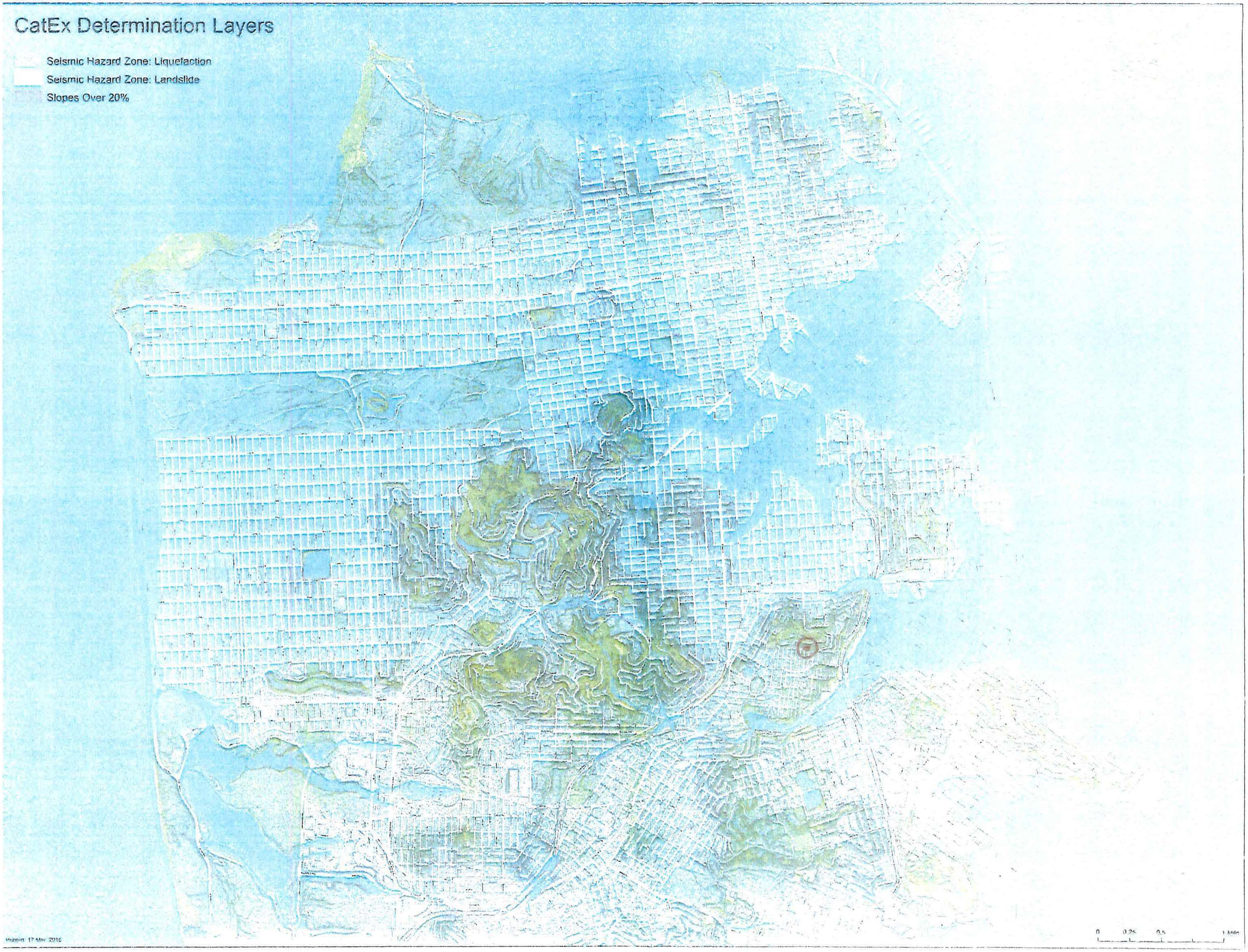
CALIFORNIA GEOLOGICAL SURVEY'S PUBLIC INFORMATION OFFICES:

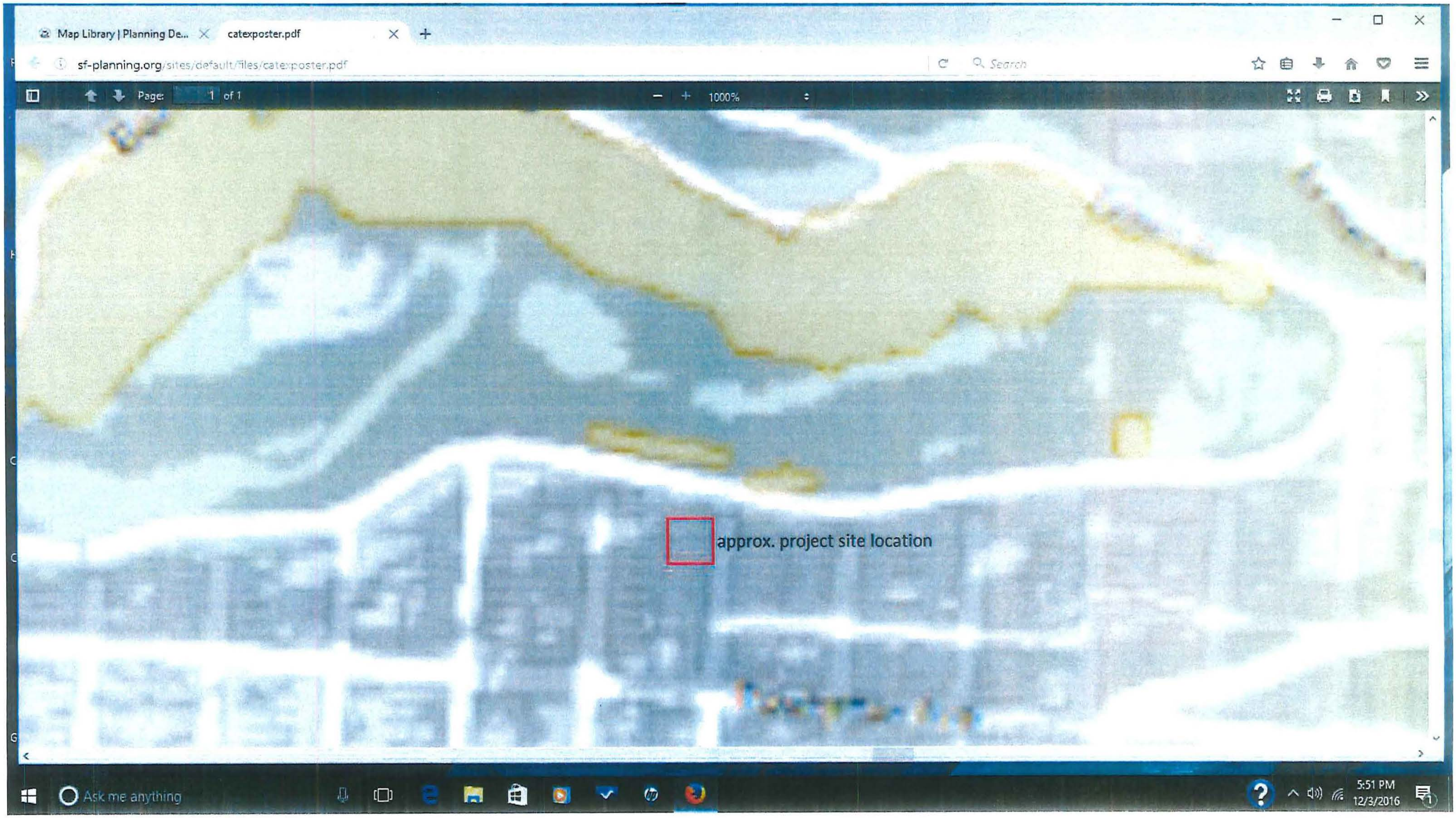
Southern California Regional Office
655 South Hope Street, Suite 700
Los Angeles, CA 90017-3231
(213) 239-0878

Publications and Information Office
801 K Street, MS 14-33
Sacramento, CA 95814-3532
(916) 445-5716

Bay Area Regional Office
185 Berry Street, Suite 210
San Francisco, CA 94107-1728
(415) 904-7707

Attachment H


SAN FRANCISCO PLANNING DEPARTMENT
CatEx Determination Layers
Seismic Hazard Zone: Liquefaction
Seismic Hazard Zone: Landslide
Slopes Over 20%
0
0.25
0.5
1 Mile
Printed: 17 Mar, 2016


Map Library | Planning De...
catexposter.pdf
sf-planning.org/sites/default/files/catexposter.pdf
Search
Page: 1 of 1
1000%
approx. project site location
Ask me anything
5:51 PM
12/3/2016

CatEx Determination Layers

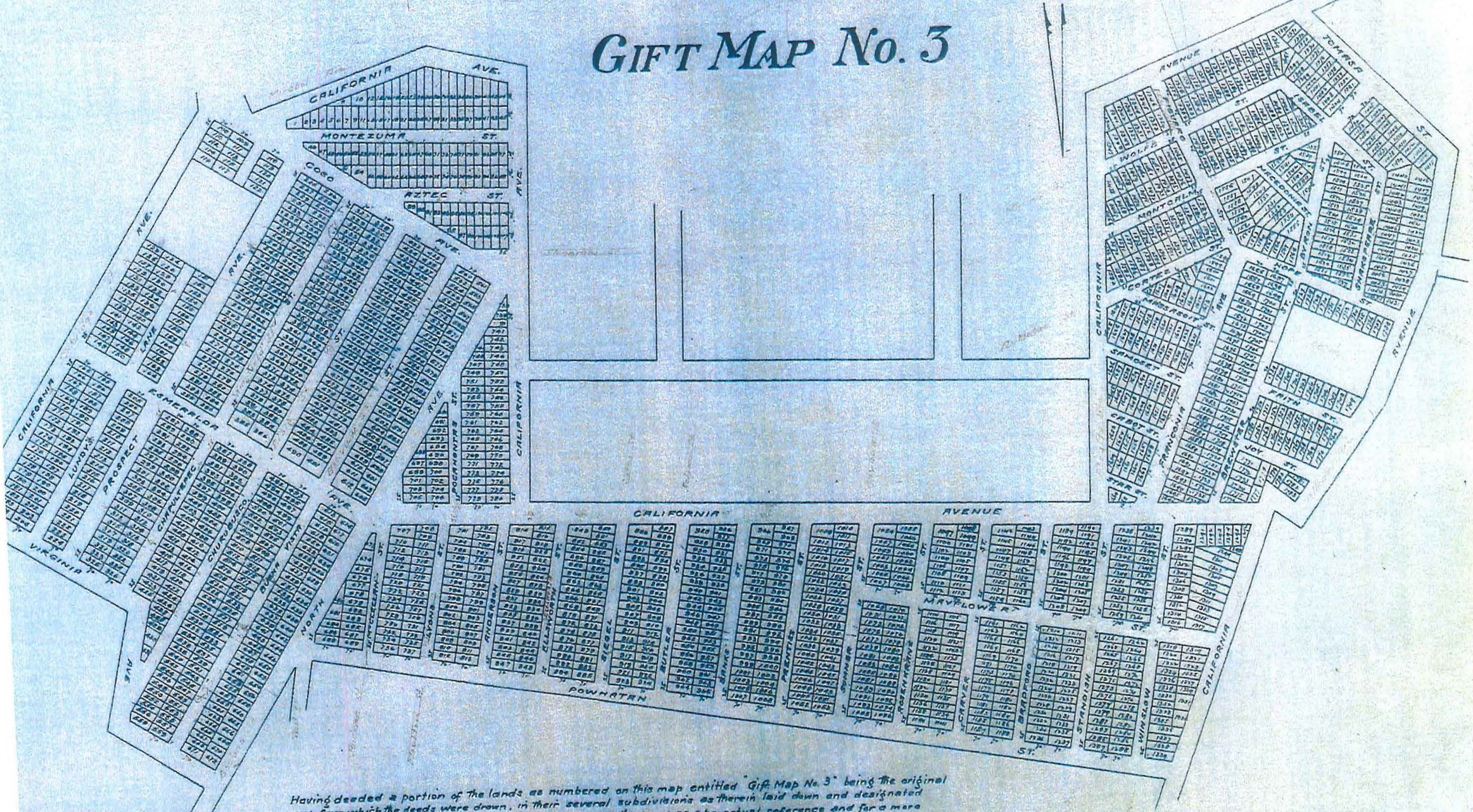
Seismic Hazard Zone: Liquefaction

Seismic Hazard Zone: Landslide

Slopes Over 20%

Attachment I

GIFT MAP No. 3



Having deeded a portion of the lands as numbered on this map entitled "Gift Map No. 3" being the original
map from which the deeds were drawn, in their several subdivisions as therein laid down and designated
numbered from 1 to 1783 inclusive. We hereby record the same as a perpetual reference and for a more
perfect location of the property as actually sold by us.

H. S. BROWN
JOHN F. COBB, by his attorney in fact H. A. COBB.

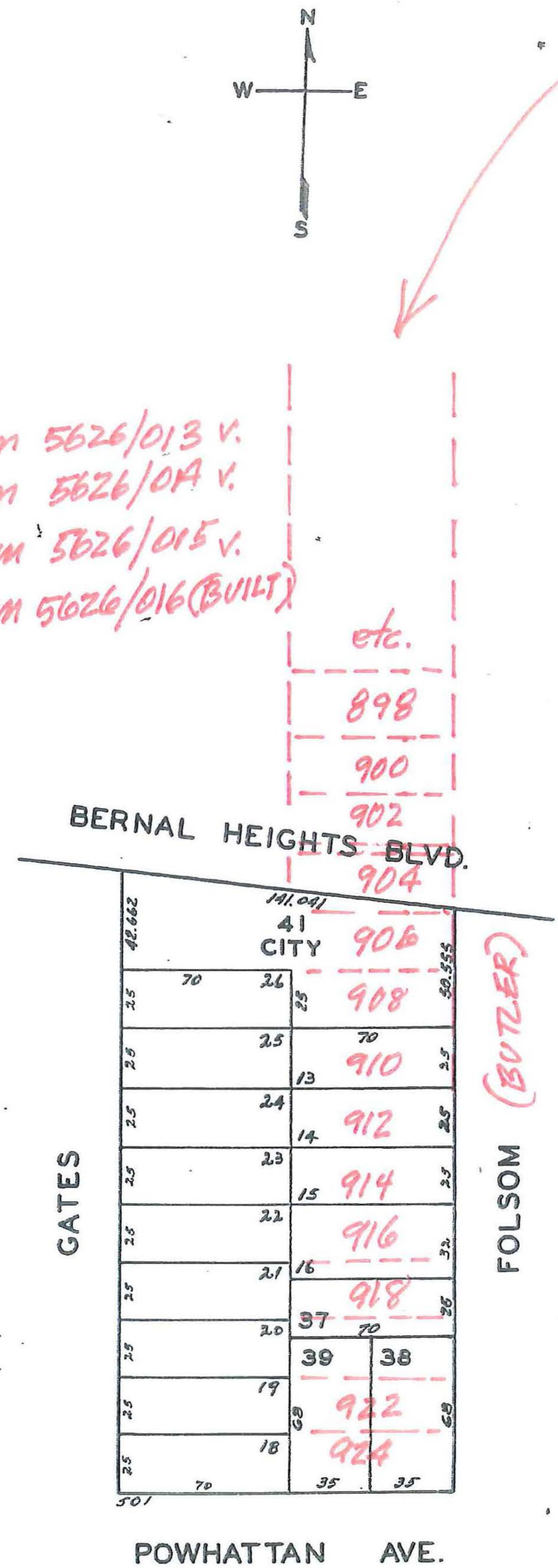
A true copy of the original recorded at request of H. S. BROWN, December 31st, 1861, at 3 o'clock P. M.
T. YOUNG, County Recorder

5626

GIFT MAP NO 3
LOTS 886-924

REVISED '62
" '66
" '69
" '70

910 → 3516 Folsom 5626/013 V.
912 → 3526 Folsom 5626/014 V.
914 → 3550 Folsom 5626/015 V.
916 → 3574 Folsom 5626/016 (BUILT)



E 7397

DEED NO. 169

Conveyance of Real Estate

SOLD FOR NONPAYMENT OF STATE AND COUNTY TAXES FOR THE YEAR 19 29

SALE NO. 2565, VOL. 34, PAGE 59, SUB. ____, BILL NO. 760

THIS INDENTURE, Made the 2nd day of July A.D. 19 35 between EDWARD F. BRYANT, Tax Collector of the City and County of San Francisco, State of California, first party, and the State of California, second party, witnesseth:

THAT WHEREAS, The real property hereinafter described was duly assessed for taxation in the year A.D. 19 29 to NELLIE V. HALL

and was thereafter on the 23rd day of June A.D. 19 30 duly sold to the State of California by EDWARD F. BRYANT, Tax Collector of said City and County of San Francisco, for nonpayment of delinquent taxes which had been legally levied in said year A.D. 19 29 for the year 19 29, and were a lien on said real property, the total amount for which the same was sold being FOUR AND 83/100 Dollars;

AND WHEREAS, The period of five years has elapsed since said sale and no person has redeemed the said property;

NOW THEREFORE, The said first party in consideration of the premises, and in pursuance of the statute in such case made and provided, does hereby grant to the said second party that certain real property in the City and County of San Francisco, State of California, more particularly described as follows, to wit:

The lot of land numbered 13 in Block Numbered 5626 as delineated and designated in Assessor's Map Book filed in the office of the City and County Recorder on October 22, 1929.

IN WITNESS WHEREOF, Said first party has hereunto set his hand the day and year first above written.

EDWARD F. BRYANT
Tax Collector of the City and County of San Francisco.

Witness:

T. A. SICOTTE

STATE OF CALIFORNIA
CITY AND COUNTY OF SAN FRANCISCO. } ss.

On this 15th day of August, in the year one thousand nine hundred thirty-five before me, H. I. MULCREVY, County Clerk and ex officio Clerk of the Superior Court of the City and County of San Francisco, State of California, personally appeared the within named Edward F. Bryant, known to me to be the Tax Collector of said City and County of San Francisco, whose name is subscribed to the within instrument, and personally known to me to be the person who executed the within instrument and subscribed his name thereto as Tax Collector, and he duly acknowledged to me that he executed the same as such Tax Collector.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official Seal at my office in the City and County of San Francisco, the day and year in this Certificate first above written.

(Seal)

H. I. MULCREVY,
County Clerk and ex officio Clerk of the Superior Court

Filed for record at the request of EDWARD F. BRYANT, *Tax Collector,* Aug. 19, *A.D. 19* 35, *at* 30 *min. past* 8 *o'clock,* A. *M., and recorded in Vol.* 2756 *of* Official Records, *page* 345

Edward T. Gallagher
~~RECORDER~~ County Recorder

By ____ Deputy Recorder

Compared--Book W/LSH Compared--Document Kinroc

PRINTED BY CARLISLE, S. F. 8111

J. S. HAUKE)
TO) RESOLUTION NO.34125 (New Series)
CITY AND COUNTY OF S. F.)

RESOLVED, that the offers of sale made by the following named persons to sell to the City and County of San Francisco, the following described land required for the opening of Bernal Heights Boulevard, for the sums set forth opposite their names, be accepted:

J. S. HAUKE, all of lots 11 and 12, in Block 5626, as per the Assessor's Block Books of the City and County of San Francisco, $2,800.00.

AND the City Attorney is hereby authorized to examine the titles to said property, and if the same is found satisfactory, to accept on behalf of the City, deeds conveying said property to the City, free and clear of all encumbrances and to record said deeds, together with a copy of this resolution in the office of the Recorder of the City and County of San Francisco, State of California.

ADOPTED--Board of Supervisors, San Francisco, March 16, 1931.

AYES: Supervisors Andriano, Canepa, Colman, Gallagher, Garrity, Havenner, Hayden, Miles, Peyser, Shannon, Spaulding, Stanton, Suhr.

ABSENT: Supervisors Breyer, McGovern, McSheehy, Power, Roncovieri,

J. S. DUNNIGAN, Clerk.

APPROVED, San Francisco, March, 18, 1931.

ANGELO J. ROSSI, Mayor.

THIS INDENTURE, made this 27" day of March, One Thousand Nine Hundred Thirty-one, by and between JOSEPH S. HAUKE (also known as J. S. Hauke), a widower, of the City and County of San Francisco, State of California, the party of the first part, and the CITY AND COUNTY OF SAN FRANCISCO, a municipal corporation, the party of the second part,

WITNESSETH: That the said party of the first part, in consideration of the sum of TWO THOUSAND EIGHT HUNDRED AND 00/100 DOLLARS ($2,800.00), lawful money of the United States of America, to him in hand paid by the said party of the second part, the receipt whereof is hereby acknowledged, does by these presents, grant, bargain and sell unto the said party of the second part, and to its successors and assigns forever, all that certain lot, piece or parcel of land situate in the City and County of San Francisco, State of California, and more particularly described as follows, to-wit:

LOTS 906 and 908, according to Map entitled "Gift Map No. 3", filed in the office of the Recorder of the City and County of San Francisco, State of California, December 31, 1861, and recorded in Map Book "2 A and B", at page 15.

TOGETHER with the tenements, hereditaments and appurtenances thereunto belonging or appertaining, and the reversion and reversions, remainder and remainders, rents, issues and profits thereof.

TO HAVE AND TO HOLD the said premises, together with the appurtenances, unto the said party of the second part, and to its successors and assigns forever.

IN WITNESS WHEREOF, the said party of the first part has hereunto set his hand the day and year first hereinabove written.

J. S. HAUKE

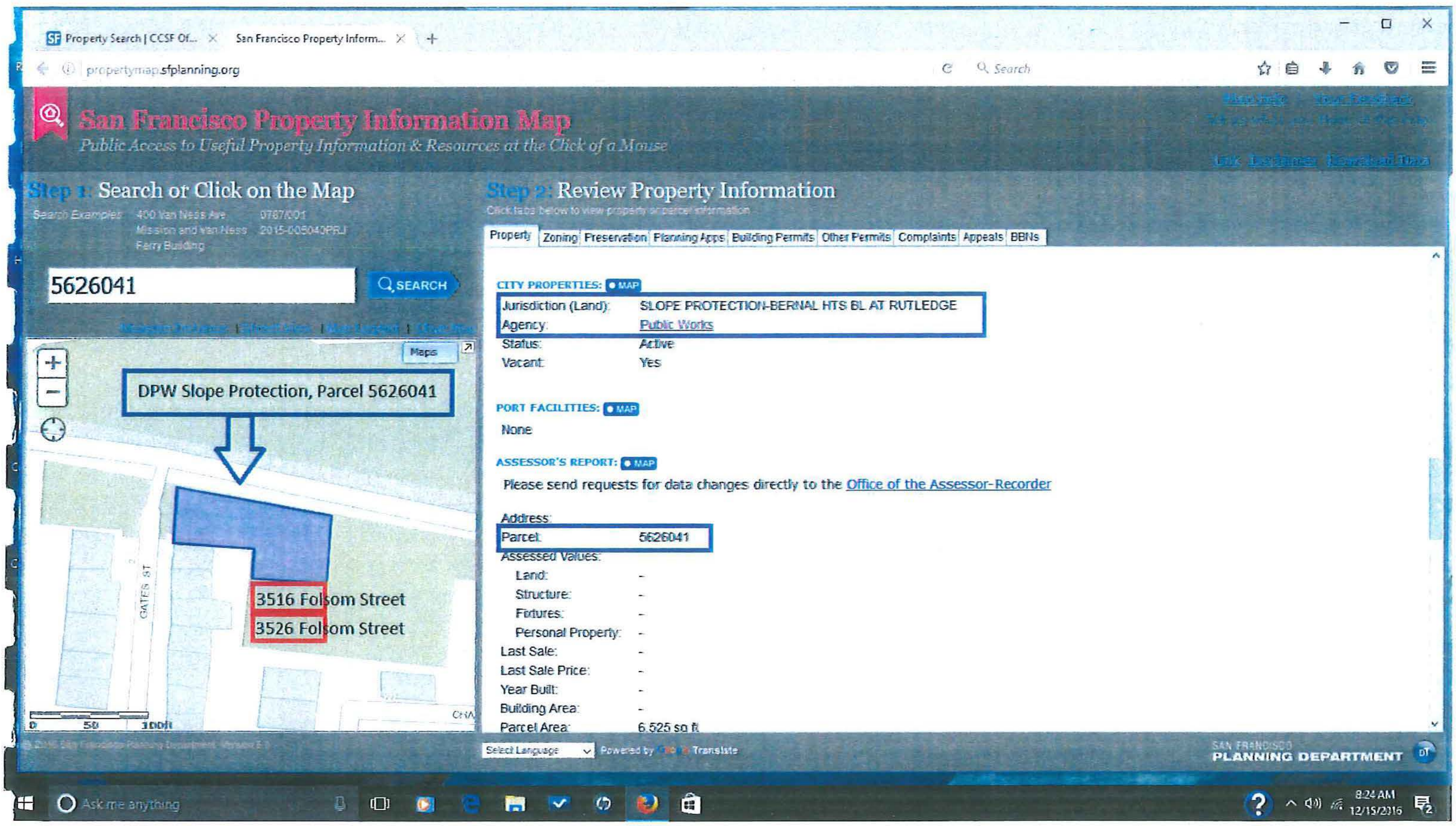
JOSEPH S. HAUKE

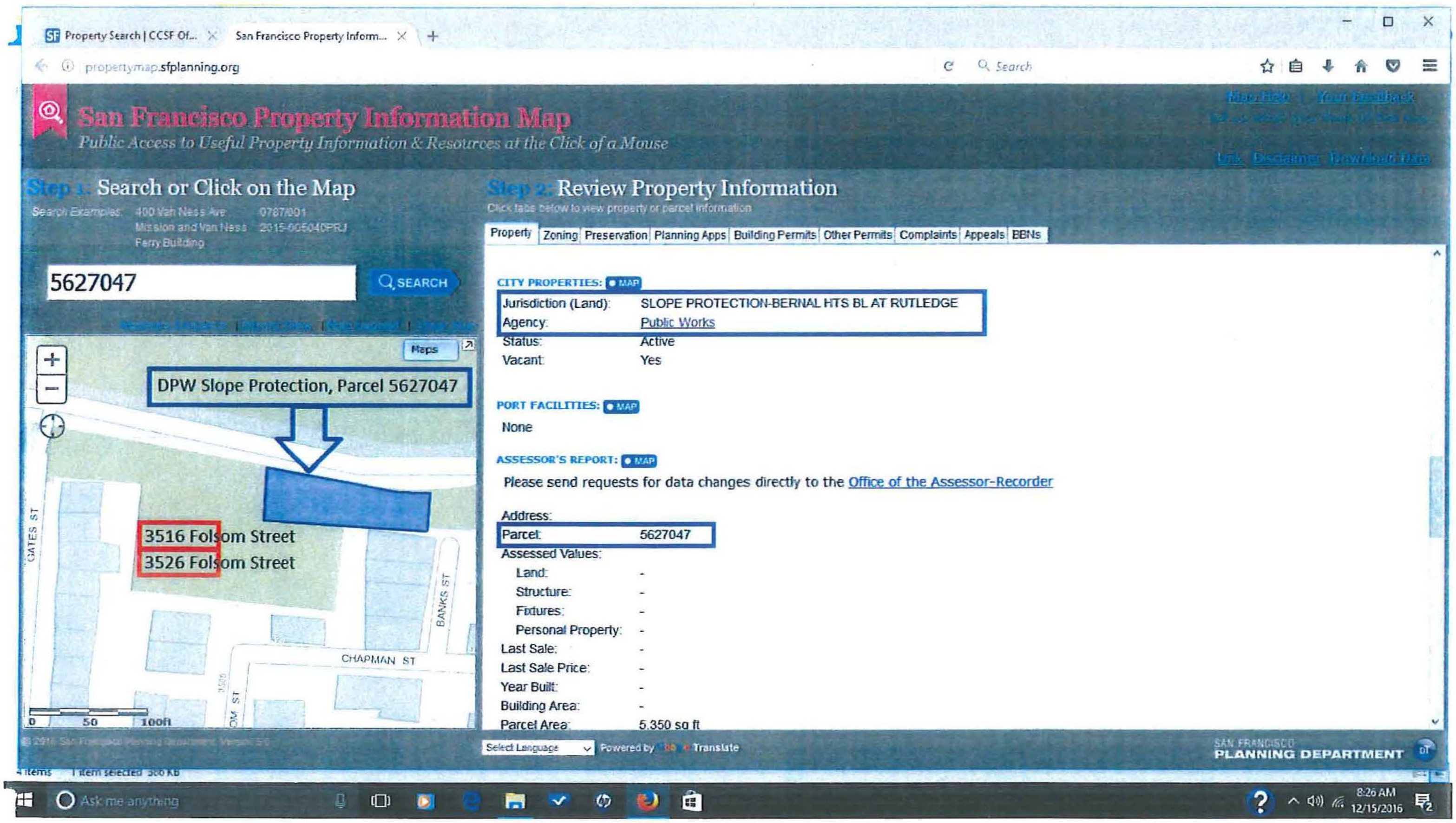
State of California,)
) ss.
City and County of San Francisco)

ON the 27th day of March, in the year one thousand nine hundred and thirty-one, (1931) before me, Charles D. O'Connor, a Notary Public, in and for the said City and County,

Attachment J


3574 Folsom St


Property Search | CCSF Of...
San Francisco Property Inform...
propertymap.sfplanning.org
Search
San Francisco Property Information Map
Public Access to Useful Property Information & Resources at the Click of a Mouse
Step 1: Search or Click on the Map
Search Examples: 400 Van Ness Ave 0787/001
Mission and Van Ness 2015-005040PRJ
Ferry Building
5626041
SEARCH
Maps
DPW Slope Protection, Parcel 5626041
3516 Folsom Street
3526 Folsom Street
GATES ST
0 50 100ft
Step 2: Review Property Information
Click tabs below to view property or parcel information
Property
Zoning
Preservation
Planning Apps
Building Permits
Other Permits
Complaints
Appeals
BBNs
CITY PROPERTIES: MAP
Jurisdiction (Land): SLOPE PROTECTION-BERNAL HTS BL AT RUTLEDGE
Agency: Public Works
Status: Active
Vacant: Yes
PORT FACILITIES: MAP
None
ASSESSOR'S REPORT: MAP
Please send requests for data changes directly to the Office of the Assessor-Recorder
Address:
Parcel: 5626041
Assessed Values:
Land: -
Structure: -
Fixtures: -
Personal Property: -
Last Sale: -
Last Sale Price: -
Year Built: -
Building Area: -
Parcel Area: 6,525 sq ft
Select Language
Powered by Translate
SAN FRANCISCO PLANNING DEPARTMENT
Ask me anything
8:24 AM
12/15/2016



Property Search | CCSF Of...
San Francisco Property Inform...
propertymap.sfplanning.org
Search
San Francisco Property Information Map
Public Access to Useful Property Information & Resources at the Click of a Mouse
Step 1: Search or Click on the Map
Search Examples: 400 Van Ness Ave 0787/001
Mission and Van Ness 2015-005040PRJ
Ferry Building
5627047
SEARCH
Maps
DPW Slope Protection, Parcel 5627047
3516 Folsom Street
3526 Folsom Street
GATES ST
BANKS ST
CHAPMAN ST
0 50 100ft
Step 2: Review Property Information
Click tabs below to view property or parcel information
Property
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CITY PROPERTIES: MAP
Jurisdiction (Land): SLOPE PROTECTION-BERNAL HTS BL AT RUTLEDGE
Agency: Public Works
Status: Active
Vacant: Yes
PORT FACILITIES: MAP
None
ASSESSOR'S REPORT: MAP
Please send requests for data changes directly to the Office of the Assessor-Recorder
Address:
Parcel: 5627047
Assessed Values:
Land: -
Structure: -
Fixtures: -
Personal Property: -
Last Sale: -
Last Sale Price: -
Year Built: -
Building Area: -
Parcel Area: 5,350 sq ft
Select Language
Powered by Translate
SAN FRANCISCO PLANNING DEPARTMENT
Ask me anything
8:26 AM
12/15/2016

#25

WWW.BUSCOVICH.COM

Patrick Buscovich & Associates Structural Engineers, Inc.

235 MONTGOMERY STREET, SUITE 1140 SAN FRANCISCO, CALIFORNIA 94104-2906 • TEL.: (415) 760-0636 • Email: patrick@buscovich.com

File# 170851

September 12, 2017

Board of Supervisors
City Hall
1 Dr. Carlton B, Goodlett Pl.
San Francisco, CA 94102

Folsom Street Extension
3516 and 3526 Folsom Street

The following is a Civil Engineering Study and analysis of the proposed "Folsom Street Extension." It is currently an unimproved dirt hill. This analysis is based on my review of the proposed project plans and numerous site visits.

- The Bureau of Street Use and Mapping (BSUM), Department of Public Works (DPW) has standards for street design[1] and construction for the city to accept and maintain a street after it is built. This includes the sidewalks. The current design is so out of conformance with city standards, it is my opinion that the city will never accept this street for maintenance.[2] The street has varying slope from the intersection up the hill, and the sidewalks are not level with each other. Warping of a street and sidewalk like this is not allowed. If the City does not accept the street, the fronting property owner will be required to maintain this street and sidewalk in perpetuity. In addition, drainage down the street may flood the downhill homes.

- This proposed street will be one of the steepest streets in San Francisco at +/- 36% slope.[3] It will be 20 feet wide with no vehicle turnaround at the top. It is a dead end street. Streets this steep are almost always thru streets or at a minimum have a turnaround. Without a turnaround at the top, cars will be forced to back down the street in reverse. California Vehicle Code (CVC) discourages this maneuver due to losing control of a vehicle.

- Most vehicles, other than a specialized car, will not be able to drive onto this dead end street and into the garages of the houses. Most drivers of passenger cars will stop at the corner of Folsom & Chapman and park.

- It will be a challenge to turn around and change direction on this street in a vehicle, based upon the extreme slope. Average car lengths range from 15 feet to 18 feet long. The street will be 20 feet wide. It will be precarious to have an average car turn from uphill, to 90° to

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[1] Subdivision Regulations, 2015, Department of Public Works, City and County of San Francisco, Appendix XII
[2] Ibid, Appendices I-XII, XIII; and http://www.sfpublicworks.org/services/acceptance
[3] Von Worley, Stephen, *More Steeps of San Francisco,* February 4, 2010. Available at http://www.datapointed.net/2010/02/more-steeps-of-san-francisco/

curb, to downhill. At 36% slope, vehicles with a medium to high center of mass will experience "tipping over" when turning around in the 90° position. Thus, any vehicles that are tall (e.g., mail truck, pick up, delivery van, garbage truck, etc.) or have a long wheel base will not be able to drive onto this dead end street. The only passenger car that could use this dead end street safely is a low height, short wheel base, compact car. Backing down the hill is not going to be a viable or safe solution.

- Ironically, the vehicles that can most easily turn around on this street (i.e., compact car) will have the most difficulty traversing the base of the dead end street. This vehicle will need to cross a very steep sidewalk and down a warped driveway; this will require a high undercarriage. The ideal vehicle to navigate this proposed street is a compact car with a high undercarriage and no front or rear end. The only vehicle that meets this description is an off road Jeep.[4] It is short, has a low center of mass, high undercarriage clearance and no front or rear end. It is not a passenger vehicle. It is for off road driving, that is what will be required to drive this hill. This vehicle is not meant for speed in excess of 50 MPH; it will not be a freeway vehicle.

It is also important to note that garbage trucks will not go up this street and Recology will not walk up the street to pick up recycling. Recycling bins will have to be left at the comer of Folsom and Chapman Streets. With two homes now, two proposed and with four more sites ready, the size of this garbage zone will be large. There is no sidewalk envisioned at the corner, so no garbage zone is available. This is a public health problem that needs to be addressed now in the street design for these homes to be livable.

Additionally, the mail truck will not go up this street. The mailman will have to hike up this street leaving his truck at the comer. This will potentially create a significant traffic problem at the intersection of Folsom and Chapman. It is advisable for the project sponsor to contact the US Postal Service to confirm they will hike the street to deliver the mail. Otherwise, mail boxes will be required by the USPS at the intersection of Chapman and Folsom. There is no location I see that works for a mail box, let alone the recycle garbage bin zone.

The proposed two homes will need off-street vehicle parking. Plausibly one vehicle could be a true off road Jeep, which could drive this street. The Jeep will also be able to traverse the sidewalk cross slope. Most passenger vehicles can not traverse the extremely warped driveway. Exiting the garage and backing up the driveway will create a blind spot for the driver, creating a safety hazard for any pedestrians or other drivers in the vicinity. At a minimum, a second car will be used at this house. This second car is not going to be a Jeep but a passenger car. This car will not be able to use the garage parking in the house but will use Street Parking. On this 20-foot section of Folsom Street there is no street parking. For planning purposes, six homes times one car per home need to be accounted for neighborhood street parking. For guest visits, more parking will be required. A simple study shows the need for 10 additional street parking spots in a neighborhood with an acute shortage of on-street parking. These 10 cars cannot go up and down the street or across the sidewalk down the warped driveway. There is no street parking in front of these homes. These 10 cars are going to park in a 200-foot walking radius on the adjoining block of Folsom Street, below the intersection or the adjoining block of Chapman. In this walking radius there are roughly 50 to 60 street parking spots that are almost always full. Adding 20% more parking is impossible. The garages in these homes will not work and a 20-foot wide street with no street parking in front of homes will congest parking in this neighborhood and will cause issues with General Plan Priority

[4] Values for 2015-2017 Jeep Renegade approach, breakover and departure angles, running clearance and water crossing are available at https://www.allpar.com/SUVs/jeep/renegade.html.

Policy 2: "neighborhood character is conserved and protected."[5] I am also concerned that this parking congestion issue will impede emergency vehicles (Police, Fire, and EMS).

Summary

In summary, the vehicle issue and parking demand will create a traffic mess for this neighborhood. This problem has simply not been addressed by the project sponsor. It will be borne by the neighborhood. This problem is exacerbated by the size of the homes and number of bedrooms proposed per home by the project sponsor. This will be the steepest street with driveways in San Francisco, if not the State. In addition, the lack of thru street or turnaround will, in my professional opinion, create a significant traffic and parking problem, which has not been mitigated.

Sincerely,

Patrick Buscovich, P.E.

REGISTERED PROFESSIONAL ENGINEER
PATRICK BUSCOVICH
S 2700
STRUCTURAL
STATE OF CALIFORNIA

[5] San Francisco General Plan Priority Policies, available at http://generalplan.sfplanning.org/index.htm.

Patrick Buscovich & Associates Structural Engineers, Inc.
WWW.BUSCOVICH.COM
235 MONTGOMERY STREET, SUITE 823, SAN FRANCISCO, CALIFORNIA 94104-3105 • TEL: (415) 788-2708 FAX: (415) 788-8653

Patrick Buscovich S.E.

Education:

University of California, Berkeley ~ Bachelors of Science, Civil Engineering 1978
~ Masters of Science, Structural Engineering 1979

Organizational:

State of California, Building Standards Commission
Commissioner 2000 – 2002
City & County of San Francisco, Department of Building Inspection (DBI)
Commissioner\Vice President 1995 – 1996
Chair, SF Housing Code Update 1995
UMB Appeals Board 2005 – 2006
Code Advisory Committee 1990 – 1992
Chair of Section 104 Sub-Committee.
Structural Engineers Association of Northern California (SEAONC)
President 1997 – 1998
Vice President 1996 – 1997
Board of Directors 1994 – 1999
College of Fellows Elected 2002
Edwin Zacher Award 1999
Structural Engineers Association of California (SEAOC)
Board of Directors 1996 – 2000
Applied Technology Council (ATC)
President 2007 – 2008
Board of Directors 2000 – 2009

Licenses:

California, Civil Engineer C32863, 1981
Structural Engineer S2708, 1985

Experience:

Patrick Buscovich and Associates, Structural Engineer – Senior Principal (1990 to Present)
Specializing in Existing Buildings, Seismic Strengthening/Structural Rehabilitation, Building Code/Permit Consultation, Peer Review, Expert Witness/Forensic Engineering

- Code Consulting and Peer Review for projects in San Francisco (Planning Department, Fire Preventing, Street Use & Mapping, Building Department, Board of Appeals).
- Permit Consultant in San Francisco (DBI, DCP, SFFD, BSUM & BOA).
- Expert Witness/Forensic Engineering/Collapse & Failure Analysis
- Seismic Retrofit Consultation.
- Member of the following SEAONC/DBI Committees:
  - Committee to revise San Francisco Building Code Section 104F/3304.6.
  - 1988-1990 Committee to draft San Francisco UMB ordinance.
  - 1993 Committee to revise the San Francisco UMB ordinance.
  - SEONC Blue-Ribbon panel to revise earthquake damage trigger, 1998
  - Secretary, Blue Ribbon Panel on seismic amendments to the 1998 SFBC.
  - Secretary, Blue Ribbon Panel Advising The San Francisco Building Department on CAPSS.
- Co-Authored of the following SF Building Code Sections.
  - EQ damage trigger SFBC 3404.7.2, Repair 3405.1.3, Change of Occupancy 3408.4.1., Lateral Forces Existing Building 1604.11.1
- Author SFBC Administrative Bulletin: AB102 (Seismic alteration) & AB103 (CFC)
- Coordinator/Speaker for SEAONC San Francisco UMB Seminars 1992, 1993 & 1994.
- Speaker at 2009 SEAONC Seminar on San Francisco UMB Code, 1850 to Present.
- Member of 1993 San Francisco UMB Bond Advisory Board.
- Speaker at numerous San Francisco Department of Building Inspection Seminars on UMB.
- Speaker at numerous code workshops for the San Francisco Department Building Inspection.
- Co-author of 1990 San Francisco UMB Appeals Board Legislation.
- Co-author of San Francisco Building Code Earthquake Damage Trigger for Seismic Upgrade, Committee Rewrite 2008.
- As a San Francisco Building Commissioner:
  - Directed formulation of Building Occupancy Resumption Plan (BORP)
  - Chaired the 1995 update on the San Francisco Housing Code.
  - Directed formulation of UMB tenant protection program
- Consultant to the City of San Francisco for evaluation of buildings damaged in the Loma Prieta Earthquake (October 17, 1989) to assist the Bureau of Building Inspection regarding shoring or demolition of "Red-Tagged" structures (SOHA).
- Consultant to San Francisco Department of Building Inspection on the Edgehill Land Slide 1997.
- Consultant to 100's of private clients for evaluating of damage to their buildings from the October 17, 1989 Loma Prieta Earthquake.
- Project Administrator for multi-team seismic investigation of San Francisco City-owned Buildings per Proposition A, 1989 ($350 million bond). (SOHA).
- Project Manager for seismic strengthening of the Marin Civic Center (SOHA).
- Structural Engineer for the Orpheum Theater, Curran Theater and Golden Gate Theater.
- Consultant on numerous downtown SF High Rise Buildings.
- Rehabilitation & Seismic Strengthening design for 1000's of commercial and residential buildings in San Francisco.
- Commercial Tenant Improvement
- Structure Rehabilitation of Historic Building.
- Structural consultant for 1000's of single family homes and apartment buildings alteration in San Francisco

Previous Employment

- SOHA 1980-1990, Associate
- PMB 1979-1980, Senior Designer

Public Service:

Association of Bay Area Government – Advisory Panels
Holy Family Day Home – Board of Director
Community Action Plan for Seismic Safety (CAPPS), Advisory Panel.

Awards:

Congressional Award, 2003.
SFDBI Certificate of Recognition, 1996.

F.U.# 170851

Slope Protection Act: History of Uncompleted Amendment to Reduce Scope

Issue: Effective January 1, 2017, the Department of Building Inspection implemented an amendment to reduce the scope of the Slope Protection Act, SFBC Section 106A.4.1.4.3, without an approval action from the Board of Supervisors or its Land Use and Transportation Committee.

Amendment as proposed and implemented by DBI without BOS enactment:

SECTION 106A— PERMITS
106A.4.1.4 The Slope Protection Act.

106A.4.1.4.3 Scope. Properties are subject to these requirements where any portion of the property lies within the areas of "Earthquake-Induced Landslide" in the Seismic Hazard Zone Map, released by California Department of Conservation, Division of Mines and Geology, dated November 17, 2000, or amendments thereto~~; or within the "Landslide Hazard Areas" mapped as "Landslide Locations" in Figure 4 of the San Francisco Seismic Safety Investigation report prepared by URS/John A. Blume & Associates, Engineers, June 1974, or any successor map thereto~~.

Date	Action
6/2/15	Amendment proposed. See attachment.
7/14/15	CAC (Code Advisory Committee) Structural Subcommittee reviews amendment.
10/14/15	CAC (Code Advisory Committee) reviews amendment.
10/21/15	BIC (Building Inspection Commission) unanimously approves amendment, without acknowledging it reduces the area covered by the Act.
10/31/16	BOS Land Use and Transportation Committee approves "Repeal of Existing 2013 Building Code and Enactment of 2016 Edition." The proposed language amending Section 106A.4.1.4.3 was not included. (Agenda Item 1, File No. 160944)
11/15/16	BOS (Board of Supervisors) repeals 2013 Building Code and enacts 2016 Edition. The proposed language amending Section 106A.4.1.4.3 was not included. (File No. 160944)
1/1/17	DBI issues a new Information Sheet No. S-05, Geotechnical Report Requirements, omitting reference to the Blume Map.
1/10/17	DBI issues Information Sheet No. S-13, Errata in 2016 SFBC and SFEBC Structural Provisions, effective 1/1/17, "to correct errors" in the 2016 SFBC, Section 106A.4.1.4.3.

Slope Protection Act: History of Uncompleted Amendment to Reduce Scope

Observations:

1. The original legislation specifies that both the Blume and the CDMG maps taken together define the properties subject to the requirements of the Slope Protection Act.

2. Neither map has changed since enactment of the legislation in 2008.

3. Properties that lie within the Blume Map but not the CDMG Map would no longer be subject to the Act.

4. No study has been conducted to analyze whether it is appropriate to remove these properties from the jurisdiction of the Slope Protection Act.

5. The only argument on the record for deleting the 1974 Blume Map is that it is old. It was old in 2008, but was nonetheless included in the 2008 legislation along with the 2000 CDMG Map.

   Rationale Offered for Deleting Blume Map:

   a. According to Frank Rollo in the attached document dated 6/2/15, "the [1974] Blume Map is obsolete and replaced by [2000] CDMG Map."

   b. According to Minutes from the 10/21/15 BIC Meeting, "Mr. Kirk Means of the Technical Services Division and Secretary to the Code Advisory Committee, . . . explained that the CAC wanted to remove the Blume map and use the more current map, because the report was done in June 1974 and has not been revised since then so it dealt with old data. The other report was done in 2000 and it was a state generated map, which regularly gets updated."

6. There is no successor map.

7. The amendment was never reviewed or approved by the BOS Land Use and Transportation Committee or the Board of Supervisors.

8. DBI has implemented an amendment that has not completed the approval process.

SECTION 106A— PERMITS

106A.4.1.4 The Slope Protection Act.

106A.4.1.4.3 Scope. Properties are subject to these requirements where any portion of the property lies within the areas of "Earthquake-Induced Landslide" in the Seismic Hazard Zone Map, released by California Department of Conservation, Division of Mines and Geology, dated November 17, 2000, or amendments thereto; or within the "Landslide Hazard Areas" mapped as "Landslide Locations" in Figure 4 of the San Francisco Seismic Safety Investigation report prepared by URS/John A. Blume & Associates, Engineers, June 1974, or any successor map thereto.

NOTE : THE ABOVE ITEM IS REVISED AS FOLLOWS:

COMMENT 1:

Name: Frank Rollo
Date: June 2, 2015

Comments/Findings:

106A.4.1.4.3 Scope. Properties are subject to these requirements where any portion of the property lies within the areas of "Earthquake-Induced Landslide" in the Seismic Hazard Zone Map, released by California Department of Conservation, Division of Mines and Geology, dated November 17, 2000, or amendments thereto~~; or within the "Landslide Hazard Areas" mapped as "Landslide Locations" in Figure 4 of the San Francisco Seismic Safety Investigation report prepared by URS/John A. Blume & Associates, Engineers, June 1974, or any successor map thereto.~~

[Note: To revise San Francisco Amendments in 2013 to reflect that the Blume Map is obsolete and replaced by CDMG Map.

Recommend to be brought to the full CAC committee for further action.]

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

COMMENT 2:				
Name: CAC Structural Subcommittee Date: June 9, 2015				
Comments/Findings:				
Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:	
			X	

COMMENT 3:				
Name: Code Advisory Committee Date:				
Comments/Findings:				
Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:	
			X	

Slope Protection Act: History of Uncompleted Amendment to Reduce Scope

Links to meeting agendas, supporting documents, minutes (where available), and information sheets.

CAC (Code Advisory Committee) Structural Subcommittee, agenda and supporting documents:

http://sfdbi.org/sites/default/files/CAC%20Structural%2007-14-15.pdf

http://sfdbi.org/meeting/structural-subcommittee-july-14-2015-supporting-documents

CAC (Code Advisory Committee), agenda and supporting documents:

http://sfdbi.org/sites/default/files/CAC%20Agenda%2010-14-15.pdf

http://sfdbi.org/sites/default/files/CAC%20Agenda%20Item%204%20for%2010-14-15.pdf

BIC (Building Inspection Commission), agenda, supporting documents and minutes:

http://sfdbi.org/sites/default/files/BIC%20Agenda%2010-21-15.pdf

http://sfdbi.org/sites/default/files/BIC%20Meeting%20of%20Oct%2021%2C%202015%20Agenda%20Item%20%236.pdf

http://sfdbi.org/sites/default/files/BIC%20Minutes%2010-21-15.pdf

BOS Land Use and Transportation Committee, agenda and minutes:

http://sfbos.org/sites/default/files/lut103116_agenda.pdf

http://sfbos.org/sites/default/files/lut103116_minutes.pdf

BOS (Board of Supervisors), agenda and minutes:

http://sfbos.org/sites/default/files/bag111516_agenda.pdf

http://sfbos.org/sites/default/files/bag111516_minutes.pdf

DBI (Department of Building Inspection), information sheets:

http://sfdbi.org/sites/default/files/IS%20S-05.pdf

http://sfdbi.org/sites/default/files/IS%20S-13.pdf

From: Board of Supervisors, (BOS)
To: Jalipa, Brent (BOS); Lew, Lisa (BOS)
Subject: FW: Appeal of CEQA Mitigated Declaration Planning Case No. 2013.1383ENV - 3516 and 3526 Folsom Street ("Project Site") - Documents
Date: Tuesday, September 12, 2017 4:21:33 PM

Let me know if I should distribute to the Supervisors.

From: Autumn Skerski [mailto:autumn@zfplaw.com]
Sent: Tuesday, September 12, 2017 3:32 PM
To: Board of Supervisors, (BOS) <board.of.supervisors@sfgov.org>
Cc: Ryan Patterson <ryan@zfplaw.com>
Subject: Appeal of CEQA Mitigated Declaration Planning Case No. 2013.1383ENV - 3516 and 3526 Folsom Street ("Project Site") - Documents

Dear President Breed and Honorable Members of the Board of Supervisors,

Please find a copy of the documents hand delivered to City Hall Room 244 for Case No. 2013.1383ENV in the below link

https://zacks.egnyte.com/fl/BHtLdCHxFl

Thank you,

Autumn Skerski
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September 12, 2017

VIA HAND DELIVERY AND EMAIL

President London Breed
c/o Angela Calvillo, Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place
City Hall, Room 244
San Francisco, CA 94102

Re: Appeal of CEQA Mitigated Negative Declaration
Planning Case No. 2013.1383ENV
Building Permit Application Nos. 2013.12.16.4318 and 2013.12.16.4322
3516 and 3526 Folsom Street ("Project Site")

Dear President Breed and Honorable Members of the Board of Supervisors:

Please find the following documents enclosed:

Documents reviewed in preparation of Independent Evaluation of the San Francisco Planning Department Mitigated Negative Declaration, prepared by Engineering Design & Testing Corp. (Kenneth Ridings, P.E. and Steven Viani, P.E.), Sept. 11, 2017 (Exhibit O)

1. San Francisco Planning Department Mitigated Negative Declaration ("MND")
2. MND Appeal dated September 5, 2017
3. Spectra Energy Partners - Algonquin Incremental Market Project - Analysis of the West Roxbury Crushed Stone Operations on Construction and Operation of the West Roxbury Lateral dated March 31, 2014
4. Letter from Lubin Olson to President London Breed dated September 1, 2017 regarding Appeal of MND
5. Reported email from Austin Sharp with PG&E, contained as Appendix A in letter from Lubin Olson to President London Breed dated September 1, 2017
6. 49 Code of Federal Regulations Part 192 - Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
7. ASME B31.8S-2016 Managing System Integrity of Gas Pipelines (cover page)
8. U.S. Department of Transportation - Pipeline and Hazardous Materials Administration - Reportable Incident Data

9. Footnote 3: John Dolcini, Pipeline Engineer-Gas Transmission, Pacific Gas and Electric Company, Letter Re: 3516/3526 Folsom Street, March 30, 2017
10. Footnote 20: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment, May 2006, pp. 8-1 to 8-3, Table 8-1
11. Footnote 30: US Department of Transportation, Federal Highway Administration, Construction Noise Handbook, Table 9.1, July 2011.
12. Footnote 31: Illingworth and Rodkin, Inc., Construction Vibration Evaluation for 3516 and 3526 Folsom Street, March 24, 2017
13. Illingsworth & Rodkin Inc., Memo: Ground Characteristics and Effect on Predicted Vibration, April14, 2017
14. California Department of Transportation, Transportation and Construction Vibration Guidance Manual, September 2013
15. Appeal of CEQA Mitigated Negative Declaration (exhibits filed with BOS and available upon request)
16. H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3516 Folsom Street, San Francisco, California, August 3, 2013. H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3526 Folsom Street, San Francisco, California, August 3, 2013, attached to letter dated April 14, 2017
17. Geotechnical Report Update, Proposed Residence at 3516 & 3526 Folsom Street San Francisco, California by H. Allen Gruen, 11/29/16
18. Geotechnical Responses to Project Review Letter, Proposed Residence at 3516 & 3526 Folsom Street San Francisco, California by H. Allen Gruen, 1/24/17
19. Review of Proposed Pipeline Impacts 3516 & 3526 Folsom Street, San Francisco, California, Storesund Consulting, June 14, 2017
20. David J. Franco PE, 3516 & 3526 Folsom Street Grading Plan, 9/21/16
21. Planned Street and Utility Improvements at 3516 & 3526 Folsom Street San Francisco, California by H. Allen Gruen, 7/6/17

Very truly yours,

ZACKS, FREEDMAN & PATTERSON, PC

Ryan J. Patterson
Attorneys for Herb Felsenfeld and Gail Newman

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Very truly yours,

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Ryan J. Patterson
Attorneys for Herb Felsenfeld and Gail Newman

EXHIBIT 1

SAN FRANCISCO
PLANNING DEPARTMENT

1650 Mission St.
Suite 400
San Francisco,
CA 94103-2479

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415.558.6378

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Information:
415.558.6377

Mitigated Negative Declaration

Date:	April 19, 2017; amended on June 8, 2017
Case No.:	2013.1383ENV
Project Title:	3516 and 3526 Folsom Street
Zoning:	RH-1 (Residential—House, One Family) Use District 40-X Height and Bulk District Bernal Heights Special Use District
Block/Lot:	5626/013 and 5626/014
Lot Size:	1,750 square feet (each lot)
Project Sponsor:	Fabien Lannoye, Bluorange Designs 415-626-8868 Fabien@bluorange.com
Staff Contact:	Justin Horner – (415) 575-9023 Justin.Horner@sfgov.org

PROJECT DESCRIPTION

The project site is located on the block bounded by Bernal Heights Boulevard to the north, Gates Street to the west, Powhattan Avenue to the south and Folsom Street to the east. The project site is located along the west side of an approximately 145-foot-long unimproved segment of Folsom Street, north of Chapman Street, that ends at the Bernal Heights Community Garden. This unimproved right-of-way is known as a "paper street." Undeveloped land along this unimproved segment of Folsom Street has been subdivided into six lots, three on each side of Folsom Street. PG&E Natural Gas Transmission Pipeline 109 (PG&E Pipeline 109) runs along Folsom Street adjacent to the project site. The project site is at a slope of 28%.

The proposed project involves the construction of two single-family residences on two of the vacant lots along the west side of the unimproved portion of Folsom Street, ~~and~~ the construction of the connecting segment of Folsom Street to provide vehicle and pedestrian access to the project site, and the construction of a stairway between Folsom Street and Bernal Heights Boulevard. The Folsom Street extension and stairway would be subject to approval by San Francisco Public Works (Public Works) Each single-family home would be 27 feet tall, two stories over-garage with two off-street vehicle parking spaces accessed from a twelve-foot-wide garage door.

The 3516 Folsom Street building would be approximately 2,230 square feet in size with a side yard along its north property line. The 3526 Folsom Street building would be approximately 2,210 square feet in size with a side yard along its south property line. The proposed buildings would include roof decks and a full fire protection sprinkler system. The proposed buildings would be supported by a shallow building foundation using a mat slab with spread footings.

The proposed Folsom Street extension improvements would include an approximately 20-foot-wide road with an approximately 10-foot-wide sidewalk on the west side of the street, adjacent to the proposed residences. The proposed sidewalk would be stepped, would incorporate landscaping that would perform storm water retention, and would provide public access to Bernal Heights Boulevard/Bernal Heights Park. The stairway would run to the northwest of Folsom Street, within Public Works property, and at least 15 feet downhill from an existing stand of hummingbird sage, a locally sensitive plant species, along Bernal Heights Boulevard. The proposed project would not create direct vehicular access to Bernal Heights Boulevard as the Folsom Street extension would terminate ~~at~~ south of the Bernal Heights Community Garden. Construction of the street extension would require the removal of the existing vegetation within the public right-of-way on the "paper street." An existing driveway utilized by both the 3574 Folsom Street and 3577 Folsom Street buildings would also be removed; however, the extension would provide access to the two existing residences.

The proposed project would include the installation of new street trees (subject to approval from PG&E) and street lighting on the west side of the street. No on-street parking would be provided along the Folsom Street extension. In addition to providing utilities for the proposed residences, the project sponsor would install utilities for the four vacant lots located on the "paper street" segment of Folsom Street (one on the west side and three on the east side). No residences are proposed at this time on those lots; the proposed connections would be provided to minimize disruption in the case of future development. Construction would continue for approximately 12 months and would require excavation of up to approximately 10 feet below the existing ground surface.

FINDING

This project could not have a significant effect on the environment. This finding is based upon the criteria of the Guidelines of the State Secretary for Resources, Sections 15064 (Determining Significant Effect), 15065 (Mandatory Findings of Significance), and 15070 (Decision to prepare a Negative Declaration), and the following reasons as documented in the Initial Evaluation (Initial Study) for the project, which is attached. Mitigation measures are included in this project to avoid potentially significant effects. See pages 113-114

In the independent judgment of the Planning Department, there is no substantial evidence that the project could have a significant effect on the environment.

7/11/2017
Date

Jessica Range for
Lisa Gibson
Environmental Review Officer

INITIAL STUDY TABLE OF CONTENTS

3516-3526 Folsom Street

SECTION **PAGE**

LIST OF FIGURES — PAGE

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ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
ABAG	Association of Bay Area Governments
ACL	Absolute Cumulative Limits
ADRP	Archeological Data Recovery Plan
ACIP	Auger cast in place
AMP	Archeological Monitoring Program
ARB	California Air Resources Board
ARDTP	Archeological Research Design and Treatment Plan
ATP	Archeological Testing Plan
BAAQMD	Bay Area Air Quality Management District
BART	Bay Area Rapid Transit
BCDC	Bay Conservation and Development Commission
bgs	below grade surface
BMPs	best management practices
BMR	below market rate
CAA	Clean Air Act
CalEEMod	California Emissions Estimator Model
Cal/OSHA	State Occupational Safety and Health Administration
Caltrans	Californian Department of Transportation
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CCAA	California Clean Air Act
CGS	California Geological Survey
CNEL	Community Noise Equivalent Level
CO	carbon monoxide
CO_2e	carbon dioxide equivalents
CRHR	California Register of Historical Resources
CSO	Combined Sewer Overflow
dB	decibel
dBA	decibel (A-weighted)
DBI	Department of Building Inspection
DEHP	bis (2-ethylhexyl) phthalate
DPH	Department of Public Health
DPM	diesel particulate matter
DSM	deep soil mixing
DTSC	Department of Toxic Substances Control
ERO	Environmental Review Officer
ESA	Environmental Site Assessment
ESLs	Environmental Screening Levels
FAR	floor area ratio
FARR	Final Archeological Resource Report
FEMA	Federal Emergency Management Agency

FTA	Federal Transit Administration
GHG	greenhouse gas
gsf	gross square feet
g/hp-hr	gram per horsepower per hour
g/bhp-hr	gram per brake horsepower per hour
HCD	California Department of Housing and Community Development
HEPA	High Efficiency Particulate Air Filter
HRE	Historic Resources Evaluation
HVAC	heating, ventilation and air conditioning
in/sec	inches per second
IWMP	Integrated Waste Management Plan
L_{dn}	day-night noise level
LEED	Leadership in Energy and Environmental Design
L_{eq}	equivalent continuous sound level
LUST	leaking underground storage tank
mgd	million gallons per day
mg/kg	milligram per kilogram
mg/L	milligram per liter
MLD	Most Likely Descendant
MLP	maximum load point
mph	miles per hour
MRZ-4	Mineral Resource Zone 4
MSTL	District Market Street Theatre and Loft National Register Historic District
MTBE	methyl tertiary-butyl ether
MTC	Metropolitan Transportation Commission
$MTCO_2E$	metric ton of carbon dioxide equivalents
Muni	San Francisco Municipal Railway
M_w	moment magnitude
NAHC	California State Native American Heritage Commission
NAVD88	1988 North American Vertical Datum
NCT	Neighborhood Commercial Transit (zoning designation)
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NO_x	oxides of nitrogen
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NSR	New Source Review
NWIC	Northwest Information Center
OPR	State Office of Planning and Research
OS	open space
PAHs	polynuclear aromatic hydrocarbons
PAR	Preliminary Archeological Review
PCBs	polychlorinated biphenyls
PM	particulate matter
$PM_{2.5}$	PM composed of particulates that are 10 microns in diameter or less
PM_{10}	PM composed of particulates that are 2.5 microns in diameter or less

POPOS	privately owned public open spaces
ppm	parts per million
PPV	peak particle velocity
QACL	Qualified Archaeological Consultants List
RED	Residential Enclave (zoning designation)
RMS	root mean square
ROG	reactive organic gases
RWQCB	Bay Area Regional Water Quality Control Board
SB	Senate Bill
SamTrans	San Mateo County Transit District
SEWPCP	Southeast Water Pollution Control Plant
sq. ft.	square feet
SFBAAB	San Francisco Bay Area Air Basin
SFCTA	San Francisco County Transportation Authority
SFFD	San Francisco Fire Department
sfh	square foot hours
SFMTA	San Francisco Municipal Transportation Agency
SFO	San Francisco International Airport
SFPD	San Francisco Police Department
SFPL	San Francisco Public Library
SFPUC	San Francisco Public Utilities Commission
SFPW	San Francisco Public Works
SFUSD	San Francisco Unified School District
SO_2	sulfur dioxide
SOMA	South of Market
SoMa	South of Market
STLC	soluble threshold limit concentration
SUD	Special Use District
TAAS	Theoretically Available Annual Sunlight
TACs	toxic air contaminants
TASC	Transportation Advisory Staff Committee
TBACT	Best Available Control Technology
TCLP	toxicity characteristic leaching procedure
TDM	Transportation Demand Management
TEP	Transit Effectiveness Project
TTLC	total threshold limit concentration
U.S. EPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
UWMP	Urban Water Management Plan
VDECS	verified diesel emission control strategy
VMT	vehicle miles traveled
WSA	Water Supply Assessment

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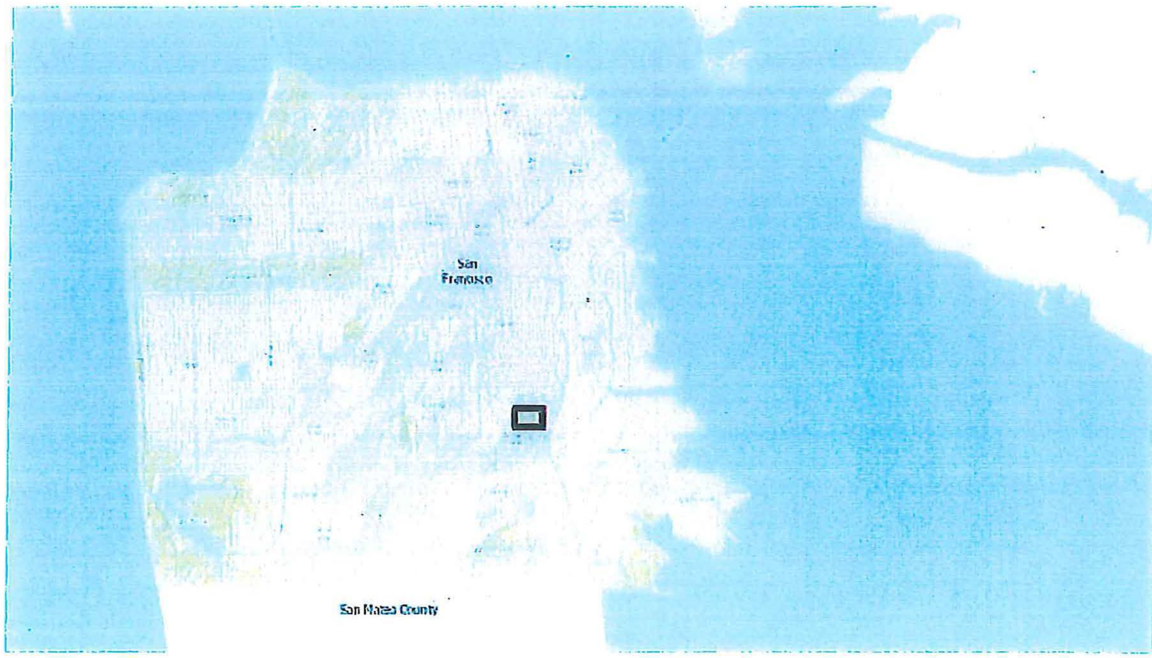
Initial Study
3516-3626 Folsom Street Project
Planning Department Case No. 2013.1383ENV

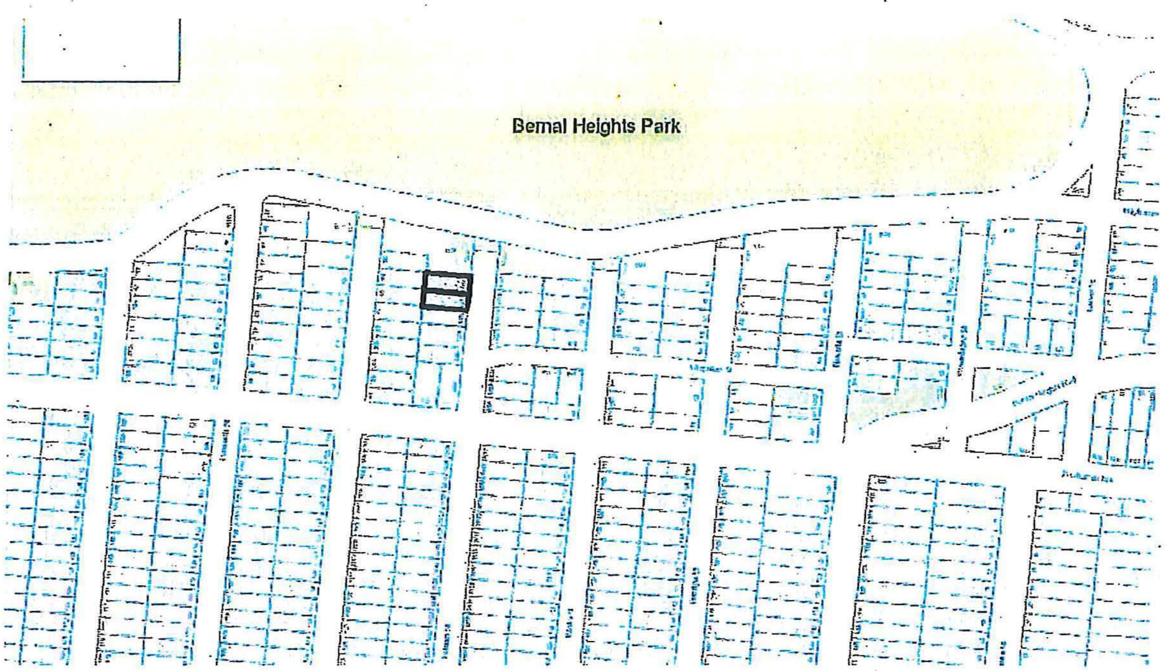
The proposed 3516-3526 Folsom Street Project (project) would result in the development of two residential units on two 1,750 square-foot parcels (Assessor's Block 5626, Lots 013 and 014) located at 3516-3526 Folsom Street, the improvement of a "paper street" section of Folsom Street, and a new stairway between the project site and Bernal Heights Boulevard in the Bernal Heights neighborhood in the City of San Francisco (City). The two buildings would each be approximately 2,230 gross square feet (gsf) in size, and each would include a two-car garage. The proposed buildings would not exceed 30 feet in height. A complete description of the proposed project, a detailed description of the proposed project's regional and local context, planning process and background, as well as a discussion of requested project approvals is included below.

A. PROJECT SITE

The approximately 6,500 square-foot project site (two lots at 1,750 sf (25 feet by 70 feet) each and an approximately 2,000 sf street improvement) is located in the Bernal Heights neighborhood and is located within a block bounded by Bernal Heights Boulevard to the north, Gates Street to the west, Powhattan Avenue to the south and Folsom Street to the east. The site is located on the west side of an approximately 145 foot long unimproved segment of Folsom Street, north of Chapman Street, that ends at the Bernal Heights Community Garden. This unimproved right-of-way is known as a "paper street." Undeveloped land along this unimproved segment of Folsom Street has been subdivided into six lots, three on each side of Folsom Street. There are two existing residences on this unimproved segment of Folsom Street (3574 and 3577 Folsom Street) that are accessible via private driveways running from Chapman Street. **Figure 1** shows the location of the project site and **Figure 2** provides an aerial view of the site. **Figure 3** illustrates the project site.

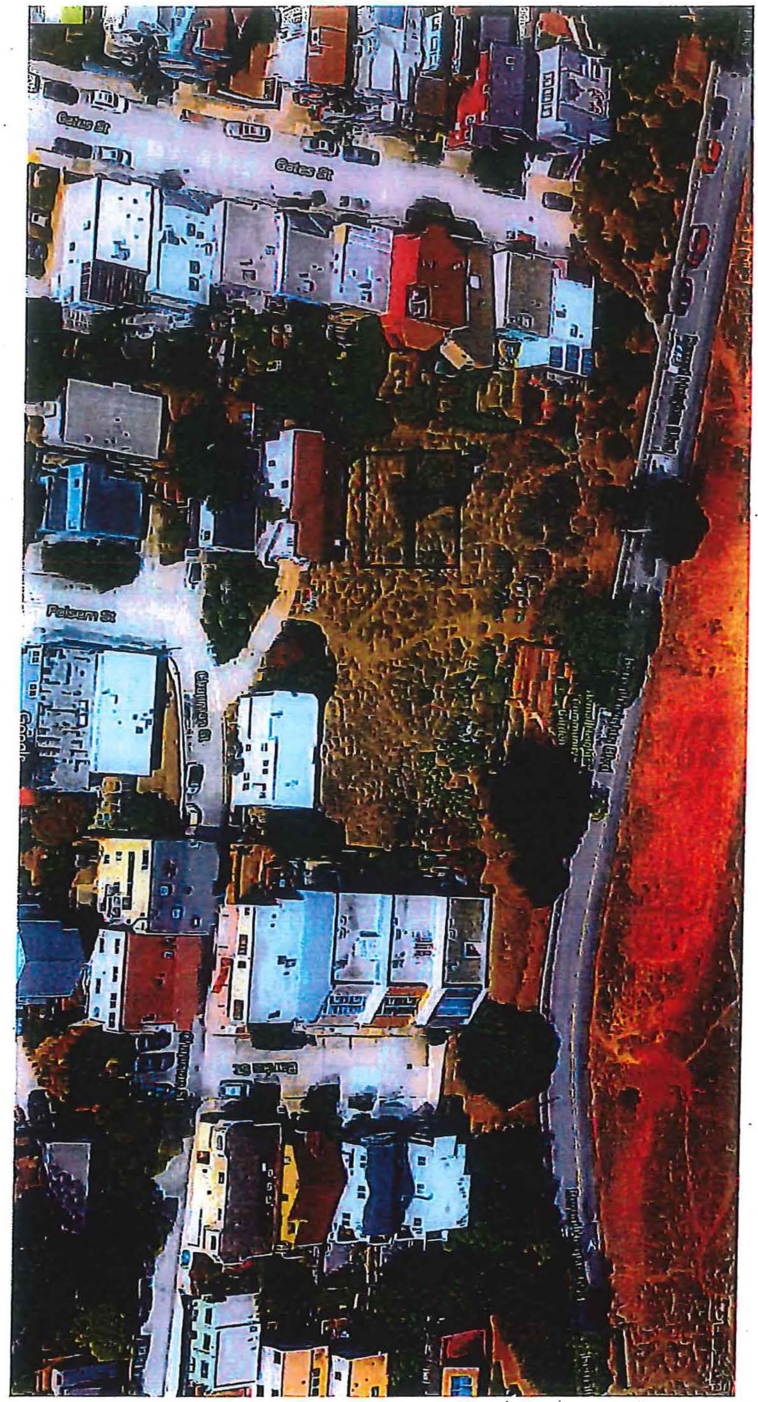
Figure 1: Project Location and Regional Vicinity Map





Source: San Francisco Planning Department

Figure 2: Existing Site Conditions



The project site is currently vacant and has not been previously developed. There are bushes and other small plants on the project site. The project site is at a slope of 28% and slopes downward from north to south.

B. PROPOSED PROJECT

The project sponsor proposes the construction of two single-family residences on two of the vacant lots along the west side of the unimproved portion of Folsom Street, ~~and~~ the construction of the connecting segment of Folsom Street to provide vehicle and pedestrian access to the project site and the construction of a stairway to provide pedestrian access from the improved section of Folsom Street to Bernal Heights Boulevard that would run to the northwest of Folsom Street, within Public Works property, and at least 15 feet downhill from an existing stand of hummingbird sage, a locally sensitive plant species. Both single-family homes would be 27 feet tall, two-story-over-garage buildings and would each include two off-street vehicle parking spaces accessed from a twelve-foot-wide garage door. Vehicle access would be provided by a 10-foot wide curb cut on Folsom Street.

The existing, unimproved project site is represented in **Figure 4**. Plans for the proposed project are depicted in **Figures 5 through 12**.

Project Building Characteristics

The proposed project would result in the construction of two immediately adjacent single-family homes, each with three levels of living area (a garage and recreation room with two levels above). Each building would be approximately 2,230 gsf.

Each building would be set back between approximately three and three-and-a-half feet from the street front property line at grade and stepped back up to 10 feet from the building façade at the second level. Each building would be set back approximately 24-and-a-half feet from the rear property line.

Figure 3: Project Site

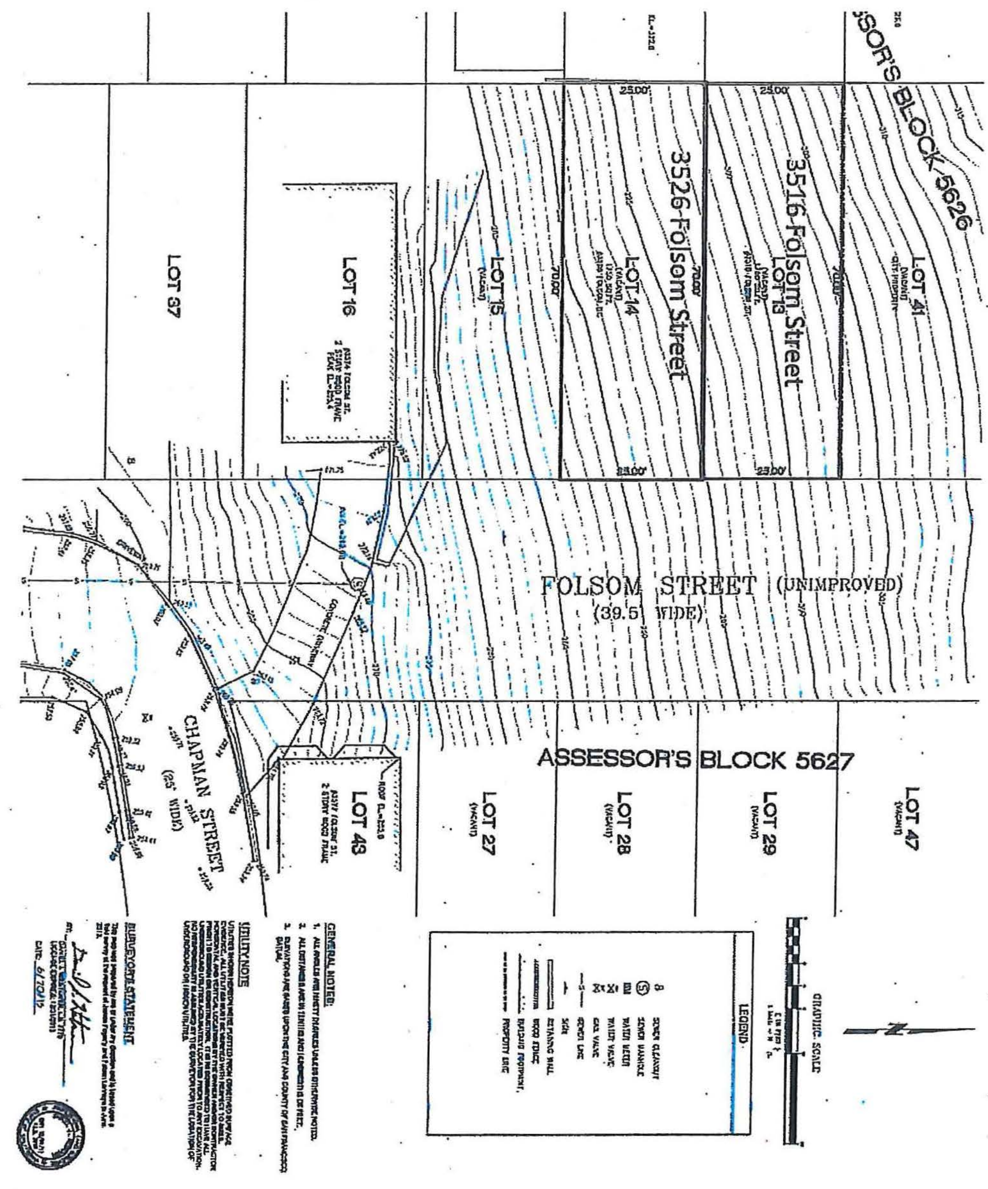


Figure 4: 3526 Folsom Street: Garage and First Floor Plans

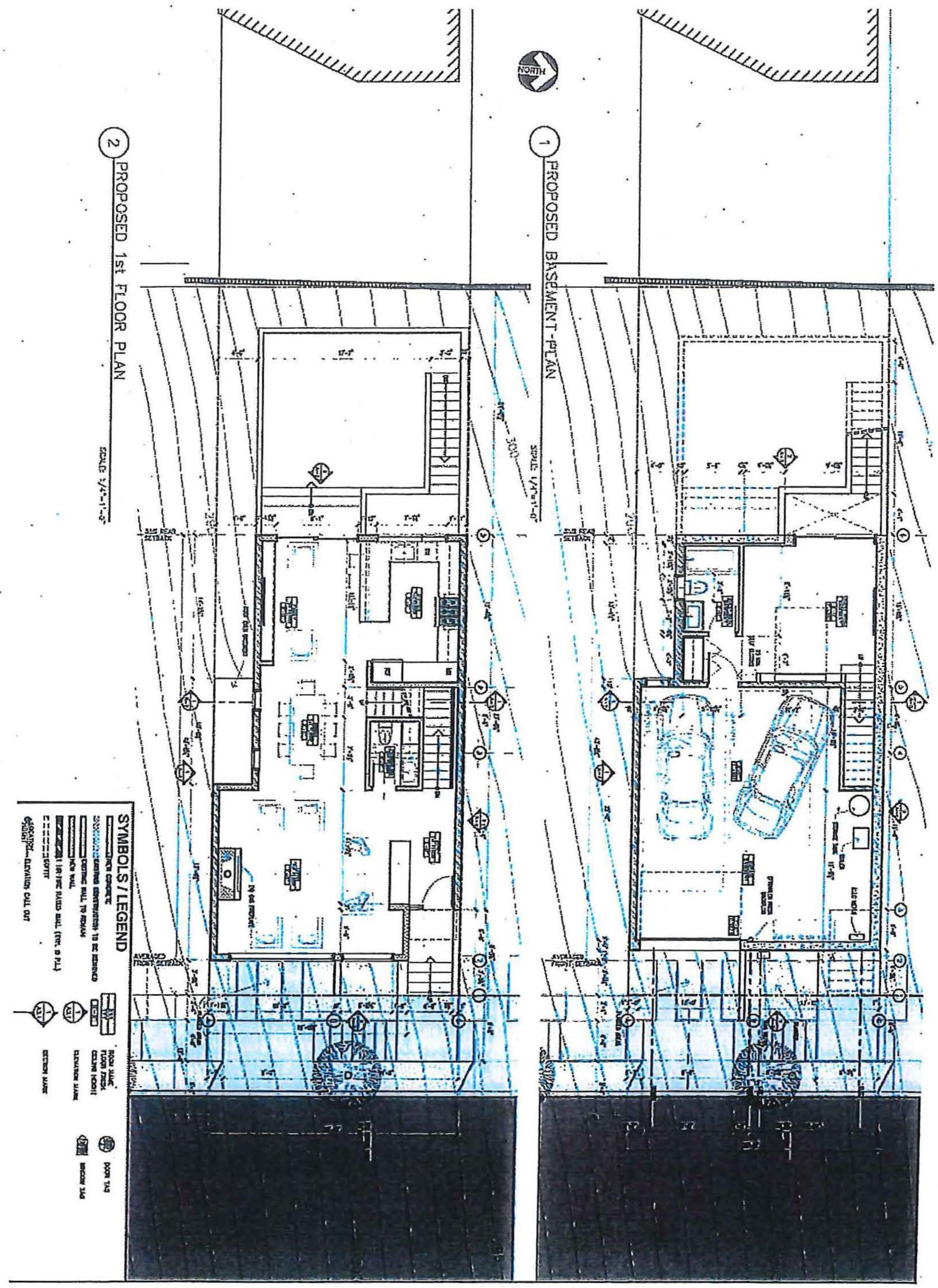


Figure 5: 3526 Folsom Street: Second Floor and Roof Plans

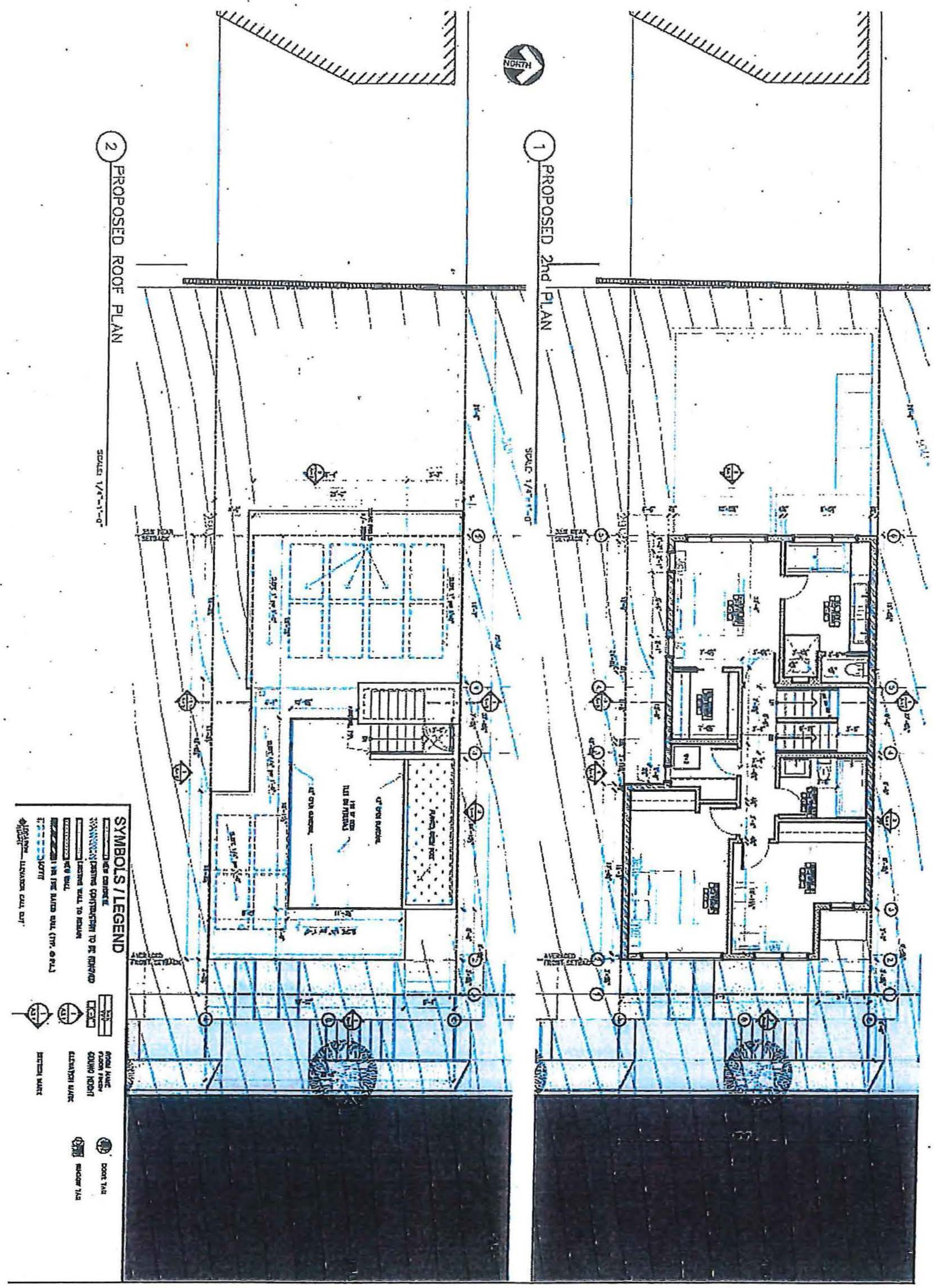


Figure 6: 3526 Folsom Street: North and South Elevations

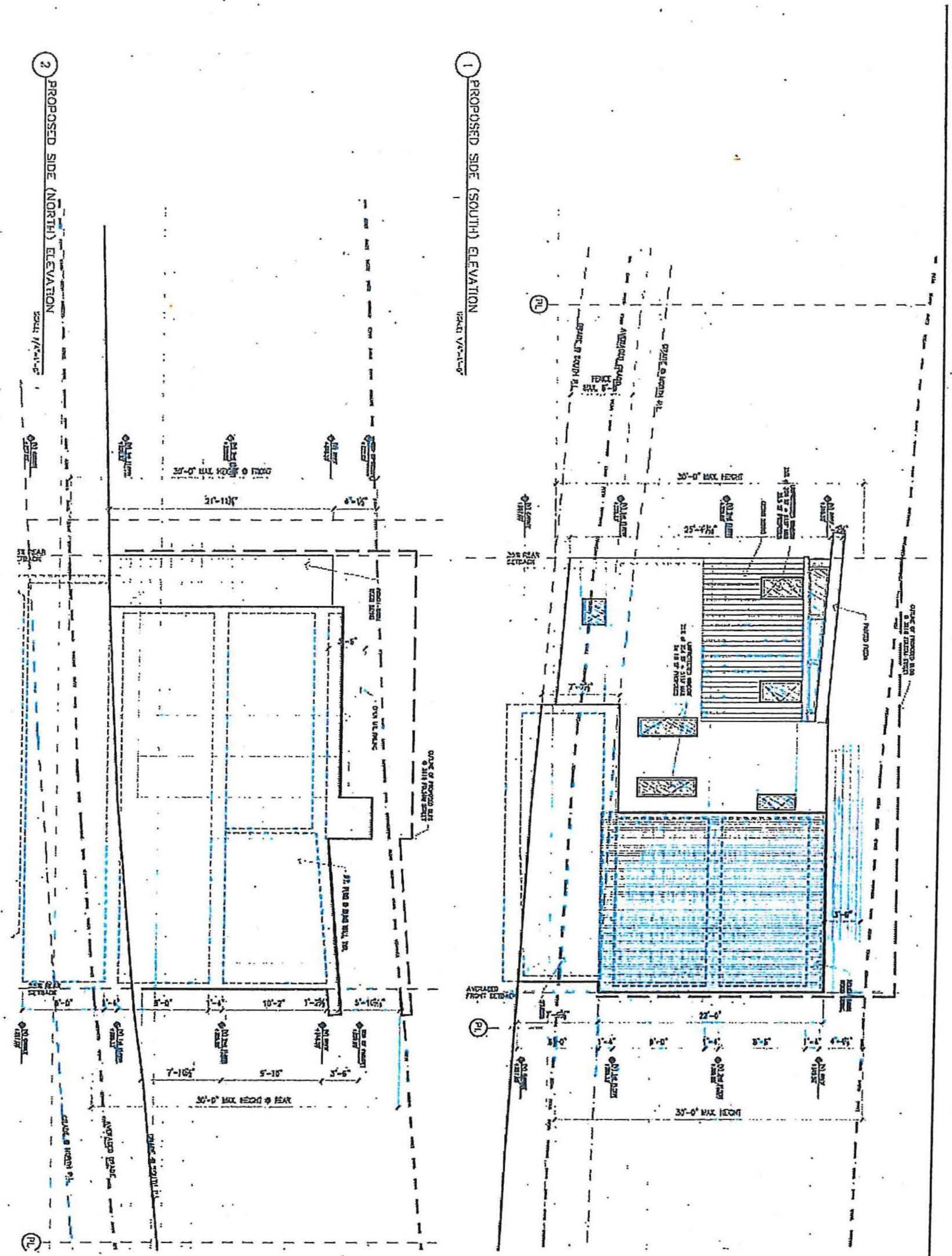


Figure 7: 3526 Folsom Street: East and West Elevations

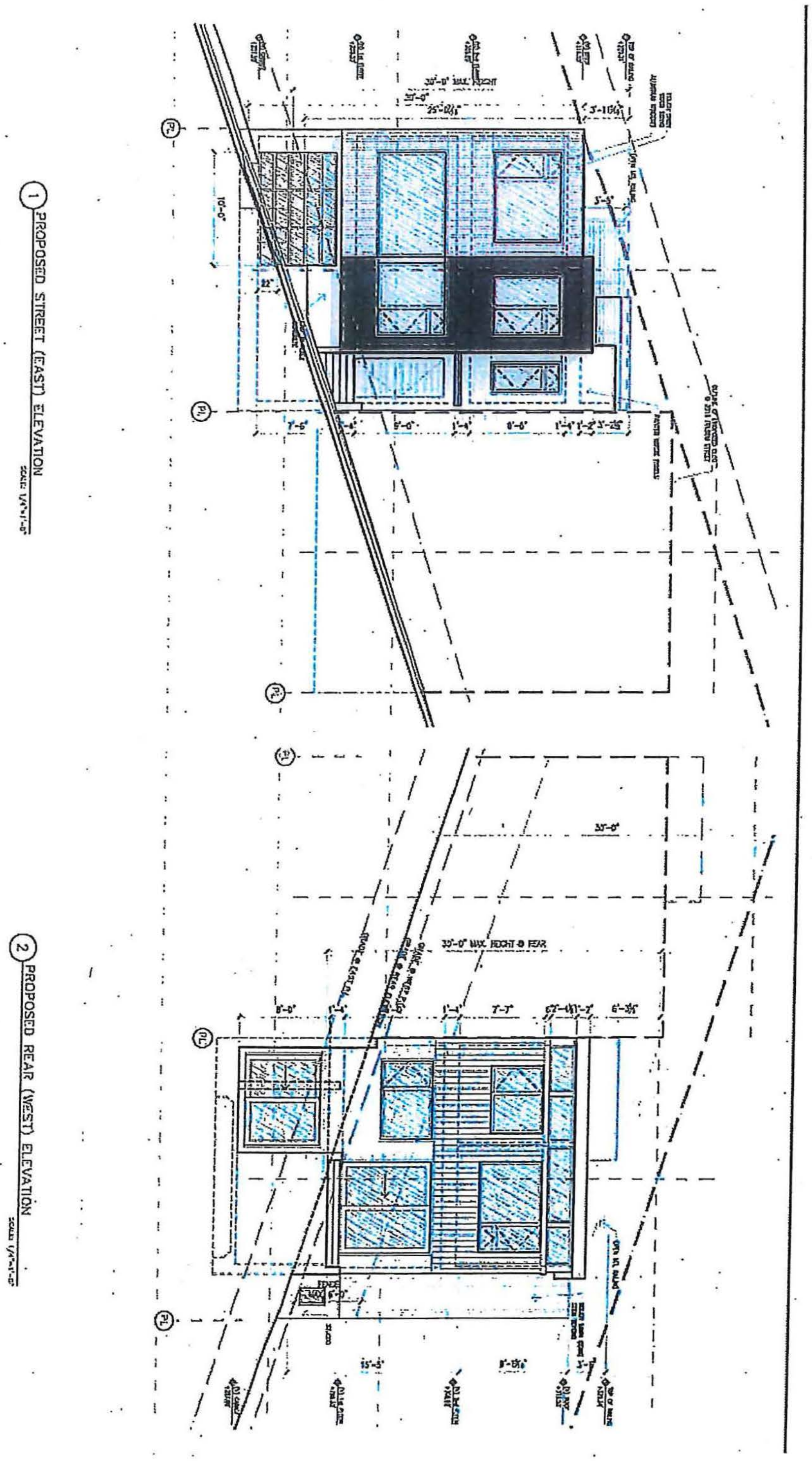


Figure 8: 3516 Folsom Street: Garage and First Floor Plans

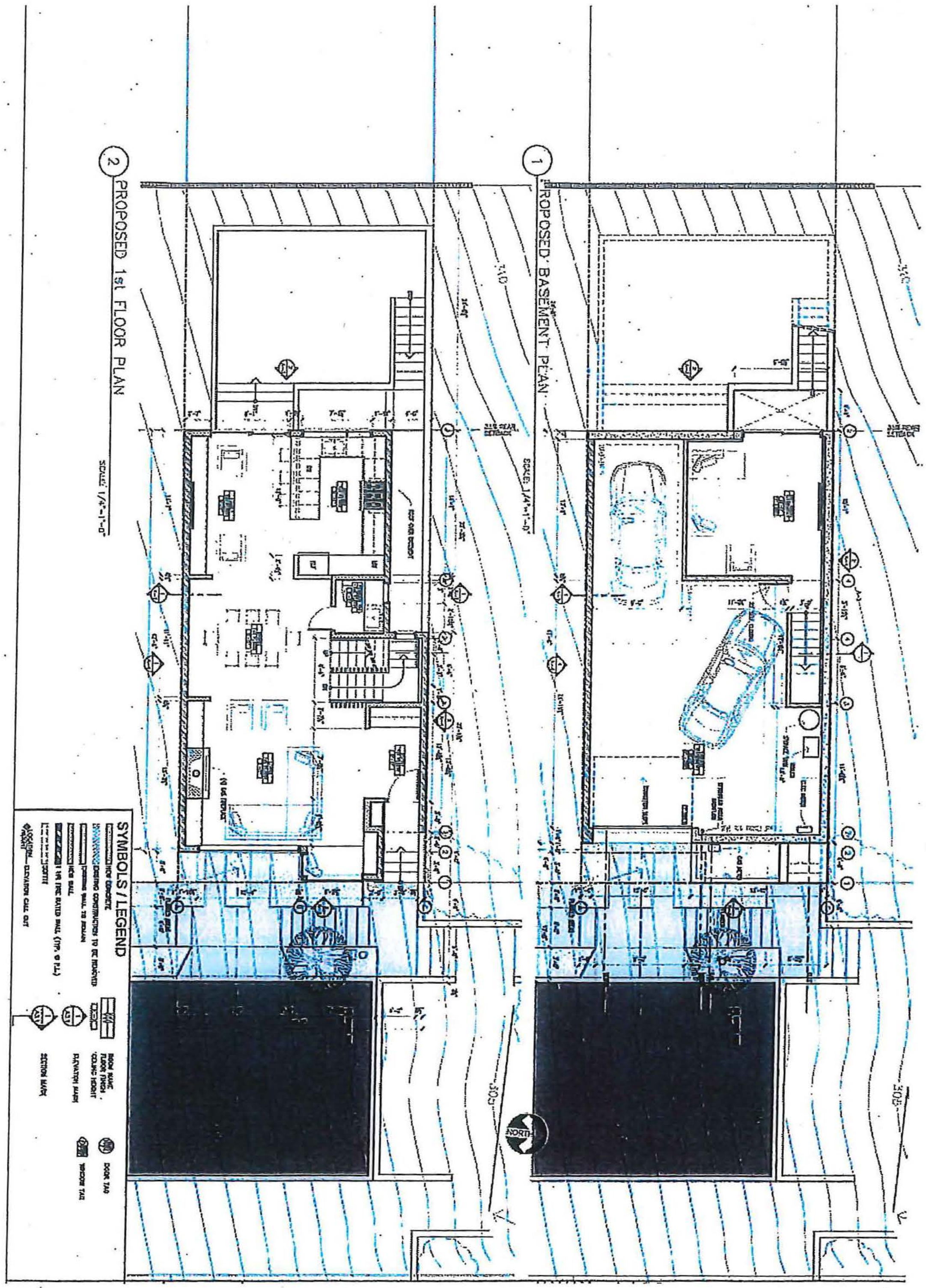


Figure 9: 3516 Folsom Street: Second Floor and Roof Plans

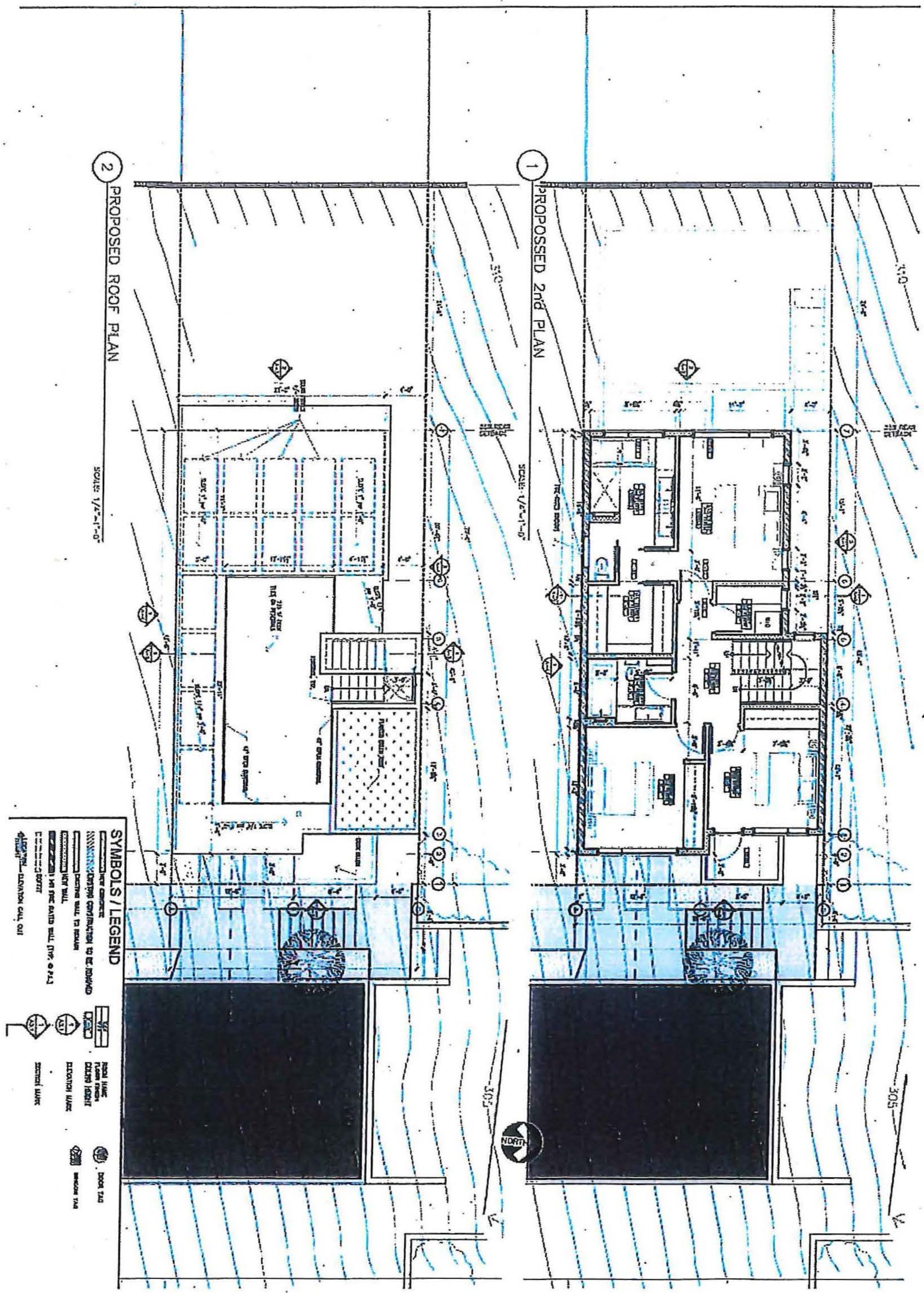


Figure 10: 3516 Folsom Street: North and South Elevations

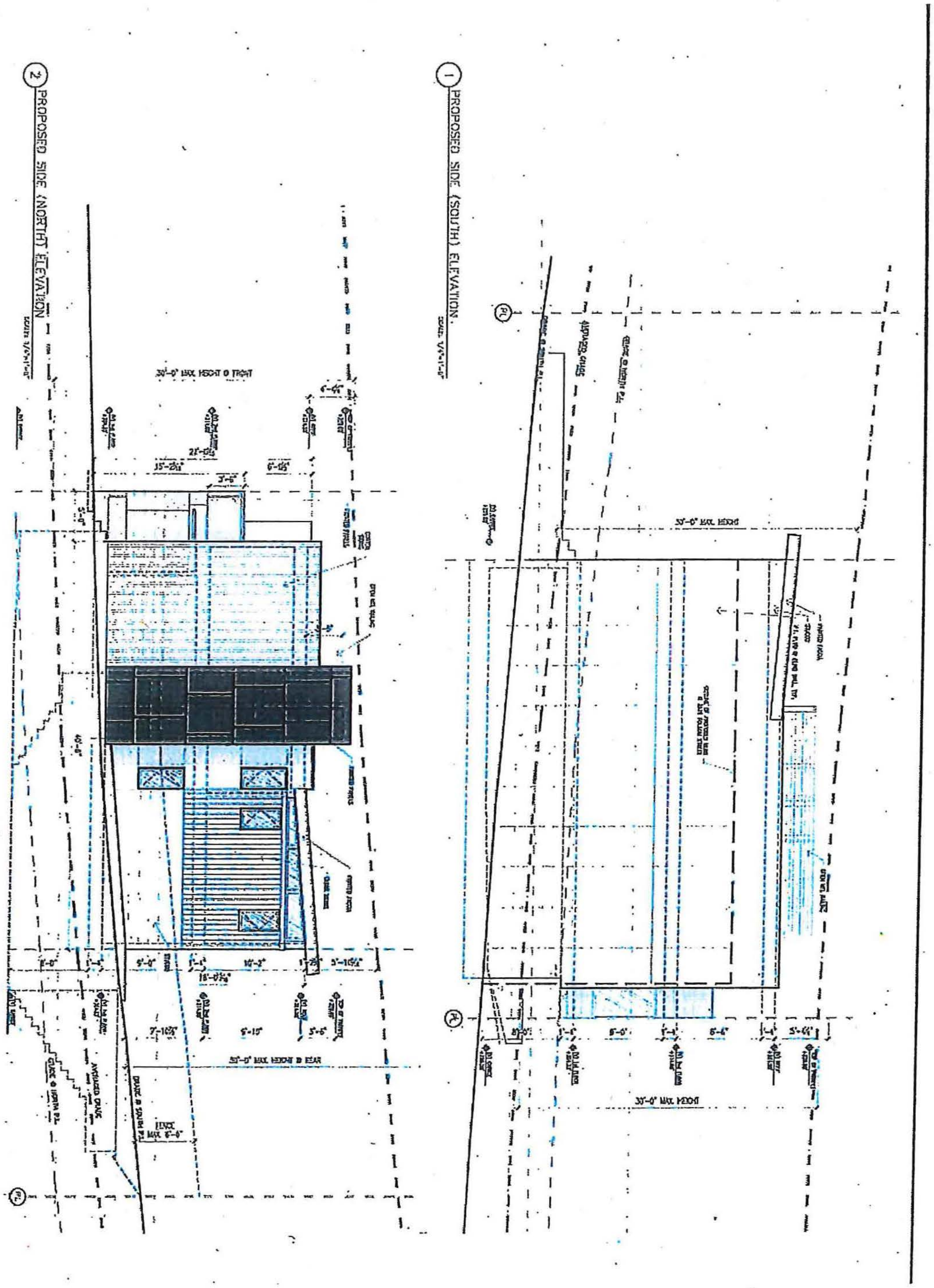


Figure 11: 3516 Folsom Street: East and West Elevations

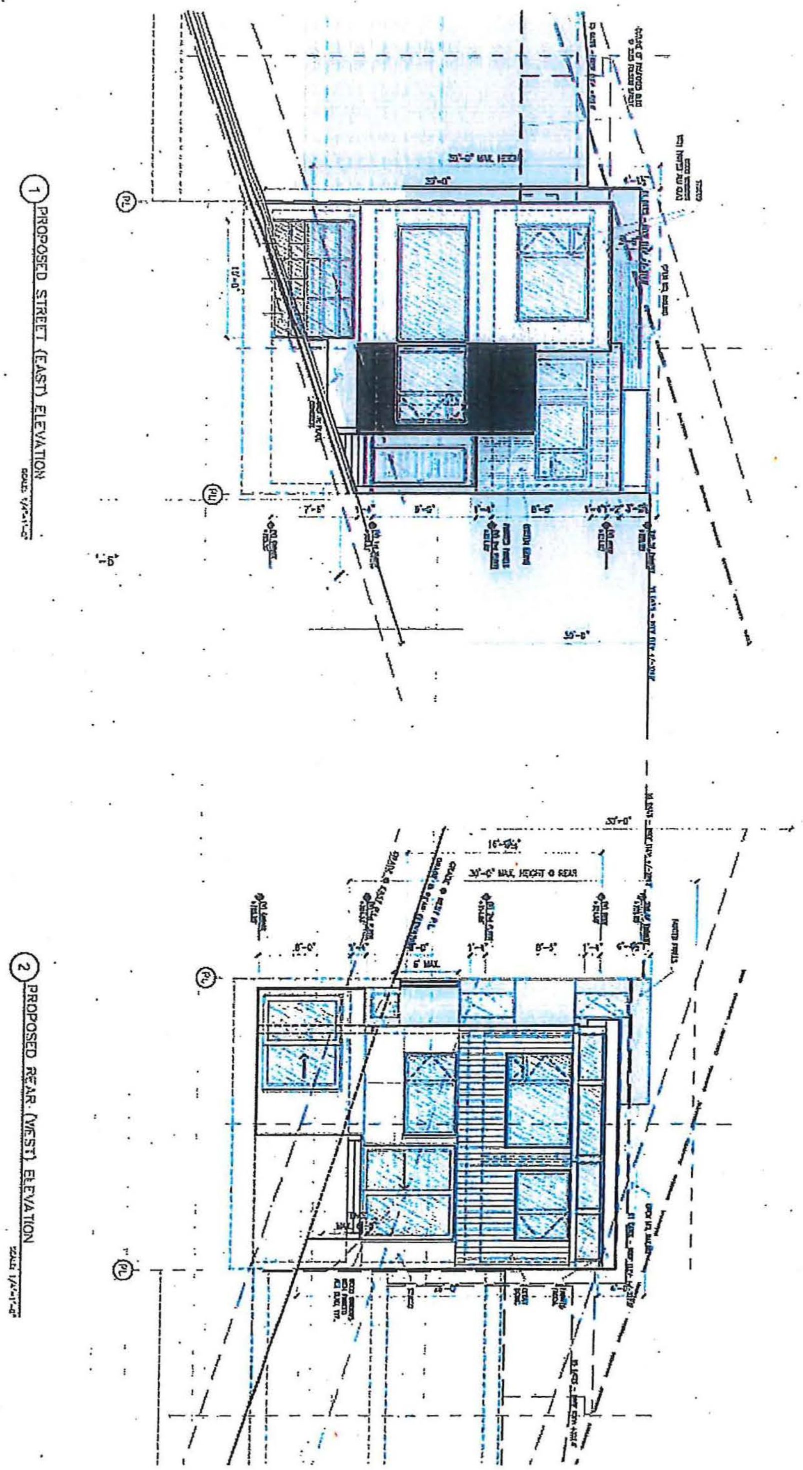
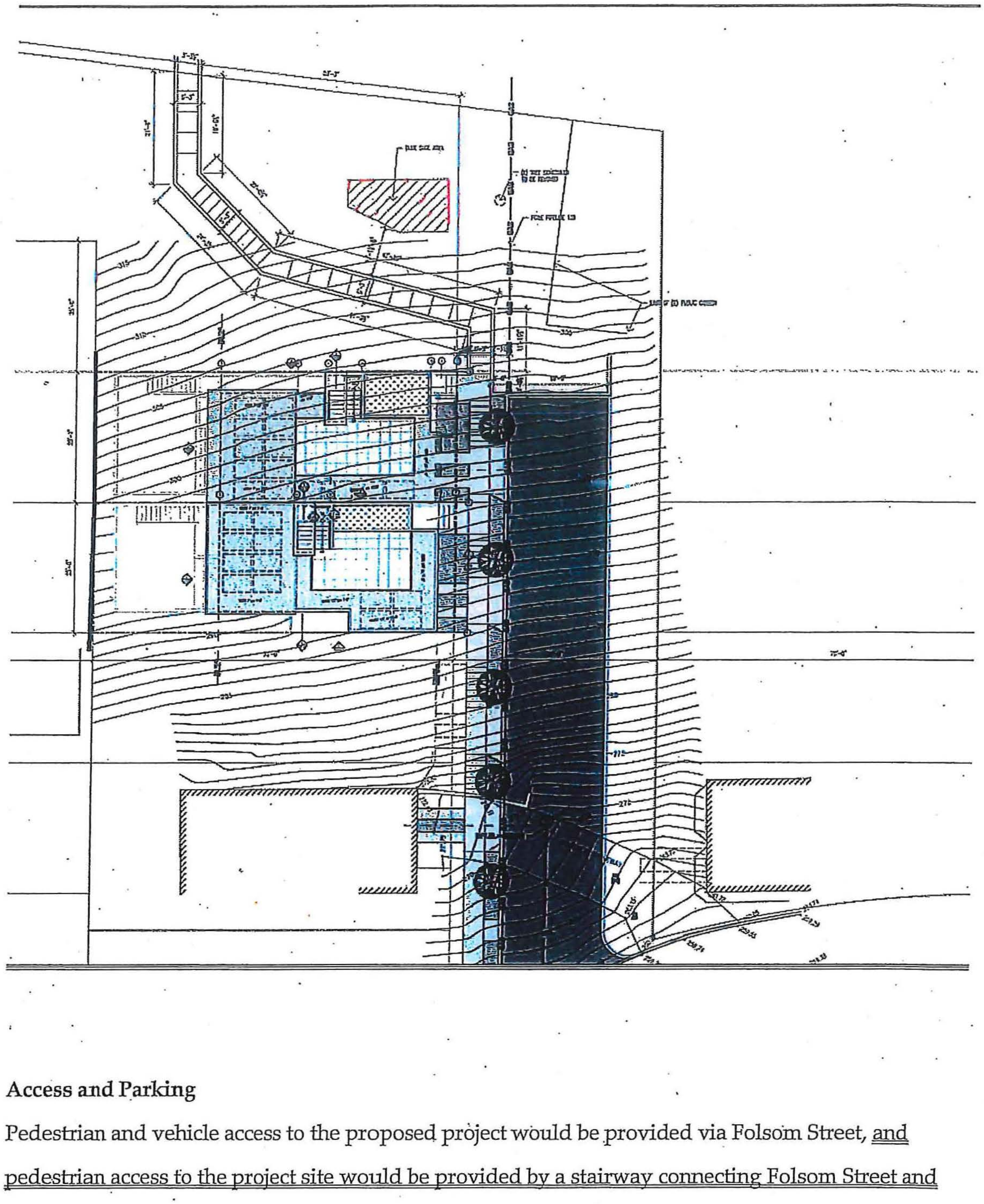


Figure 12: Proposed Street Improvement and Stairway Alignment



Access and Parking

Pedestrian and vehicle access to the proposed project would be provided via Folsom Street, and pedestrian access to the project site would be provided by a stairway connecting Folsom Street and Bernal Heights Boulevard, which would be improved consistent with a Street Improvement Permit that would be issued by San Francisco Public Works (Public Works). Resident access to each unit would be provided from within the ground level garage and through a front door along Folsom Street. A total of four parking spaces (two for each unit) would be provided on site. New curb cuts for each proposed garage access driveway would be 12 feet in width.

Demolition and Construction

Construction activities at the project site would begin with clearing the site. A total of approximately 650 cubic yards of soil would be excavated from the site to accommodate new foundations and utility connections. Excavated materials would be delivered to 20 cubic yard capacity haul trucks located on Bernal Heights Boulevard by conveyor belt. The excavation of 3516 Folsom Street would include approximately 30 truck trips and the excavation of 3526 Folsom Street would include approximately 25 truck trips. Construction of the proposed project is anticipated to occur over a 12 month period. The concrete required for each foundation slab would require four cement truck trips for each residence (eight, total) plus another four trips per residence for the concrete retaining walls for each residence (eight, total). Concrete trucks and concrete pumps would operate from Bernal Heights Boulevard, and all materials deliveries would occur from Bernal Heights Boulevard. The proposed project would connect to water, sewer, electrical, natural gas, and telecommunications connections that would be brought to the project site by the improvement of the "paper street" section of Folsom Street. The proposed project would include approximately two weeks of excavation, eight weeks of foundation work, and ten weeks for framing. The construction of the two houses would take approximately twelve months. Trucks would access the project site to and from the 101 freeway via Cesar Chavez Street, to Folsom Street and Bernal Heights Boulevard.

The improvement of the "paper street" segment of Folsom Street would be performed under a separate Street Improvement Permit issued by the Department of Public Works. This improvement would include the removal of plants and topsoil along the current right-of-way and the creation of a paved roadway and the construction of a stairway between Folsom Street and Bernal Heights Boulevard. The proposed road improvement would require 92 cubic yards of material to be removed from the project site, which would result in approximately seven haul truck trips. Concrete imported onto the project site for the road improvement would require about ten truck trips. Road work would be conducted from the intersection of Folsom Street and Chapman Street.

C. PROJECT APPROVALS

The project is located in the RH-1 (Residential House, Single-Family) residential zoning district and within the 40-X height and bulk district and within the Bernal Heights Special Use District which reflects the special characteristics and hillside topography of an area of the City that has a collection of mostly older buildings situated on lots generally smaller than the lot patterns in other low-density areas of the City. The proposed project would require the following City, State, and regional approvals. These approvals may be considered in conjunction with the required environmental review, but will not be granted until the required environmental review has been completed:

- Approval of building permits by the Department of Building Inspection (DBI);
- Street Improvement Permit from Department of Public Works for improvement of Folsom Street.

The approval of the building permits by the Department of Building Inspection constitutes the Approval Action for the proposed project, pursuant to Section 31.04(h)(3) of the San Francisco Administrative Code. The Approval Action date establishes the start of the 30-day appeal period for the California Environmental Quality Act determination pursuant to Section 31.16(d) of the San Francisco Administrative Code.

D. PROJECT SETTING

As previously noted, the project site occupies two parcels located on the west side of an unimproved section of Folsom Street in the Bernal Heights neighborhood of San Francisco. Existing uses within the same block consist of unimproved open space, two other primarily two- to three-story single-family residential homes and the Bernal Heights Community Garden. Two-to-three-story residential uses border the site to the south and west, and unimproved lots border the site to the north and east. A two-story residential building borders the site to the south. **Figure 2** illustrates the surrounding residential and open space land uses within the vicinity of the site.

No MUNI bus or light rail lines border the proposed project site. The project site is within ¼ mile of MUNI bus line 24-Divisidero and 67-Bernal Heights. The nearest BART station is 24th Street Mission, which is approximately ¾ mile from the project site. There are no bike routes within 250 feet of the project site.

E. CUMULATIVE SETTING

Past, present and reasonably foreseeable cumulative development projects within ¼-mile radius of the project site include three residential additions and renovations as well as new construction, including a new single family home at 495 Chapman Street, a vertical addition to a home at 100 Gates Street, a demolition of an existing home and construction of a new home at 49 Nevada Street, and a subdivision with new construction at 40 Bernal Heights Blvd. These cumulative projects are the subject of individual Environmental Evaluation Applications on file with the Planning Department, where applicable.[1] There are no active planning applications for any adjacent properties or for the other four lots on this unimproved section of Folsom Street.

F. COMPATIBILITY WITH ZONING AND PLANS

	Applicable	*Not Applicable*
Discuss any variances, special authorizations, or changes proposed to the Planning Code or Zoning Map, if applicable.	☐	☒
Discuss any conflicts with any adopted plans and goals of the City or Region, if applicable.	☐	☒
Discuss any approvals and/or permits from City departments other than the Planning Department or the Department of Building Inspection, or from Regional, State, or Federal Agencies.	☒	☐

San Francisco Planning Code and Zoning Maps

The San Francisco Planning Code (Planning Code) incorporates by reference the City's Zoning Maps, governs permitted uses, densities, and the configuration of buildings within San Francisco. Permits to construct new buildings (or to alter and demolish existing ones) may not be issued unless: 1) the proposed project conforms to the Planning Code; 2) allowable exceptions are granted pursuant to provisions of the Planning Code; or 3) legislative amendments to the Planning Code are included as part of the proposed project.

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[1] 100 Gates Street (Case #2016-011777ENV), 49 Nevada Street (Case #2013-0223ENV), 40 Bernal Heights Blvd (Case #2014-002982ENV).

The project site is located in the RH-1 District. As stated in Planning Code Section 209.1, the RH-1 District allows up to one dwelling unit per lot and up to one unit per 3,000 square feet of lot area with conditional use approval. Under the Bernal Heights Special Use District, buildings on lots which have a depth of 70 feet or less shall have a rear yard depth equal to 35 percent of the total depth of the lot. The proposed project would result in the development of two residential units with two buildings on two existing 1,750 square-foot lots, each with a rear yard with a depth that is 35% of the total depth of the lot. Within the RH-1 District, the proposed residential uses are principally permitted.

The project site is located within a 40-X Height and Bulk District, which permits a maximum building height of 40 feet, and the Bernal Heights Special Use District, which does not permit any dwelling unit to exceed a height of 30 feet. The proposed project buildings would be less than 30 feet in height. Bernal Heights Special Use District bulk controls reduce the size of a building's floorplates as the building increases in height. Therefore, the proposed structures would comply with existing height and bulk controls.

According to Planning Code Section 242, two off-street parking spaces are required for a dwelling unit with a usable floor area of between 1,201 square feet (-sf) and 2,250-sf, as is the case with each unit of the proposed project. Thus, the proposed four off-street parking spaces (two per building) would comply with Planning Code Section 242. Planning Code Section 155.2 requires new residential buildings to provide one secured (Class 1) bicycle parking space per each dwelling unit. As the proposed project would provide Class 1 bicycle parking spaces in each garage (for a total of four spaces), the project would comply with the Planning Code's bicycle parking requirements.

Plans and Policies

San Francisco General Plan

The San Francisco General Plan (General Plan) establishes objectives and policies to guide land use decisions related to physical development in the City. It is comprised of ten elements, each of which addresses a particular topic that applies citywide: Air Quality; Arts; Commerce and Industry; Community Facilities; Community Safety; Environmental Protection; Housing; Recreation and Open Space; Transportation; and Urban Design.

Two General Plan elements that are particularly applicable to planning considerations associated with the proposed project are the Housing and Urban Design elements. These elements are discussed in more detail below. Other elements of the General Plan that are applicable to technical aspects of the proposed project include Air Quality, Community Safety, Recreation and Open Space, and Transportation. The proposed project's potential to conflict with the individual policies contained in these more technical elements is discussed in the appropriate topical sections of this Initial Study.

Objectives of the General Plan's Urban Design Element that are applicable to the proposed project include emphasizing the characteristic pattern which gives the City and its neighborhoods an image, a sense of purpose, and a means of orientation and conserving resources which provide a sense of nature, continuity with the past, and freedom from overcrowding.

The Housing Element Update was originally adopted by the Planning Commission on March 2011 and certified by the California Department of Housing and Community Development in July 2011.[2] The key objective of the Housing Element is to promote the development of new housing in San Francisco and the retention of existing housing in a way that is protective of neighborhood identity, sustainable, and is served by adequate community infrastructure. A particular focus of the Housing Element is on the creation and retention of affordable housing, which reflects intense demand for such housing, a growing economy (which itself puts increasing pressure on the existing housing stock), and a constrained supply of land (necessitating infill development and increased density). In general, the Housing Element supports projects that increase the City's housing supply (both market-rate and affordable housing), especially in areas that are close to the City's job centers and are well-served by transit. The proposed project, which is a residential project consisting of two dwelling units, would not obviously conflict with any objectives or policies in the Housing Element.

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[2] Pursuant to a court order, the 2011 certification was set aside and a partially Revised Environmental Impact Report (Revised EIR) for the 2004 and 2009 Housing Element was later certified by the Planning Commission on April 24, 2014. No changes were made to the objectives or policies contained within the Housing Element as a result of this action.

The proposed project would not obviously or substantially conflict with any goals, policies, or objectives of the General Plan. A conflict between a proposed project and a General Plan policy does not, in itself, indicate a significant effect on the environment within the context of the California Environmental Quality Act (CEQA). Any physical environmental impacts that could result from such conflicts are analyzed in this Initial Study. In general, potential conflicts with the General Plan are considered by the decisions-makers (typically the Planning Commission) independently of the environmental review process. Thus, in addition to considering inconsistencies that affect environmental issues, the Planning Commission considers other potential inconsistencies with the General Plan independently of the environmental review process, as part of the decision to approve or disapprove a proposed project. Any potential conflict not identified in this environmental document would be considered in that context and would not alter the physical environmental effects of the proposed project that are analyzed in this Initial Study.

The Accountable Planning Initiative

In November 1986, the voters of San Francisco approved Proposition M, the Accountable Planning Initiative, which added Section 101.1 to the Planning Code to establish eight Priority Policies. These policies are: 1) preservation and enhancement of neighborhood-serving retail uses; 2) protection of neighborhood character; 3) preservation and enhancement of affordable housing; 4) discouragement of commuter automobiles; 5) protection of industrial and service land uses from commercial office development and enhancement of resident employment and business ownership; 6) maximization of earthquake preparedness; 7) landmark and historic building preservation; and 8) protection of open space. The Priority Policies, which provide general policies and objectives to guide certain land use decisions, contain certain policies that relate to physical environmental issues. Where appropriate these issues are discussed in the topical sections of this Initial Study.

Prior to issuing a permit for any project which requires an Initial Study under CEQA; prior to issuing a permit for any demolition, conversion, or change of use; and prior to taking any action which requires a finding of inconsistency with the General Plan, the City is required to find that the proposed project or legislation would be consistent with the Priority Policies. As noted above, the physical environmental effects of the project as they may relate to the Priority Policies are addressed in the analyses in this Initial Study. The information contained in this Initial Study will be referenced as appropriate in the Planning Department's comprehensive project analysis and findings regarding the consistency of the proposed project with the Priority Policies.

Other Local Plans and Policies

In addition to the *General Plan*, the *Planning Code* and Zoning Maps, and the Accountable Planning Initiative, other local plans and policies that are relevant to the proposed project are discussed below.

- The *San Francisco Sustainability Plan* is a blueprint for achieving long-term environmental sustainability by addressing specific environmental issues including, but not limited to, air quality, climate change, energy, ozone depletion, and transportation. The goal of the *San Francisco Sustainability Plan* is to enable the people of San Francisco to meet their present needs without sacrificing the ability of future generations to meet their own needs.
- The *Climate Action Plan for San Francisco: Local Actions to Reduce Greenhouse Emissions* is a local action plan that examines the causes of global climate change and the human activities that contribute to global warming, provides projections of climate change impacts on California and San Francisco based on recent scientific reports, presents estimates of San Francisco's baseline greenhouse gas emissions inventory and reduction targets, and describes recommended actions for reducing the City's greenhouse gas emissions. The 2013 Climate Action Strategy is an update to this plan.
- The *Transit First Policy* (City Charter, Section 8A.115) is a set of principles that underscore the City's commitment to prioritizing travel by transit, bicycle, and on foot over travel by private automobile. These principles are embodied in the objectives and policies of the Transportation Element of the *General Plan*. All City boards, commissions, and departments are required by law to implement Transit First principles in conducting the City's affairs.
- The *San Francisco Bicycle Plan* is a citywide bicycle transportation plan that identifies short-term, long-term, and other minor improvements to San Francisco's bicycle route network. The overall goal of the *San Francisco Bicycle Plan* is to make bicycling an integral part of daily life in San Francisco.
- The *San Francisco Better Streets Plan* consists of illustrative typologies, standards, and guidelines for the design of San Francisco's pedestrian environment, with the central focus of enhancing the livability of the City's streets.

- *Transportation Sustainability Fee Ordinance* requires that development projects that filed environmental review applications prior to July 21, 2015, but have not yet received approval, pay 50 percent of the applicable Transportation Sustainability Fee (TSF). TSF funds may be used to improve transit services and pedestrian and bicycle facilities.

The proposed project has been reviewed in the context of these local plans and policies and would not obviously or substantially conflict with them. Staff reports and approval motions prepared for the decision-makers would include a comprehensive project analysis and findings regarding the consistency of the proposed project with applicable local plans and policies.

Regional Plans and Policies

There are several regional planning agencies whose environmental, land use, and transportation plans and policies consider the growth and development of the nine-county San Francisco Bay Area. Some of these plans and policies are advisory, and some include specific goals and provisions that must be considered when evaluating a project under CEQA. The regional plans and policies that are relevant to the proposed project are discussed below.

- The principal regional planning documents and the agencies that guide planning in the nine-county Bay Area include *Plan Bay Area,* the region's first Sustainable Communities Strategy, developed in accordance with Senate Bill 375 and adopted jointly by the Association of Bay Area Governments (ABAG) and the Metropolitan Transportation Commission (MTC) on July 18, 2013. *Plan Bay Area* is a long-range land use and transportation plan that covers the period from 2010 to 2040. *Plan Bay Area* calls for concentrating housing and job growth around transit corridors, particularly within areas identified by local jurisdictions as Priority Development Areas. In addition, *Plan Bay Area* specifies strategies and investments for maintaining, managing, and improving the region's multi-modal transportation network and proposes transportation projects and programs to be implemented with reasonably anticipated revenue. *Plan Bay Area* will be updated every four years;
- *Plan Bay Area* includes the population and employment forecasts from ABAG's Projections 2013, which is an advisory policy document used to assist in the development of local and regional plans and policy documents, and MTC's 2040 *Regional Transportation Plan,* which is a policy

document that outlines transportation projects for highway, transit, rail, and related uses through 2040 for the nine Bay Area counties;

- The *Regional Housing Needs Plan* for the San Francisco Bay Area: 2014–2022 reflects projected future population growth in the Bay Area region as determined by ABAG and addresses housing needs across income levels for each jurisdiction in California. All of the Bay Area's 101 cities and nine counties are given a share of the Bay Area's total regional housing need. The Bay Area's regional housing need is allocated to each jurisdiction by the California Department of Housing and Community Development (HCD) and finalized though negotiations with ABAG;
- The Bay Area Air Quality Management District (BAAQMD)'s *2010 Clean Air Plan* updates the Bay Area 2005 Ozone Strategy, in accordance with the requirements of the California Clean Air Act (CCAA), to implement feasible measures to reduce ozone and provide a control strategy to reduce ozone, particulate matter (PM), air toxics, and greenhouse gas emissions throughout the region; and
- The San Francisco Regional Water Quality Control Board's *Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan)* is a master water quality control planning document. It designates beneficial uses and water quality objectives for waters of the state, including surface waters and groundwater, and includes implementation programs to achieve water quality objectives.

The proposed project has been reviewed against these regional plans and policies. Due to the relatively small size and infill nature of the proposed project, there would be no anticipated conflicts with regional plans. Therefore, the proposed project would not obviously or substantially conflict with regional plans or policies.

Other Related Policies

The proposed project includes work in proximity to Pacific Gas & Electric (PG&E) gas Pipeline 109, and is therefore subject to PG&E's rules and regulations regarding work near their facilities. In a letter to the San Francisco Planning Department, PG&E outlined the requirements that would apply to the proposed project.[3] These requirements include the physical presence of a PG&E inspector whenever work within 10 feet of the pipeline is performed; grading and digging standards; the placement of pipeline markers during demolition and construction; standards for construction machinery and loading near and on top of underground pipelines; and limitations on placing landscaping, structures or fencing within certain distances from the pipeline.

Subsequent to the proposed project receiving entitlements from the City of San Francisco, the proposed project would be submitted to PG&E for their review to ensure the safety and integrity of their pipeline. Compliance with PG&E's regulations, and additional requirements found necessary subsequent to project approval, would be a requirement of the proposed project.

G. SUMMARY OF ENVIRONMENTAL EFFECTS

Environmental effects are discussed with mitigation measures, where appropriate, in **Section H, Evaluation of Environmental Effects,** of this Initial Study. All mitigation measures identified are listed in **Section I, Mitigation Measures and Improvement Measures,** have been agreed to by the project sponsor, and will be incorporated into the proposed project. For items designated "Not Applicable" or "No Impact," the conclusions regarding potential significant environmental effects are based upon field observations, staff and consultant experience and expertise on similar projects, and/or standard reference materials available within the San Francisco Planning Department, such as the California Natural Diversity Database and maps published by the California Department of Fish and Wildlife, the California Division of Mines and Geology Mineral Resource Zone designations, and the California Department of Conservation's Farmland Mapping and Monitoring Program. For each checklist item, the evaluation has considered both individual and cumulative impacts of the proposed project.

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[3] John Dolcini, Pipeline Engineer-Gas Transmission, Pacific Gas and Electric Company, *Letter Re: 3516/3526 Folsom Street,* March 30, 2017

H. EVALUATION OF ENVIRONMENTAL EFFECTS

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
1. LAND USE AND LAND USE PLANNING—Would the project:					
a) Physically divide an established community?	☐	☐	☒	☐	☐
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☒	☐	☐

Impact LU-1: The proposed project would not physically divide an established community. *(Less-Than-Significant Impact)*

The division of an established community would typically involve the construction of a barrier to neighborhood access (such as a new freeway segment) or the removal of a means of access (such as a bridge or roadway). The proposed project would result in the construction of two two-story, up to 30-foot-tall buildings with a total of two dwelling units and street improvements, including a pedestrian connection between Bernal Heights Boulevard and Folsom Street. The proposed project would be incorporated into the existing street configuration. The proposed project includes the improvement of a currently unimproved "paper street" segment of Folsom Street, which would improve connectivity between Bernal Heights Park to the north and the existing residential neighborhood south of the project site. The proposed project would not construct a physical barrier to neighborhood access or remove an existing means of access, such as a bridge or roadway which would create an impediment to the passage of persons or vehicles. The existing access driveway for two existing buildings adjacent to the project site would be replaced by the proposed extension of Folsom Street. As such, the proposed project would not physically divide an established community.

The established community surrounding the project site includes primarily residential uses. The proposed project would introduce new residential uses within an existing residential area and would not alter the land use pattern of the immediate area. The proposed project would not introduce any new land uses, such as industrial uses, that would either create potential conflicts through incompatible uses or result in disruptions to the community's established land use patterns.

For these reasons, the proposed project would not physically divide an established community. This impact would be less than significant and no mitigation measures would be required.

Impact LU-2: The proposed project would not conflict with any applicable land use plans, policies or regulations of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigating an environmental effect. ***(Less-Than-Significant Impact)***

Land use impacts are also considered to be significant if the proposed project would conflict with any plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect. Environmental plans and policies are those, like the Bay Area Air Quality Management District's 2017~~0~~ Clean Air Plan, which directly address environmental issues and/or contain targets or standards that must be met in order to preserve or improve characteristics of the City's physical environment.

The General Plan contains objectives and policies that guide land use decisions, as well as some objectives and policies that relate to physical environmental issues. As identified in **Section F, Compatibility with Zoning and Plans** (page 16), the proposed project does not conflict with any existing General Plan objectives or policies. Therefore, this impact would be less than significant and no mitigation measures would be required.

Impact C-LU-1: The proposed project would not make a considerable contribution to any significant cumulative land use impacts. ***(Less-Than-Significant Impact)***

The project as proposed is for the construction of two single-family residences on two vacant lots located on the "paper street" segment of Folsom Street as well as utility extensions and street improvements that would serve the two homes and four undeveloped lots along this segment of

Folsom Street. The four adjacent lots are all under different ownership than the project lots and no Environmental Evaluation applications are on file with the Planning Department for development of those lots. Any future development proposals on the adjacent lots would require further environmental review and City approval.

Since the 3516 and 3526 Folsom Street project is the first proposed development on the "paper street" segment of Folsom Street, the project sponsor would be required to construct pedestrian and vehicular access to this segment of Folsom Street. The project sponsor has also agreed to construct utilities to service the remaining four undeveloped lots so as to avoid any need to excavate the improved section of Folsom Street in the event homes are proposed for the four remaining vacant lots in the future.

Pursuant to CEQA, cumulative impacts refer to two or more individual effects which, when considered together, are considerable or which compound or increase other physical environmental impacts. The proposed project would construct two single-family homes, improve a segment of Folsom Street, and provide utilities for the two proposed homes and four adjacent lots. While there are no Environmental Evaluation applications on file with the Planning Department for the four adjacent lots, the improvements proposed by the project would facilitate future development of those lots. Any subsequent development would be required to comply with the same regulations as the proposed project including, but not limited to, compliance with the San Francisco Building and Fire Codes, Slope Protection Act, PG&E regulations for work in proximity to their pipeline, the SFPUC's Stormwater Management Ordinance and Construction Site Runoff Ordinance, the Migratory Bird Treaty Act (MBTA) and Department of Fish and Wildlife (DFW) regulations protecting nesting birds and the Bernal Heights East Slope Design Guidelines. These regulations would ensure that development of the adjacent lots would not result in significant environmental effects.

The proposed project and cumulative projects would be consistent with the envisioned land uses for this area, and no other potential conflicts with policies adopted for the purpose of mitigating an environmental effect have been identified. Thus, the proposed project, in combination with past, present, and reasonably foreseeable future projects, would not result in a considerable cumulative land use impact.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
2. POPULATION AND HOUSING—Would the project:					
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☒	☐	☐
b) Displace substantial numbers of existing housing units or create demand for additional housing, necessitating the construction of replacement housing?	☐	☐	☒	☐	☐
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☒	☐	☐

Impact PH-1: The proposed project would not directly or indirectly induce substantial population growth in San Francisco. *(Less-Than-Significant Impact)*

In general, a project would be considered growth-inducing if its implementation would result in a substantial population increase and/or new development that might not occur if the project were not approved and implemented. The addition of the two new residential units would increase the residential population on the site by approximately five persons,[4] resulting in a direct increase in population on the project site and contributing to anticipated population growth in both the neighborhood and citywide context.

However, the addition of five residents represents an incremental increase in the population of the area and would not result in a substantial increase to the population of the larger neighborhood or

[4] The project site is located in Census Tract 252, which is generally bounded by Cesar Chavez Street to the north, Cortland Ave to the south, Nebraska and Alabama Streets to the east, and Elsie Street to the west. The population calculation is based on Census 2010 data, which estimates 2.52 people per household in Census Tract 252. It should be noted that this census tract has somewhat larger households than the citywide average of 2.26 persons per household.

citywide. The 2010 U.S. Census indicates that the population in the project vicinity (Census Tract 252) is approximately 5,369 persons.[5] The proposed project would increase the population near the project site by approximately 0.1 percent. The proposed project could indirectly induce additional population growth in the project area because the proposed improvement of the "paper street" section of Folsom Street could enable additional development of four additional houses in the currently undeveloped area. However the addition of four units, with approximately 10 residents, would not be considered substantial population growth. The project would also not generate new employment on the site which could in turn indirectly increase the demand for housing elsewhere. Therefore, the proposed project would not directly or indirectly induce substantial population growth in San Francisco. This impact would be less than significant and no mitigation measures are necessary.

Impact PH-2: The proposed project would not displace substantial numbers of existing housing units or people and would not create demand for additional housing elsewhere. ***(Less-Than-Significant Impact)***

The project site is currently undeveloped, and there are no existing housing units on the project site. Therefore, implementation of the proposed project would not displace existing housing units or residents. The proposed project would result in the development of two new residential units and would not include uses that could generate demand for additional housing citywide, such as commercial space. Therefore, this impact would be less than significant and no mitigation measures are necessary.

[5] The population estimate is based on data from the 2010 Census for Census Tract 252.

Impact C-PH-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects, would not result in a cumulative impact related to population and housing. *(Less-Than-Significant Impact)*

The proposed project includes the improvement of the "paper street" segment of Folsom Street which could induce the development of the four remaining lots adjacent to the project site.[6] Four more single-family homes could increase the area population by an additional ten residents, or a 0.2 percent increase in the population of the census tract. As described under Impact PH-1, the proposed project's individual contribution to population and employment growth would not be considerable and represents a minimal percentage of overall population increase within the neighborhood and Citywide. The population of San Francisco is projected to increase by approximately 280,490 persons for a total of 1,085,725 persons by 2040.[7] The residential population introduced as a result of the proposed project would constitute less than one percent of projected city-wide growth. Thus, this population increase would be accommodated within the planned growth for San Francisco. Furthermore, these additional residential units would provide more opportunities for housing, which is a Citywide need. Additionally, the proposed project, in combination with other past, present, and reasonably foreseeable future projects, would not result in the displacement of substantial numbers of housing units as the majority of the approved and proposed projects would include development of housing or unimproved parcels or the expansion of existing residential properties.

For these reasons, the proposed project in combination with other past, present, and reasonably foreseeable future projects would not result in a cumulatively considerable impact related to population and housing.

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6 Assumes the City of San Francisco average of 2.52 persons per household.

7 ABAG, *Plan Bay Area*, p. 40. Available online at http://files.mtc.ca.gov/pdf/Plan_Bay_Area_FINAL/Plan_Bay_Area.pdf, accessed January 25, 2017.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
3. CULTURAL RESOURCES— Would the project:					
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5, including those resources listed in Article 10 or Article 11 of the San Francisco *Planning Code*?	☐	☐	☒	☐	☐
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☒	☐	☐
c) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☒	☐	☐
d) Cause a substantial adverse change in the significance of a tribal cultural resource as defined in Public Resources Code §21074?	☐	☐	☒	☐	☐

Impact CP-1: Implementation of the proposed project would not cause a substantial adverse change in the significance of a historical resource as defined in §15064.5, including those resources listed in Article 10 or Article 11 of the San Francisco *Planning Code*. *(Less-Than-Significant Impact)*

As discussed on page 1 of **Section A, Project Site**, the project site is currently vacant, undeveloped land, and does not include any historic resources. Neither the project site nor the immediately surrounding neighborhood is within a historic district designated under federal, state or local regulations. Therefore, the proposed project would result in a Less-Than-Significant Impact on historical resources.

Impact CP-2: The proposed project would not result in a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5. *(Less-Than-Significant Impact)*

This section discusses archaeological resources, both as historical resources according to Section 15064.5 as well as unique archaeological resources as defined in Section 21083.2(g).

The potential for encountering archaeological resources is determined by several relevant factors including archaeological sensitivity criteria and models, local geology, site history, and the extent of a potential projects soils disturbance/modification, as well as any documented information on known archaeological resources in the area. A Planning Department archaeologist completed a preliminary archeological review (PAR) for the proposed project.[8] The PAR determined that there is a no potential to adversely affect archaeological resources. There are no documented or recorded archaeological sites in the immediate vicinity of the proposed project. Therefore, the proposed project construction would have a Less-Than-Significant Impact on prehistoric or historical archaeological resources.

Impact CP-3: Construction activities for the proposed project would not result in the disturbance of human remains, including those interred outside of formal cemeteries, should such remains exist beneath the project site. ***(Less-Than-Significant Impact)***

There are no known human remains, including those interred outside of formal cemeteries, located in the immediate vicinity of the site. It is considered highly unlikely that human remains would be encountered at the project site during excavation and grading for the proposed project. Therefore, this impact is considered less than significant.

Impact CP-4: Construction activities for the proposed project would not result in the disturbance of tribal resources, should such resources exist beneath the project site. ***(Less-Than-Significant Impact)***

CEQA Section 21074.2 requires the lead agency to consider the effects of a project on tribal cultural resources. As defined in Section 21074, tribal cultural resources are sites, features, places, cultural landscapes, sacred places, and objects with cultural value to a California Native American tribe that are listed, or determined to be eligible for listing, on the national, State, or local register of historical resources. Based on discussions with Native American tribal representatives, in San Francisco, prehistoric archeological resources are presumed to be potential tribal cultural resources. A tribal cultural resource is adversely affected when a project causes a substantial adverse change in the resource's significance.

[8] Randall Dean, Archeologist, San Francisco Planning Department, Preliminary Archeological Review, 3516-26 Folsom Street, September 23, 2013.

Pursuant to CEQA Section 21080.3.1(d), within 14 days of a determination that an application for a project is complete or a decision by a public agency to undertake a project, the Lead Agency is required to contact the Native American tribes that are culturally or traditionally affiliated with the geographic area in which the project is located. Notified tribes have 30 days to request consultation with the Lead Agency to discuss potential impacts on tribal cultural resources and measures for addressing those impacts. On March 29, 2017, the Planning Department contacted Native American individuals and organizations for the San Francisco area, providing a description of the project and requesting comments on the identification, presence and significance of tribal cultural resources in the project vicinity.

No Native American tribal representatives have contacted the Planning Department to request consultation as of the publication of this Initial Study. Department staff has determined that the proposed project would not be expected to affect legally-significant archeological resources, including prehistoric archeological resources. Therefore, the proposed project would have a Less-Than-Significant Impact on previously unknown tribal cultural resources.

Impact C-CP-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects in the vicinity would not result in cumulative impacts to historic architectural resources. *(Less-Than-Significant Impact)*

The proposed project would have Less-Than-Significant Impacts on historical resources, and there are no proposed projects within the vicinity of the project that would result in historical resources impacts, so the proposed project could not result in a cumulatively considerable contribution to cumulative historic resource impacts.

Impact C-CP-2: The proposed project, in combination with past, present, and reasonably foreseeable future projects in the vicinity would not result in a substantial adverse change in the significance of previously undiscovered archaeological resources, human remains, including those interred outside of formal cemeteries; and tribal resources should such resources exist on or beneath the project site. *(Less-Than-Significant Impact)*

Archeological resources and tribal cultural resources are non-renewable and finite, and all adverse effects to subsurface archeological resources and tribal cultural resources have the potential to erode a dwindling cultural/scientific resource base. Past, present, and reasonably foreseeable future development projects within San Francisco and the Bay Area region would include construction activities that could disturb archaeological resources and tribal cultural resources and could contribute to cumulative impacts related to the loss of significant historical, scientific, and cultural information about California, Bay Area, and San Francisco history and prehistory including the historic and prehistory of Native American peoples. Similar to the proposed project, development projects within San Francisco would be subject to the City's standard archeological and human remains mitigation measures, thereby reducing the potential for cumulative archeological-related and tribal-cultural-resource-related impacts.

As discussed above, the proposed project would have Less-Than-Significant Impacts on archeological resources, and therefore the proposed project could not contribute to cumulative impacts and would not be cumulatively considerable. Therefore, this impact would be less than significant with mitigation.

Topics:	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less-Than-Significant Impact*	*No Impact*	*Not Applicable*
4. TRANSPORTATION AND CIRCULATION—Would the project:					
a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?	☐	☐	☒	☐	☐
b) Conflict with an applicable congestion management program, including but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?	☐	☐	☒	☐	☐
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location, that results in substantial safety risks?	☐	☐	☐	☐	☒

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses?	☐	☐	☒	☐	☐
e) Result in inadequate emergency access?	☐	☐	☒	☐	☐
f) Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?	☐	☐	☒	☐	☐

The proposed project would not result in a change in air traffic patterns, and would therefore not cause substantial air traffic safety risks. Therefore, topic 4c is not applicable to the project.

Setting

The proposed project includes two single-family homes along the west side of a "paper street" section of Folsom Street in the Bernal Heights neighborhood. The immediate vicinity of the project site is made up of two- to-three story residential properties and is exclusively residential, save for the Bernal Heights Community Garden and Bernal Heights Park, both to the north of the project site. The project site is not adjacent to any MUNI transit lines. The project site is within ¼ mile of MUNI bus line 24-Divisidero and 67-Bernal Heights. The nearest BART station is 24th Street Mission, which is approximately ¾ mile from the project site. There are no bike routes within 250 feet of the project site. The proposed project will include the improvement of the paper street and the addition of a sidewalk and stairs to create a pedestrian connection between Bernal Heights Boulevard and Folsom Street and the immediate neighborhood to the south.

Background on Vehicle Miles Traveled (VMT) in San Francisco and Bay Area

In January 2016, OPR published for public review and comment a Revised Proposal on Updates to CEQA Guidelines on Evaluating Transportation Impacts in CEQA[9] (proposed transportation impact guidelines) recommending that transportation impacts for projects be measured using a VMT metric. VMT measures the amount and distance that a project might cause people to drive, accounting for the number of passengers within a vehicle. OPR's proposed transportation impact guidelines provides substantial evidence that VMT is an appropriate standard to use in analyzing transportation impacts to protect environmental quality and a better indicator of greenhouse gas, air quality, and energy impacts than automobile delay. Acknowledging this, San Francisco Planning Commission Resolution 19579, adopted on March 3, 2016:

- Found that automobile delay, as described solely by LOS or similar measures of vehicular capacity or traffic congestion, shall no longer be considered a significant impact on the environment pursuant to CEQA, because it does not measure environmental impacts and therefore it does not protect environmental quality.
- Directed the Environmental Review Officer to remove automobile delay as a factor in determining significant impacts pursuant to CEQA for all guidelines, criteria, and list of exemptions, and to update the Transportation Impact Analysis Guidelines for Environmental Review and Categorical Exemptions from CEQA to reflect this change.
- Directed the Environmental Planning Division and Environmental Review Officer to replace automobile delay with VMT criteria which promote the reduction of greenhouse gas emissions, the development of multimodal transportation networks, and a diversity of land uses; and consistent with proposed and forthcoming changes to CEQA Guidelines by OPR.

Planning Commission Resolution 19579 became effective immediately for all projects that have not received a CEQA determination and all projects that have previously received CEQA determinations, but require additional environmental analysis.

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9 This document is available online at: https://www.opr.ca.gov/s_sb743.php.

Many factors affect travel behavior. These factors include density, diversity of land uses, design of the transportation network, access to regional destinations, distance to high-quality transit, development scale, demographics, and transportation demand management. Typically, low-density development at great distance from other land uses, located in areas with poor access to non-private vehicular modes of travel, generate more automobile travel compared to development located in urban areas, where a higher density, mix of land uses, and travel options other than private vehicles are available.

Given these travel behavior factors, San Francisco has a lower vehicle miles traveled (VMT) ratio than the nine-county San Francisco Bay Area region. In addition, some areas of the City have lower VMT ratios than other areas of the City. These areas of the City can be expressed geographically through transportation analysis zones (TAZs). TAZs are used in transportation planning models for transportation analysis and other planning purposes. The zones vary in size from single city blocks in the downtown core, multiple blocks in outer neighborhoods, to even larger zones in historically industrial areas like the Hunters Point Shipyard.

The San Francisco County Transportation Authority (Transportation Authority) uses the San Francisco Chained Activity Model Process (SF-CHAMP) to estimate VMT by private automobiles and taxis for different land use types. Travel behavior in SF-CHAMP is calibrated based on observed behavior from the California Household Travel Survey 2010-2012, Census data regarding automobile ownership rates and county-to-county worker flows, and observed vehicle counts and transit boardings. SF-CHAMP uses a synthetic population, which is a set of individual actors that represents the Bay Area's actual population, who make simulated travel decisions for a complete day. The Transportation Authority uses tour-based analysis for office and residential uses, which examines the entire chain of trips over the course of a day, not just trips to and from the project. For retail uses, the Transportation Authority uses trip-based analysis, which counts VMT from individual trips to and from the project (as opposed to an entire chain of trips). A trip-based approach, as opposed to a tour-based approach, is necessary for retail projects because a tour is likely to consist of trips stopping in multiple locations, and the summarizing of tour VMT to each location would over-estimate VMT.[10,11]

Impact TR-1: The proposed project would not conflict with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit. ***(Less-Than-Significant Impact)***

VMT Analysis

Land use projects may cause substantial additional VMT. The following identifies thresholds of significance and screening criteria used to determine if a residential land use project would result in significant impacts under the VMT metric. For residential projects, a project would generate substantial additional VMT if it exceeds the regional household VMT per capita minus 15 percent.[12] As documented in the *Revised Proposal on Updates to the CEQA Guidelines on Evaluating Transportation Impacts in CEQA* ("proposed transportation impact guidelines"), a 15 percent threshold below existing development is "both reasonably ambitious and generally achievable."[13] OPR's proposed transportation impact guidelines provides screening criteria to identify types, characteristics, or locations of land use projects that would not exceed these VMT thresholds of significance. OPR recommends that if a project or land use proposed as part of the project meets any

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[10] To state another way: a tour-based assessment of VMT at a retail site would consider the VMT for all trips in the tour, for any tour with a stop at the retail site. If a single tour stops at two retail locations, for example, a coffee shop on the way to work and a restaurant on the way back home, then both retail locations would be allotted the total tour VMT. A trip-based approach allows us to apportion all retail-related VMT to retail sites without double-counting.

[11] San Francisco Planning Department, Executive Summary: Resolution Modifying Transportation Impact Analysis, Appendix F, Attachment A, March 3, 2016.

[12] OPR's proposed transportation impact guidelines state a project would cause substantial additional VMT if it exceeds both the existing City household VMT per capita minus 15 percent and existing regional household VMT per capita minus 15 percent. In San Francisco, the City's average VMT per capita is lower (8.4) than the regional average (17.2). Therefore, the City average is irrelevant for the purposes of the analysis.

[13] Governor's Office of Planning and Research, *Revised Proposal on Updates to CEQA Guidelines on Evaluating Transportation Impacts in CEQA,* January 20, 2016, p. III:20. This document is available online at: https://www.opr.ca.gov/s_sb743.php.

of the below screening criteria, then VMT impacts are presumed to be less than significant for that land use and a detailed VMT analysis is not required. These screening criteria and how they are applied in San Francisco are described below:

- Map-Based Screening for Residential, Office, and Retail Projects. OPR recommends mapping areas that exhibit where VMT is less than the applicable threshold for that land use. Accordingly, the Transportation Authority has developed maps depicting existing VMT levels in San Francisco for residential, office, and retail land uses based on the SF-CHAMP 2012 base-year model run. The Planning Department uses these maps and associated data to determine whether a proposed project is located in an area of the City that is below the VMT threshold.
- Small Projects – OPR recommends that lead agencies may generally assume that a project would not have significant VMT impacts if the project would either: (1) generate fewer trips than the level required for studying consistency with the applicable congestion management program or (2) where the applicable congestion management program does not provide such a level, fewer than 100 vehicle trips per day. The Transportation Authority's 2015 San Francisco Congestion Management Program does not include a trip threshold for studying consistency. Therefore, the Planning Department uses the 100 vehicle trip per day screening criterion as a level generally where projects would not generate a substantial increase in VMT.
- Proximity to Transit Stations. OPR recommends that residential, retail, and office projects, as well projects that are a mix of these uses, proposed within ½ mile of an existing major transit stop (as defined by CEQA Section 21064.3) or an existing stop along a high quality transit corridor (as defined by CEQA Section 21155) would not result in a substantial increase in VMT. However, this presumption would not apply if the project would: (1) have a floor area ratio[14] of less than 0.75; (2) include more parking for use by residents, customers, or employees of the project than required or allowed, without a conditional use; or (3) is inconsistent with the applicable Sustainable Communities Strategy.[15]

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[14] Floor area ratio means the ratio of gross building area of the development, excluding structured parking areas, proposed for the project divided by the net lot area.

[15] A project is considered to be inconsistent with the Sustainable Communities Strategy if development is located outside of areas contemplated for development in the Sustainable Communities Strategy.

The existing average daily VMT per capita for the transportation analysis zone the project site is located in, TAZ 432, is below the existing regional average daily VMT. For residential uses in TAZ 432, the average daily VMT per capita is 10.2, which is about 41 percent below the existing regional average daily VMT per capita of 17.2.

Thus, as described above, the project site is located within an area of the City where the existing VMT is more than 15 percent below the regional VMT, and the proposed project land uses would not generate substantial additional VMT.[16]

Trip Generation

The proposed project would result in the construction of two new single-family residences. Trip generation rates from the Institute of Transportation Engineer's (ITE) Trip Generation Manual, 9th Edition, were used to estimate the daily and peak-hour trip generation for the proposed project. Table 1 below summarizes the trip generation for the proposed project.

Table 1: Project Trip Generation

Land Use	Units	Daily Person Trips	PM Peak Hour
Residential—Single Family	2	20	2

Notes: Rates per ITE *Trip Generation Manual, 9th Edition;* Land Use Code (230) Residential Condominium/Townhouse

Source: San Francisco Planning Department, Trip Generation Table for 3516-3526 Folsom Street, 2017.

[16] The Map-Based Screening for Residential, Office, and Retail Projects was applied to the proposed project. The project site is located within TAZ 432, which is within an area of the City where the existing VMT is more than 15 percent below the regional VMT thresholds, as documented in Executive Summary Resolution Modifying Transportation Impact Analysis, Attachment F (Methodologies, Significance Criteria. Thresholds of Significance, and Screening Criteria for Vehicle Miles Traveled and Induced Automobile Travel Impacts), Appendix A (SFCTA Memo), March 3, 2016. Available online at http://commissions.sfplanning.org/cpcpackets/Align-CPC%20exec%20summary_20160303_Final.pdf. Accessed March 21, 2016.

As shown in Table 1 above, the proposed project is expected to generate approximately 20 daily vehicle trips, with 2 trips occurring during the PM peak hour.

Construction

Construction of the proposed project would be expected to take approximately 12 months. During this period, temporary and intermittent transportation impacts would result from truck movements to and from the project site during excavation and construction activities associated with the proposed buildings. Construction activities would generate construction worker trips to and from the project site and a temporary demand for parking and public transit. However, the additional trips would not exceed the capacity of local or regional transit service. Due to the temporary nature of the construction activities, the construction related impacts on transportation and circulation would be less than significant.

Due to the limited addition of project-related traffic (2 PM peak hour trips), the proposed project is not anticipated to result in a conflict with any established plans or policies. In addition, as discussed above, the proposed project would meet the VMT Map screening criteria. Implementation of the proposed project would result in Less Than Significant construction-related transportation impacts. Therefore, the proposed project would not conflict with any plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system or congestion management program. This impact would be less than significant and no mitigation measures would be required.

Impact TR-2: The proposed project would not result in substantially increased hazards due to particular design features (e.g., sharp curves or dangerous intersections) or incompatible uses. ***(Less-Than-Significant Impact)***

The proposed project would include the construction of two two-story buildings with a total of two residential units, which is considered a compatible use with the surrounding area. Access to the project site would be provided by the improvement of a "paper street" section of Folsom Street. The proposed project would not result in roadway design changes that would include sharp curves or other roadway design elements that would create dangerous conditions, and the improved street section would not be a through street; that is, the improved section would not be used by the general public but would typically be limited to the residents of the proposed project. The improved section would not include any on-street parking facilities. The proposed design of the street must be reviewed and approved by San Francisco Public Works (Public Works) and found consistent with the City's Subdivision Regulations. The proposed project would result in a Less-Than-Significant Impact related to hazards associated with a design feature and no mitigation is required.

Impact TR-3: The proposed project would not result in inadequate emergency access. ***(Less-Than-Significant Impact)***

Emergency access to the project site would remain mostly unchanged from existing conditions. The Project Sponsor has consulted the San Francisco Fire Department (SFFD) regarding emergency access.[17] While the width and grade of the proposed street improvement preclude SFFD apparatus from traversing the proposed street, the proposed project conforms to Fire Code Section 503.1.1, which requires all portions of the exterior walls of the first story of any constructed building to be within 150 feet of an approved fire apparatus access road. Both Folsom Street and Bernal Heights Boulevard are accessible to SFFD apparatus and are within 150 feet of all portions of the exterior walls of the first floor of both proposed homes. Furthermore, Fire Code Section 503.1.1 allows a Fire Code Official to offer an exception to the 150 foot requirement if subject buildings are equipped with an approved automatic sprinkler system. While the Project Sponsor is not requesting an exception to Fire Code Section 503.1.1, the proposed homes would include automatic sprinkler systems. As the proposed houses are within 150 feet of approved fire access roads and include automatic sprinkler systems, the proposed project conforms with the Fire Code. Therefore, the proposed project would not result in inadequate emergency access and the impacts would be less than significant.

[17] Sponsor meeting with SFFD Assistant Fire Marshall Rich Hill, April 29, 2016.

Impact TR-4: The proposed project would not conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities, or cause a substantial increase in transit demand which cannot be accommodated by existing or proposed transit capacity or alternative travel modes. *(Less-Than-Significant Impact)*

Implementation of the proposed project would add two residential units to the project site, increasing the residential population on the site by approximately five persons.[18] The proposed project would not substantially increase the population in the project vicinity and would result in a minimal number of transit trips, pedestrian, and bicycle trips. The proposed project would include street improvements which would increase pedestrian access and pedestrian network connectivity between Bernal Heights Boulevard and the improved section of Folsom Street and the neighborhood to the south. Thus, the proposed project would not substantially effect the utilization of local and regional transit service, pedestrian facilities, or bicycle facilities. Therefore the proposed project would not result in changes to the City's transportation and circulation system that could conflict with adopted policies, plans, or programs regarding transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities, or cause a substantial increase in transit demand which cannot be accommodated by existing or proposed transit capacity or alternative travel modes. Therefore, this impact would be less than significant and no mitigation measures would be required.

Impact C-TR-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects, would not result in substantial cumulative transportation impacts. *(Less-Than-Significant Impact)*

VMT, by its very nature, is largely a cumulative impact. The VMT associated with past, present, and future projects contributes to physical secondary environmental impacts. It is likely that no single project by itself would be sufficient in size to prevent the region or state from meeting its VMT reduction goals. Instead, a project's individual VMT contributes to cumulative VMT impacts. The

[18] The population estimate is based on Census 2010 data, which estimates 2.52 per household in Census Tract 252.

VMT and induced automobile travel project-level thresholds are based on levels at which new projects are not anticipated to conflict with state and regional long-term greenhouse gas emission reduction targets and statewide VMT per capita reduction targets set in 2020. For residential uses in TAZ 432, the average daily VMT per capita in 2040 is estimated to be 8.9, which is about 45 percent below the estimated 2040 regional average daily VMT per capita of 16.1. Therefore, because the estimated average daily VMT for TAZ 432 would be more than 15 percent below the estimated regional average daily VMT, the proposed project would not be considered to result in a cumulatively considerable contribution to VMT impacts.

Based on the foregoing, in combination with past, present, and reasonably foreseeable future projects, the proposed project would not contribute considerably to any substantial cumulative increase in VMT, impacts to the effectiveness of the circulation system, impacts related to design features or incompatible uses, inadequate emergency access, or conflicts with alternative modes of transportation. Therefore, this impact would be less than significant and no mitigation measures would be required.

Topics:	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less-Than-Significant Impact*	*No Impact*	*Not Applicable*
5. NOISE— Would the project:					
a) Result in exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☒	☐	☐
b) Result in exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☒	☐	☐	☐
c) Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐	☐
d) Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐	☐

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
e) For a project located within an airport land use plan area, or, where such a plan has not been adopted, in an area within two miles of a public airport or public use airport, would the project expose people residing or working in the area to excessive noise levels?	☐	☐	☐	☐	☒
f) For a project located in the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☐	☒
g) Be substantially affected by existing noise levels?	☐	☐	☐	☐	☒

The project site is not within an airport land use plan area or in the vicinity of a private airstrip. Therefore, topics 5e and 5f are not applicable and will not be further discussed.

Fundamentals of Environmental Noise and Groundborne Vibration

A project will normally have a significant effect on the environment related to noise if it would substantially increase the ambient noise levels for adjoining areas or conflict with the adopted environmental plans and policies of the community in which it is located. Noise impacts can be described in three categories. The first is audible impacts that increase noise levels noticeable to humans. Audible increases in noise levels generally refer to a change of 3.0 decibels (dB) or greater since this level has been found to be barely perceptible in exterior environments. The second category, potentially audible, is the change in the noise level between 1.0 and 3.0 dB. This range of noise levels has been found to be noticeable only in laboratory environments. The last category is changes in noise level of less than 1.0 dB, which are inaudible to the human ear. Only audible changes in existing ambient or background noise levels are considered when analyzing the effects of project-generated noise.

Operational Noise and Vibration

The primary existing noise sources contributing to ambient noise in the project area are traffic associated with Bernal Heights Boulevard and surrounding residential streets and other noise from motor vehicles, the interaction between the tires and the road, and vehicle exhaust systems. Existing ambient noise levels at the project site range from 55 to 60 dBA.[19] Residential land uses are not considered sources of vibration and observation indicates that there are no major sources of vibrations at the project site.

Construction Noise and Vibration

The operation of heavy construction equipment, particularly pile-driving equipment and other impact devices (e.g., pavement breakers), creates seismic waves that radiate along the surface of the ground and downward. These surface waves can be felt as ground vibration. Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Several different methods are used to quantify vibration. The most frequently used method to describe vibration impacts is peak particle velocity (PPV). PPV is defined as the maximum instantaneous peak of the vibration signal in inches per second (in/sec).[20]

Typically, groundborne vibration generated by man-made activities attenuates rapidly with distance from the source of the vibration. This attenuation is a complex function of how energy is imparted into the ground as well as the soil or rock conditions through which the vibration is traveling. Variations in geology can result in different vibration levels, with denser soils generally resulting in more rapid attenuation over a given distance. The effects of groundborne vibration on buildings include movement of building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. The rumbling sound caused by the vibration of room surfaces is called groundborne noise, which can occur as a result of the low-frequency components from a specific steady source of vibration, such as a rail line. Receptors sensitive to vibration include structures (especially older masonry structures), people (especially residents, the elderly, and sick), and

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[19] City and County of San Francisco, *General Plan, Environmental Protection Element, Map 1 (Background Noise Levels, 2009)*, 2009. This document is available for review at: http://generalplan.sfplanning.org/images/I6.environmental/ENV_Map1_Background_Noise%20Levels.pdf.

[20] Federal Transit Administration (FTA), *Transit Noise and Vibration Impact Assessment*, May 2006, pp. 8-1 to 8-3, Table 8-1. Available online at https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf. Accessed February 7, 2017.

vibration-sensitive equipment. Fragile buildings and underground facilities, in particular those that are considered historic, are included because groundborne vibration can result in structural damage. In extreme cases, high levels of vibration can damage fragile buildings or interfere with sensitive equipment. With the exception of long-term occupational exposure, vibration levels rarely affect human health. Instead, most people consider vibration to be an annoyance that can affect concentration or disturb sleep. People may tolerate infrequent, short duration vibration levels, but human annoyance to vibration becomes more pronounced if the vibration is continuous or occurs frequently. A vibration level that causes annoyance will be well below the damage threshold for normal buildings. Annoyance generally occurs in reaction to newly introduced sources of noise that interrupt ongoing activities. Community annoyance is a summary measure of the general adverse reaction of people to noise that causes speech interference, sleep disturbance, or interference with the desire for a tranquil environment.[21] People react to the duration of noise events, judging longer events to be more annoying than shorter ones, and transportation noise is usually a primary cause of community dissatisfaction. Construction noise or vibration also often generates complaints, especially during lengthy periods of heavy construction, when nighttime construction is undertaken to avoid disrupting workday activity, or when the adjacent community has no clear understanding of the extent or duration of the construction.[22]

The City does not have regulations that define acceptable levels of vibration. Therefore, this document references a Federal Transit Administration (FTA) publication concerning noise and vibration impact assessment from transit activities[23] and other relevant sources.

Noise Compatibility

San Francisco addresses noise in the General Plan's Environmental Protection Element.[24] This element includes a Transportation Noise section that provides general guidance for reducing

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[21] Ibid, pp. 2-13 to 2-17

[22] Ibid. p. 12-1.

[23] Ibid.

[24] City and County of San Francisco, *City of San Francisco General Plan*, December 2, 2004. This document is available for review at www.sf-planning.org/ftp/general_plan/index.htm.

transportation noise through "sound land use planning and transportation planning." It also states: "in a fully developed city, such as San Francisco, where land use and circulation patterns are by and large fixed, the ability to reduce the noise impact through a proper relationship of land use and transportation facility location is limited."[25]

The General Plan focuses on the effect of noise on the community due to ground transportation noise sources and establishes the "Land Use Compatibility Chart for Community Noise" for determining when noise reduction requirements for new development should be analyzed, such as providing sound insulation for affected properties. The land use compatibility standards for community noise determine the maximum acceptable noise environment for each newly developed land use, and are shown in Table 2. Although Table 2 presents a range of noise levels that are considered compatible or incompatible with various land uses, the maximum "satisfactory" noise level is 60 dBA L_{dn} for residential and hotel uses; 65 dBA L_{dn} for schools, classrooms, libraries, churches and hospitals; 70 dBA L_{dn} for playgrounds, parks, offices, retail commercial uses, and noise-sensitive manufacturing/ communication uses; and 77 dBA L_{dn} for other commercial uses such as wholesale, certain retail, industrial/manufacturing, transportation, communications, and utilities uses. If these uses are proposed to be located in areas with noise levels that exceed these guidelines, a detailed analysis of noise reduction requirements will typically be necessary prior to final building review and approval.

Overall, the General Plan recognizes that transportation noise remains a problem and provides guidance to manage incompatible transportation noise levels through various transportation noise-related policies. The City's background noise levels map identifies the project site to be exposed to traffic noise levels between 50 and 60 dBA L_{dn}.[26] According to the City's General Plan, new development should incorporate noise insulation features if the noise levels exceed the sound level guidelines shown in the land use compatibility chart.

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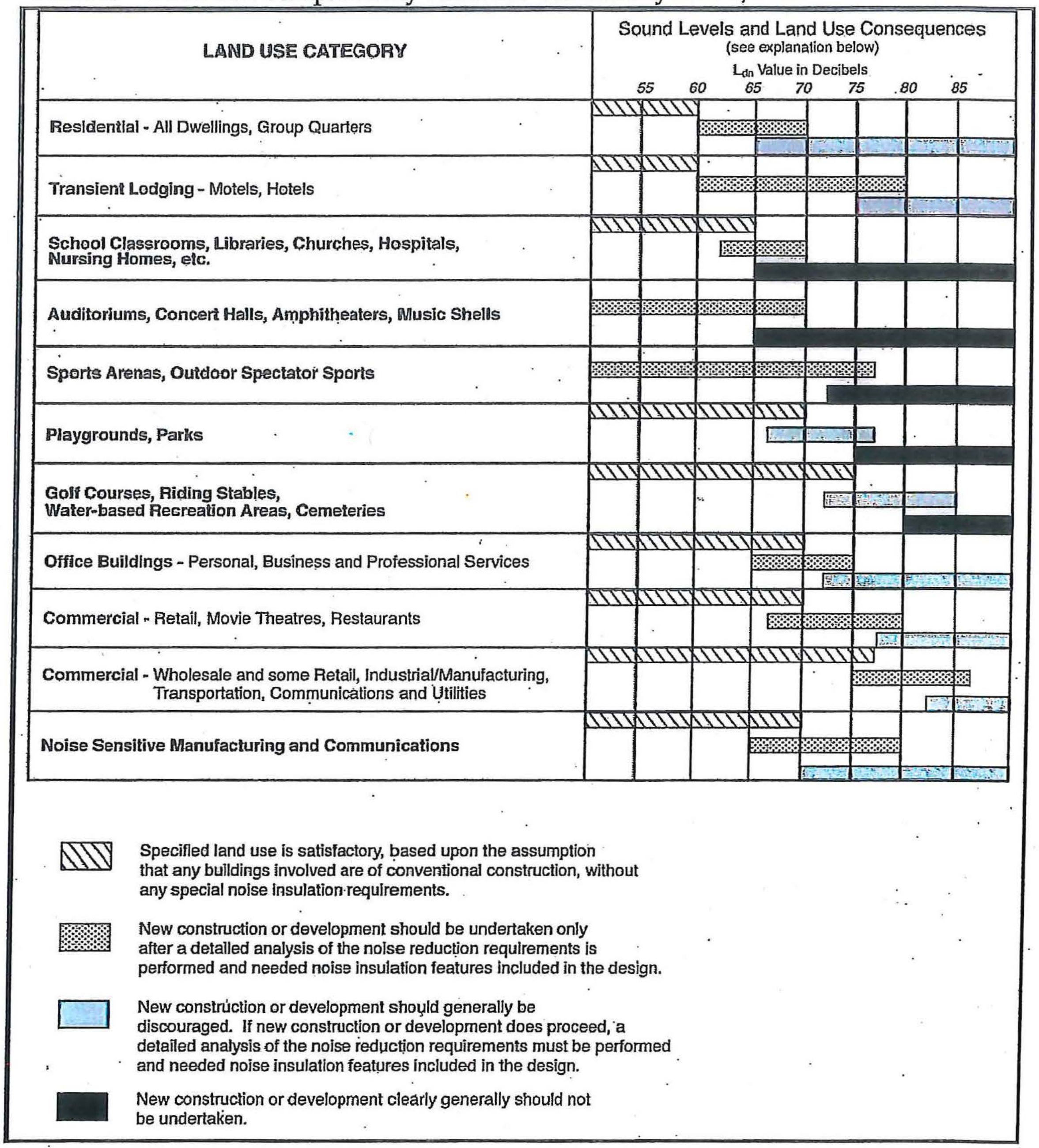
[25] Ibid.

[26] City and County of San Francisco, *General Plan, Environmental Protection Element, Map 1 (Background Noise Levels, 2009)*, 2009. This document is available for review at: http://generalplan.sfplanning.org/images/I6.environmental/ENV_Map1_Background_Noise%20Levels.pdf.

Table 2: Land Use Compatibility Chart for Community Noise, dBA



Source: City and County of San Francisco, *City of San Francisco General Plan*, December 2, 2004. This document is available for review at: www.sf-planning.org/ftp/general_plan/index.htm.

Noise Regulations

The San Francisco Noise Ordinance (Noise Ordinance) regulates both construction noise and stationary-source noise within the City, including noise from transportation, construction, mechanical equipment, entertainment, and human or animal behavior. Found in Article 29, "Regulation of Noise," of the San Francisco Police Code, the Noise Ordinance addresses noise from construction equipment, nighttime construction work, and noise from stationary mechanical equipment and waste processing activities.[27] The following regulations are applicable to the proposed project.

Section 2907, Construction Equipment, and Section 2908, Construction Work at Night

Section 2907(a) requires that construction work be conducted in the following manner: (1) noise levels of construction equipment, other than impact tools, must not exceed 80 dBA at a distance of 100 feet from the source (the equipment generating the noise); (2) impact tools must have intake and exhaust mufflers that are approved by the Director of San Francisco Public Works or the Director of the DBI to best accomplish maximum noise reduction; and (3) if the noise from the construction work would exceed the ambient noise levels at the site property line by 5 dBA, the work must not be conducted between 8:00 p.m. and 7:00 a.m. unless the Director of Public Works authorizes a special permit for conducting the work during that period.

Section 2909, Noise Limits

This section of the Noise Ordinance regulates noise from mechanical equipment and other similar sources. This includes all equipment, such as electrical equipment (transformers, emergency generators) as well as mechanical equipment that is installed on commercial/industrial and residential properties. Mechanical equipment operating on residential property must not produce a noise level more than 5 dBA above the ambient noise level at the property boundary. Section 2909 also states in subsection (d) that no fixed (permanent) noise source (as defined by the Noise Ordinance) may cause the noise level inside any sleeping or living room in a dwelling unit on

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[27] City and County of San Francisco, *Article 29 of the San Francisco Police Code, Regulation of Noise,* 2012. This document is available for review at: www.amlegal.com/nxt/gateway.dll/California/police/article29regulation ofnoise?f=templates$fn=default.htm$3.0$vid=amlegal:sanfrancisco_ca. Accessed April 17, 2017.

residential property to exceed 45 dBA between 10:00 p.m. and 7:00 a.m. or 55 dBA between 7:00 a.m. and 10:00 p.m. when windows are open, except where building ventilation is achieved through mechanical systems that allow windows to remain closed.

Existing Sensitive Receptors

Certain land uses are considered more sensitive to noise than others. Examples of these include residential areas, educational facilities, hospitals, childcare facilities, and senior housing. The project site occupies parcels located on the west side of an unimproved section of Folsom Street. Existing uses within the same block consist primarily of two- to three-story medium-density residential uses.

Impact NO-1: The proposed project would not result in exposure of persons to, or generation of, noise levels in excess of standards established in San Francisco's Noise Ordinance, nor would the proposed project result in a substantial permanent increase in ambient noise levels above levels existing without the project. *(Less-Than-Significant Impact)*

For the purpose of this analysis, operation of the proposed project would result in a significant noise impact if:

1. Implementation of the proposed project would increase ambient noise levels from traffic-generated sources by greater than 3 (dBA)[28] *and* the resulting noise level is greater than the "satisfactory" standards for adjacent land uses cited in Table 2. Land Use Compatibility Chart, below, or
2. Where the existing or existing plus project noise levels are within "satisfactory" standards for adjacent land uses (again, according to Table 2) if implementation of the proposed project would result in project-related traffic noise increases above ambient noise levels by more than 5 dBA.

[28] A-weighted decibels, abbreviated dBA, are an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted system, the decibel values of sounds at low frequencies are reduced, compared with unweighted decibels, in which no correction is made for audio frequency.

Additionally, the proposed project would result in a significant operational noise impact if noise from the project exceeds the standards in Section 2909 (a) and (d) of the San Francisco Noise Ordinance (Noise Ordinance), discussed above.

As discussed above in **Section H.4, Transportation and Circulation,** the increase in traffic associated with the proposed project would be minimal. An estimated two PM peak-hour vehicle trips would be generated by the project. As such, project-related increases in traffic noise levels are also anticipated to be minimal along Folsom Street and would not be perceptible by the human ear. Therefore, project-related traffic noise on off-site land uses would be less than significant, and no mitigation would be required.

In addition to generating imperceptible traffic-related noise, the proposed project is also anticipated to result in less than significant noise levels associated with operation of mechanical systems. The proposed project would include two residential units, which are not typically associated with high levels of operational noise. In addition, the proposed project's mechanical equipment would be required to comply with the San Francisco Noise Ordinance restricting equipment operating on residential property from generating noise greater than 5 dBA above the ambient noise level at the property boundary and ensuring that the mechanical equipment does not exceed 55 dBA during daytime hours, and 45 dBA during nighttime hours inside nearby residential uses. Therefore, project-related operational noise impacts would be less than significant, and no mitigation would be required.

Impact NO-2: Project demolition and construction would result in a temporary and periodic increase in ambient noise levels in the project vicinity above existing conditions. ***(Less-Than-Significant Impact)***

In terms of construction impacts, construction activities are temporary and intermittent. Therefore, for purposes of this analysis, the proposed project would result in significant construction-related impacts if the proposed project's construction noise levels would result in a substantial temporary or periodic increase in ambient noise levels. Construction noise is evaluated for its potential to exceed the requirements in Section 2907, Construction Equipment, and Section 2908, Construction Work at

Night of the Noise Ordinance, and considering other qualitative factors such as duration and frequency of noise events in excess of Noise Ordinance standards.

Short-term noise impacts would occur during demolition, grading and site preparation activities. Construction-related short-term noise levels would be higher than existing ambient noise levels currently in the project area but would cease once construction of the project is completed.

The proposed project would require construction for approximately 12 months. Two types of short-term noise impacts could occur during construction of the proposed project. The first type involves construction crew commutes and the transport of construction equipment and materials to the project site, which would incrementally increase noise levels on roads leading to the site. The excavation of 3516 Folsom Street would include approximately 30 truck trips and the excavation of 3526 Folsom Street would include approximately 25 truck trips. Construction of the proposed project is anticipated to occur over a 12 month period. The concrete required for each foundation slab would require four cement truck trips for each residence (eight, total) plus another four trips per residence for the concrete retaining walls (eight, total). Trucks would access the project site to and from the 101 freeway via Cesar Chavez Street, to Folsom Street and Bernal Heights Boulevard. The improvement of the "paper street" segment of Folsom Street would be performed under a separate Street Improvement Permit issued by the Department of Public Works and the proposed road improvement would require 92 cubic yards of material to be removed from the project site, which would result in approximately seven haul truck trips. Concrete imported onto the project site would require about ten truck trips., Road work would be conducted from the intersection of Folsom Street and Chapman Street.

The second type of short-term noise impact is related to noise generated during excavation, grading, and construction on the project sites. Construction is performed in discrete steps, or phases, each with its own mix of equipment and, consequently, its own noise characteristics. These various sequential phases would change the character of the noise generated on site. Therefore, the noise levels vary as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction-related noise ranges to be categorized by work phase.

Table 3, below, lists maximum noise levels recommended for noise impact assessments for typical construction equipment, based on a distance of 50 feet between the equipment and a noise receptor. The Noise Ordinance limits construction equipment to 80 dBA at 100 feet. Noise attenuates by approximately 6 dBA to 7.5 dBA per doubling of distance.[29] Therefore, noise levels in Table 3 were adjusted by 6 dBA to generate noise levels of typical construction equipment at 100 feet. As shown in Table 3, there would be a relatively high single-event noise exposure potential at a maximum level of 82 dBA for haul trucks passing at 100 feet. Haul trucks would access the project site to and from the 101 freeway via Cesar Chavez Street, to Folsom Street and Bernal Heights Boulevard. The location nearest the project site on Bernal Heights Boulevard (where Bernal Heights Boulevard meets the Folsom Street right of way, near the Bernal Heights Community Garden) is approximately 115 feet away, and downhill, from the nearest sensitive receptor, with other nearby receptors located 125 feet, 140 feet, and 145 feet away and downhill from Bernal Heights Boulevard.

Typical maximum noise levels for construction equipment range from 76 to 80 dBA at 100 feet. The site preparation phase, including excavation and grading of the site, tends to generate the highest noise levels because earthmoving machinery is the noisiest construction equipment. Earthmoving equipment includes excavating machinery such as backfillers, bulldozers, draglines, and front loaders. Earthmoving and compacting equipment includes compactors, scrapers, and graders. Typical operating cycles for these types of construction equipment may involve 1 or 2 minutes of full-power operation followed by 3 or 4 minutes at lower power settings.

[29] The 1.5-dBA variation in attenuation rate (6 dBA vs. 7.5 dBA) can result from ground-absorption effects, which occur as sound travels over soft surfaces such as soft earth or vegetation (7.5 dBA attenuation rate) versus hard ground such as pavement or very hard-packed earth (6 dBA rate) (U.S. Housing and Urban Development, The Noise Guidebook, 1985, p. 24. Available online at https://www.hudexchange.info/onecpd/assets/File/Noise-Guidebook-Chapter-4.pdf. Accessed April 24, 2017.

Table 3: Project Construction Equipment Maximum Noise Levels, L_{max}			
Type of Equipment	Range of Maximum Sound Levels (dBA at 50 feet)	Suggested Maximum Sound Levels for Analysis (dBA at 50 feet)	Maximum Sound Levels (dBA) at 100 feet
Jackhammers	75 to 85	82	76
Pneumatic Tools	78 to 88	85	79
Haul Trucks	83 to 94	88	82
Hydraulic Backhoe	81 to 90	86	80
Hydraulic Excavators	81 to 90	86	80
Air Compressors	76 to 89	86	80
Trucks	81 to 87	86	80
Source: Bolt, Beranek & Newman, 1987. *Noise Control for Buildings and Manufacturing Plants.*			

Sensitive receptors are located immediately adjacent to the proposed project at 55 Gates Street, 61 Gates Street, 65 Gates Street, and 3574 Folsom Street. During the construction period for the proposed project of approximately twelve months, occupants of the nearby properties could be disturbed by construction noise. Times may occur when noise could interfere with indoor activities in nearby residences and other businesses near the project site.

As shown in Table 3, above, construction equipment would comply with the limits in the Noise Ordinance and would not exceed 80 dBA at 100 feet, with the exception of haul trucks. In the case of haul trucks, the noise impact would be less than significant, as the analysis above is based on the maximum value in the range of maximum sound level and estimated noise presented in Table 3 is at a distance 15 feet closer to the nearest actual sensitive receptor to the proposed project. Additionally, the Federal Highway Administration, in a more recent publication than that used above, estimates dump trucks to generate noise at a level closer to 70 dBA at 100 feet, a noise level 24 dBA less than the estimate utilized in the above analysis.[30] Therefore, haul trucks used during construction of the project are anticipated to meet the noise levels in the Noise Ordinance. The increase in noise in the project area during project construction would not be considered a significant impact of the proposed

[30] US Department of Transportation, Federal Highway Administration, *Construction Noise Handbook,* Table 9.1, July 2011.

project because the construction noise would be temporary, intermittent, and restricted in occurrence and level, as the contractor would be required to comply with the Noise Ordinance. Therefore, given the above, construction noise would be less than significant.

Impact NO-3: The proposed project could result in exposure of persons to, or generation of, excessive groundborne vibration or groundborne noise levels. *(Less-Than-Significant Impact with Mitigation Incorporated)*

Project operation associated with residential uses would not generate substantial groundborne noise and vibration. Construction of the proposed project would involve site preparation and other construction activities. It would include the use of construction equipment that could result in groundborne vibration affecting properties adjacent to the project site or to PG&E Pipeline 109. No pile driving, blasting, or substantial levels of excavation or grading activities are proposed.

Given the proposed project's proximity to PG&E Pipeline 109, a construction vibration analysis was performed for the proposed project to assess any potential adverse impact on the Pipeline from vibration due to construction-related equipment and work.[31] The report evaluated vibratory impacts related to excavation of the site for the purpose of developing a proper foundation for the buildings, digging trenches for utilities to the residences, and the extension of Folsom Street for access to the residences.

The analysis assumed work on the proposed project would include:

- For the foundations, the excavation and the installation of a 12-inch to 18-inch thick concrete slab, with a potential of drilling holes for piers. If needed, compaction of the site would be done by hand, and there is potential of hand operated jack hammering being required. .
- For the utility trenches, excavation would be done at distances no closer than 5 feet from Pipeline 109. For the street extension, top soil up to as much as 12 inches will be removed, and a cement concrete road surface with a thickness of 8 to 10 inches would be installed.

[31] Illingworth and Rodkin, Inc., *Construction Vibration Evaluation for 3516 and 3526 Folsom Street,* March 24, 2017.

- For both the foundations and the street extension, the soils from the sites would be transported out by a conveyor belt to Bernal Heights Boulevard.

In order to estimate the vibration level at the Pipeline, the analysis utilized the following equation:

$$PPV_{equip}=PPV_{ref}(25/D)^{n}$$

PPV_{equip}: the Peak Particle Velocity (PPV) at 25 feet measured in inches/sec
PPV_{ref}: the PPV at the distance being measured
D: the distance being measured
n: a value determined by soil conditions, ranging from 1.5 to 1[32]

The PPV_{equip} values for the equipment to be used for the proposed were collected from three sources: the Federal Transit Authority (FTA), the New Hampshire Department of Transportation, and from a study of vibration from construction activities for a project at the Haleakala National Park in Hawaii. The PPVs for each pieces of equipment proposed to be used during project construction activities are summarized in the following table:

Table 4: Peak Particle Velocities (PPVs) of Project Construction Equipment

	Source of Data		
Equipment (project phase)	**FTA**	**New Hampshire DOT**	**Haleakala Project**
Excavator (foundation and utility trenches)		0.04 PPV	0.18 PPV
Jackhammer, if needed (foundation)	0.04 PPV		
Small Bulldozer (grading)	0.003 PPV		
Caisson drilling, if needed (piers)	0.09 PPV		

[32] *Ibid.*

For the purposes of analysis, the higher (more conservative) value of 0.18 was used for the examining the impacts of the excavator. For the n-value in the equation above, the California Department of Transportation (Caltrans) recommends a value of 1.1 for "very stiff" and "firm" soils which, according to the August 2013 soils report, characterize the top 3 to 4 feet of the project site, which is also underlain with chert bedrock.[33] Caltrans suggests an *n*-value of 1.0 for "hard, competent rock: bedrock, exposed hard rock," which characterizes the chert bedrock located beneath the soils on the project site.[34] Utilizing the equation above, a lower *n*-value is associated with a lower PPV level—that is, harder rock reduces vibration more quickly than looser rock or soils. For the purposes of the analysis, however, to obtain a conservative (worst-case) result, an *n*-value of 1.5, the maximum value, was used.

To determine the potential for an adverse impact to the PG&E Pipeline 109, the analysis compared the highest estimated PPV for each piece of equipment at its nearest proximity to the pipe during project work. The criteria for damage to a pipeline due to vibration cover a wide-range of PPV, as documented by Caltrans.[35] For example, a PPV value of 25 in/sec associated with an "explosive near [a] buried pipe" resulted in no damage, as did PPV values for "explosive[s] near [a] buried pipe" of 50-150 PPV. The analysis prepared for the proposed project utilized a conservative 12 inches/second, a value based on the West Roxbury Lateral Project in Massachusetts, as the criteria for potential damage to the pipe.[36]

The calculated maximum PPVs for each type of equipment proposed to be used during project construction activities are summarized below in Table 5.

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[33] H. Allen Gruen, *Report Geotechnical Investigation Planned Residence at 3516 Folsom Street, San Francisco, California*, August 3, 2013.

[34] Illingsworth & Rodkin Inc, Memo: *Ground Characteristics and Effect on Predicted Vibration*, April 14, 2017.

[35] California Department of Transportation, *Transportation and Construction Vibration Guidance Manual*, September 2013, page 76.

[36] The analysis notes that buried pipes can withstand higher PPV because they are constrained and do not amplify ground motion, like freestanding structures, like historic buildings, do. According to the Caltrans report cited in the analysis, PPV values as high as 150 have been shown to not harm underground pipes.

Table 5: PPV Estimates and Damage Potential of Project Construction Equipment			
Equipment (project phase)	Closest Proximity to Pipe	Highest Estimated PPV (inches/second)	Damage criteria PPV at the Pipeline (inches/second)
Excavator (foundation)	13 feet	0.48	12
Jackhammer (foundation)	13 feet	0.11	12
Drilling (piers)	12 feet	0.24	12
Small bulldozer (road construction)	1 foot	0.38	12
Excavator (utility trenches)	5 feet	2.01	12

Although the vibration assessment for the proposed project is based on damage criteria of 12 in/sec, PG&E has evaluated the proposed project and, through its regulatory authority for work in proximity to its pipeline, has set a PPV standard of 2 in/sec for this section of Pipeline 109.[37] It is noted that this standard is highly conservative in that it is a factor of 10 lower (more stringent) than the already conservative damage criteria used in the vibration assessment.

As discussed above, on page 23, the proposed project would be required to comply with PG&E regulations for construction work within 10 feet of a pipeline.. These requirements include the physical presence of a PG&E inspector whenever work within 10 feet of a pipeline is performed; grading and digging standards; the placement of pipeline markers during demolition and construction; standards for construction machinery and loading near and on top of underground pipelines; and limitations on placing landscaping, structures or fencing within certain distances from

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[37] PG&E Gas Transmission Pipeline Services—Integrity Management, 3516/26 Folsom Street, March 30, 2017.

the pipeline. These practices, as required by law, are in place to ensure construction activities do not substantially affect underground services, including natural gas pipelines. Furthermore, the proposed project, including street improvements, would be subject to the same PG&E plan approvals and oversite as other excavation and street improvements in San Francisco.

In accordance with CEQA, the Planning Department does not require mitigation measures for impacts that would be less than significant through compliance with applicable regulatory requirements. Further, the vibration analysis for the project indicates that the proposed project would not exceed PG&E's highly conservative 2 in/sec PPV value (which is measured as a value rounded to a whole number). However, in an abundance of caution for the purposes of this project's environmental evaluation, this Initial Study finds that project construction would have a significant vibration impact to Pipeline 109. Implementation of Mitigation Measures M-NO-3 would ensure that PPV values remain at or below PG&E's 2 in/sec PPV value. With implementation of M-NO-3, below, there would be no possibility of a significant vibration effect on PG&E's Pipeline 109.

Mitigation Measure M-NO-3, Vibration Management Plan:

The Project Sponsor shall retain the services of a qualified structural engineer to develop, and the Project Sponsor shall adopt, a vibration management and continuous monitoring plan to cover any construction equipment operations performed within 20 feet of PG&E Pipeline 109. The vibration management and monitoring plan shall be submitted to PG&E and Planning Department staff for review and approval prior to issuance of any construction permits. The vibration management plan shall include:

- **Vibration Monitoring**: Continuous vibration monitoring throughout the duration of the major structural project activities to ensure that vibration levels do not exceed the established standard.
- **Maximum PPV Vibration Levels:** Maximum PPV vibration levels for any equipment shall be less than 2 inches per second (in/sec). Should maximum PPV vibration levels exceed 2 in/sec, all construction work shall stop and PG&E shall be notified to oversee further work.
- **Standby Inspection**: A PG&E Gas Transmission Standby Inspector must be present during any demolition or construction activity within 10 feet of the gas pipeline(s). This

includes all grading, trenching, gas line depth verifications (potholes), asphalt or concrete demolition/removal, removal of trees, signs, light poles, etc. This inspection would be coordinated through the Underground Service Alert (USA) service at **811 or 1-800-227-2600.** A minimum notice of 48 hours is required.

- **Grading/Excavation:** Any excavations, including grading work, above or around Pipeline 109 must be performed with a PG&E inspector present. This includes all laterals, subgrades, and gas line depth verifications (potholes). Work in the vicinity of Pipeline 109 must be completed consistent with PG&E Work Procedure TD-4412P-05 "Excavation Procedures for Damage Prevention." Any plans to expose and support Pipeline 109 across an open excavation must be approved by PG&E Pipeline Engineering in writing prior to performing the work. Any grading or digging within two (2) feet of Pipeline 109 shall be dug by hand. Water jetting to assist vacuum excavating must be limited to 125 pounds per square inch gage (psig).
- **Pipeline Markers:** Prior to the commencement of project activity, pipeline markers must be placed along the pipeline route. With written PG&E approval, any existing markers can be temporarily relocated to accommodate construction work, but must be reinstalled once construction is complete.
- **Fencing:** No parallel fencing is allowed within 10 feet of Pipeline 109 and any perpendicular fencing shall require 14 foot access gates to be secured with PG&E corporation locks.
- **Structures:** Permanent structures must be located a minimum distance of 10 feet from the edge of Pipeline 109. A total width of 45 feet shall be maintained for pipeline maintenance. No storage of construction or demolition materials is permitted within this 45 foot zone.
- **Construction Loading:** To operate or store any construction equipment within 10 feet of Pipeline 109 that exceeds the half-axle wheel load (half axle weight is the gross weight upon any one wheel, or wheels, supporting one end of an axle) in the table below, approval from a PG&E gas transmission pipeline engineer is required. Pipeline 109 may need to be potholed by hand in to confirm the depth of the existing cover. These weight limits also depend on the support provided by the Pipeline's internal gas pressure. If PG&E's operating conditions require the Pipeline to be depressurized, maximum wheel

loads over the pipeline will need to be further limited. For compaction within two feet of Pipeline 109, walk-behind compaction equipment shall be required. Crane and backhoe outriggers shall be set at least 10 feet from the centerline of Pipeline 109. Maximum PPV vibration levels for any equipment shall be less than 2 in/sec.

Depth of Cover to Top of Pipe (ft.)	Maximum Half-Axle Wheel Loading (lbs)
2	4,580
3	6,843
4	7,775
5	7,318

With implementation of **Mitigation Measure M-NO-3** significant vibration impacts to PG&E's Pipeline 109 would be reduced to a less-than-significant level.

Impact NO-4: The proposed project would not be substantially affected by existing noise levels. *(Not Applicable)*

This impact is only to be analyzed if the proposed project would exacerbate the existing noise environment. Impact NO-1 concluded the proposed project would not result in a significant noise impact. Therefore, this impact need not be analyzed. Impacts NO-2 and No-3 address construction related noise and vibration impacts, which would not affect the proposed project as the project site would not be occupied until completion of construction activities. However, the following is provided for informational purposes.

Roadway noise is the predominant source of noise in the project vicinity. The City's background noise levels map identifies the project site to be exposed to traffic noise levels between 55 and 60 dBA L_{dn}.[38] The City's land use compatibility chart shows that "satisfactory" sound levels for residential

[38] City and County of San Francisco, *General Plan, Environmental Protection Element, Map 1 (Background Noise Levels, 2009)*, 2009. This document is available for review at: http://generalplan.sfplanning.org/images/I6.environmental/ENV_Map1_Background_Noise%20Levels.pdf.

land uses are 60 dBA L_{dn} for outdoor environments. For indoor environments, the noise level inside any sleeping or living room in a dwelling unit on residential property should not exceed 45 dBA between 10:00 p.m. and 7:00 a.m. or 55 dBA between 7:00 a.m. and 10:00 p.m.

According to the City's General Plan, new development should incorporate noise insulation features if the noise levels exceed the sound level guidelines shown in the land use compatibility chart. The proposed project would be required to comply with the California Noise Insulation Standards in Title 24. The Title 24 acoustical requirement for residential structures is incorporated into Section 1207 of the San Francisco Building Code and requires these structures be designed to prevent the intrusion of exterior noise so that the noise level with windows closed, attributable to exterior sources, shall not exceed 45 dBA in any habitable room. With use of standard construction materials and compliance to the Title 24 standards, the proposed project would feasibly attain acceptable interior noise levels.

Impact C-NO-1: The proposed project in combination with past, present, and reasonably foreseeable future projects would not create a significant cumulative noise or vibration impact. *(Less-Than-Significant Impact)*

Construction

Construction of the proposed project, such as excavation, grading, or demolition and construction of other buildings in the area, would occur on a temporary and intermittent basis. In general, compliance with Noise Ordinance requirements would maintain the noise impact from project construction at a Less Than Significant level. Project construction-related noise would not substantially increase ambient noise levels at locations greater than a few hundred feet from the project site. There are no future projects identified within the immediate vicinity of the site that would have the potential to result in cumulative construction noise or vibration impacts.

Operations

The proposed project would include new fixed noise sources that would produce operational noise on the project site, as well as new mobile sources. The project-related contribution of two PM peak-hour vehicle trips would represent a small fraction of existing traffic volumes and would be imperceptible. In addition, any new residents that would result from implementation of the cumulative development in the project vicinity would generate a similarly low amount of new PM peak-hour trips. Furthermore, the proposed project and future projects in the vicinity primarily consist of residential uses, which are uses that do not typically generate substantial sources of operational noise, and would be subject to the Noise Ordinance's requirements for residential noise limits.

Given this, the proposed project, in combination with past, present, and reasonably foreseeable future projects would not result in considerable contribution to a permanent increase in noise or vibration in the project area. This impact would be less than significant and no mitigation measure is required.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
6. AIR QUALITY— Would the project:					
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☒	☐	☐
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☒	☐	☐
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal, State, or regional ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☒	☐	☐
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☒	☐	☐
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☒	☐	☐

The San Francisco Bay Area Air Basin (SFBAAB) encompasses San Francisco, Alameda, Contra Costa, San Mateo, and Napa Counties, and includes parts of Solano and Sonoma Counties. Although air quality in the air basin has generally improved over the last several decades, elevated levels of ozone, carbon monoxide, and particulate matter have been observed. The federal Clean Air Act and California Clean Air Act contain ambient air standards and related air quality reporting systems to be used by regional regulatory agencies in developing air pollution control measures. The Bay Area Air Quality Management District (BAAQMD) is the primary responsible regulatory agency in the Bay Area for planning, implementing, and enforcing the federal and State ambient air quality standards for criteria pollutants. Criteria air pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter ($PM_{2.5}$ and PM_{10}), and lead.

In most of the Bay Area, transportation-related sources account for a majority of air pollutant emissions. Therefore, a major focus of the BAAQMD is on reducing vehicle trips associated with new development. Localized air quality issues include CO hotspots associated with traffic.

Health Vulnerable Locations

San Francisco adopted Article 38 of the San Francisco Health Code in 2008, requiring an Air Quality Assessment for new residential projects of 10 or more units located in proximity to high-traffic roadways, as mapped by the Department of Public Health (DPH), to determine whether residents would be exposed to unhealthful levels of $PM_{2.5}$. The air quality assessment evaluates the concentration of $PM_{2.5}$ from local roadway traffic that may impact a proposed residential development site. If the DPH air quality assessment indicates that the annual average concentration of $PM_{2.5}$ at the site would be greater than 0.2 $\mu g/m^3$, Health Code Section 3807 requires development on the site to be designed or relocated to avoid exposure greater than 0.2 $\mu g/m^3$, or a ventilation system to be installed that would be capable of removing 80 percent of ambient $PM_{2.5}$ from habitable areas of the residential units. The proposed project consists of four residential units and, according to the City's Air Pollutant Exposure Zone Map, the proposed project is not within the air pollutant exposure zone.[39]

[39] City and County of San Francisco. *Air Pollutant Exposure Zone Map*. April 10, 2014. This document is available for review at: www.sfdph.org/dph/files/EHSdocs/AirQuality/AirPollutantExposureZoneMap.pdf.

Impact AQ-1: Implementation of the proposed project would not conflict with or obstruct implementation of the local applicable air quality plan. *(Less-Than-Significant Impact)*

The applicable air quality plan is the BAAQMD's 2017~~0~~ Clean Air Plan, which was adopted on April 19, 2017. The Clean Air Plan is a comprehensive plan to improve Bay Area air quality and protect public health. The Clean Air Plan defines a control strategy to reduce emissions and ambient concentrations of air pollutants; safeguard public health by reducing exposure to air pollutants that pose the greatest health risk, with an emphasis on protecting the communities most heavily affected by air pollution; and reduce greenhouse gas emissions to protect the climate. Consistency with the Clean Air Plan can be determined if the project does the following: 1) supports the goals of the Clean Air Plan; 2) includes applicable control measures from the Clean Air Plan; and 3) would not disrupt or hinder implementation of any control measures from the Clean Air Plan.

The 2017 Clean Air Plan includes measures and programs to reduce emissions of fine particulates and toxic air contaminants. In addition, the Regional Climate Protection Strategy is included in the 2017 Clean Air Plan, which identifies rules, control measures, and strategies that the BAAQMD can pursue to reduce greenhouse gases throughout the Bay Area.

The proposed project would not conflict with any of the control measures identified in the plan or designed to bring the region into attainment. Additionally, the proposed project would not substantially increase the population, vehicle trips, or vehicle miles traveled. The proposed project would not hinder the region from attaining the goals outlined in the Clean Air Plan. Therefore, the proposed project would not hinder or disrupt implementation of any control measures from the Clean Air Plan.

Additionally, as indicated in the analysis that follows, below, the proposed project would result in Less Than Significant operational and construction-period emissions.

Impact AQ-2: Implementation of the proposed project would not violate an air quality standard or contribute substantially to an existing or projected air quality violation. *(Less-Than-Significant Impact)*

The proposed project would generate air emissions during project construction and operation. Long-term operational emissions are associated with stationary sources and mobile sources. Stationary source emissions result from the consumption of natural gas and electricity. Mobile source emissions result from vehicle trips and result in air pollutant emissions affecting the entire air basin. Short-term construction emissions would occur in association with construction activities, including demolition, excavation, and vehicle/equipment use.

Operational Air Quality Emissions

Long-term air emission impacts are those associated with area sources and mobile sources related to the proposed project. In addition to the short-term construction emissions, the project would also generate long-term air emissions, such as those associated with changes in permanent use of the project site. These long-term emissions are primarily mobile source emissions that would result from vehicle trips associated with the proposed project. Area sources, such as natural gas heaters, landscape equipment, and use of consumer products, would also result in pollutant emissions.

The BAAQMD has developed screening criteria to provide lead agencies with a conservative indication of whether the proposed project would result in potentially significant air quality impacts. If all of the screening criteria are met by a proposed project, then the lead agency would not need to perform a detailed air quality assessment of the proposed project's emissions. These screening levels are generally representative of new development without any form of mitigation measures taken into consideration. In addition, the screening criteria do not account for project design features, attributes, or local development requirements that could also result in lower emissions.

For single family land uses, the BAAQMD screening size for operational criteria pollutants is 325 dwelling units. Since the proposed project would only include two dwelling units, based on the BAAQMD's screening criteria, operation of the proposed project would result in a Less-Than-

Significant Impact to air quality from criteria air pollutant and precursor emissions and no mitigation measures would be required.

Localized CO Impacts

The BAAQMD has also established a screening methodology that provides a conservative indication of whether the implementation of a proposed project would result in significant CO emissions. According to the BAAQMD CEQA Guidelines, a proposed project would result in a less-than significant impact to localized CO concentrations if the following screening criteria are met:

- The project is consistent with an applicable congestion management program established by the county congestion management agency for designated roads or highways, and the regional transportation plan and local congestion management agency plans.
- Project traffic would not increase traffic volumes at affected intersections to more than 44,000 vehicles per hour.
- The project would not increase traffic volumes at affected intersections to more than 24,000 vehicles per hour where vertical and/or horizontal mixing is substantially limited (e.g., tunnel, parking garage, bridge underpass, natural or urban street canyon, or below-grade roadway).

Implementation of the proposed project would not conflict with the San Francisco County Transportation Authority San Francisco Transportation Plan (SFTP) for designated roads or highways, a regional transportation plan, or other agency plans. The project site is not located in an area where vertical or horizontal mixing of air is substantially limited. In addition, the proposed project would not increase traffic volumes at affected intersections to more than 44,000 vehicles per hour and would not result in localized CO concentrations that exceed State or federal standards. This impact would be less than significant and no mitigation measures would be required.

Construction Emissions

During construction, short-term degradation of air quality may occur due to the release of particulate emissions generated by excavation, grading, hauling, and other activities. Emissions from construction equipment are also anticipated and would include CO, NO_x, ROG, directly-emitted particulate matter ($PM_{2.5}$ and PM_{10}), and toxic air contaminants (TACs) such as diesel exhaust particulate matter.

As discussed above, the BAAQMD has developed screening criteria to provide lead agencies with a conservative indication of whether the proposed project would result in potentially significant air quality impacts. If all of the screening criteria are met by a proposed project, then the lead agency would not need to perform a detailed air quality assessment of the proposed project's emissions. For single family residential land uses, the BAAQMD screening size for construction criteria pollutants is 114 dwelling units. Since the proposed project would only include two dwelling units, based on the BAAQMD's screening criteria, construction of the proposed project would result in a Less-Than-Significant Impact to air quality from criteria air pollutant and precursor emissions and no mitigation measures would be required.

Impact AQ-3: Implementation of the proposed project would not result in a cumulatively considerable net increase of a criteria pollutant for which the project region is non-attainment under an applicable federal, State, or regional ambient air quality standard. ***(Less-Than-Significant Impact)***

CEQA defines a cumulative impact as two or more individual effects, which when considered together, are considerable or which compound or increase other environmental impacts. According to the BAAQMD, air pollution is largely a cumulative impact and no single project is sufficient in size to itself result in nonattainment of ambient air quality standards. In developing the thresholds of significance for air pollutants used in the analysis above, BAAQMD considered the emission levels for which a project's individual emissions would be cumulatively considerable. The BAAQMD CEQA Air Quality Guidelines indicate that if a project exceeds the identified significance thresholds, its emissions would be cumulatively considerable, resulting in significant adverse air quality impacts to the region's existing air quality conditions. If daily average or annual emissions of operational-related criteria air pollutants exceed any applicable threshold established by the BAAQMD, the proposed project would result in a cumulatively significant impact.

As discussed above, implementation of the proposed project would generate Less Than Significant criteria air pollutant and precursor emissions. Therefore, the project would not make a cumulatively considerable contribution to regional air quality impacts. No mitigation measures would be required.

Impact AQ-4: Implementation of the proposed project would not expose sensitive receptors to substantial pollutant concentrations. ***(Less-Than-Significant Impact)***

Sensitive receptors are defined as residential uses, schools, daycare centers, nursing homes, and medical centers. Individuals particularly vulnerable to diesel particulate matter are children, whose lung tissue is still developing, and the elderly, who may have serious health problems that can be aggravated by exposure to diesel particulate matter. Exposure from diesel exhaust associated with construction activity contributes to both cancer and chronic non-cancer health risks. As noted above, the project site is not located within an Air Pollutant Exposure Zone.

Excessive Cancer Risk

According to the BAAQMD, a project would result in a significant impact if it would: individually expose sensitive receptors to TACs resulting in an increased cancer risk greater than 10.0 in one million, increased non-cancer risk of greater than 1.0 on the hazard index (chronic or acute), or an annual average ambient $PM_{2.5}$ increase greater than 0.3 $\mu g/m^3$. A significant cumulative impact would occur if the project in combination with other projects located within a 1,000-foot radius of the project sites would expose sensitive receptors to TACs resulting in an increased cancer risk greater than 100.0 in one million, an increased non-cancer risk of greater than 10.0 on the hazard index (chronic), or an ambient $PM_{2.5}$ increase greater than 0.8 $\mu g/m^3$ on an annual average basis. Impacts from substantial pollutant concentrations are discussed below. As discussed below, this impact would be less than significant.

The project site is located in a residential neighborhood, and the closest sensitive receptors are residential uses located immediately adjacent to the proposed project. Construction of the proposed project may expose surrounding sensitive receptors to airborne particulates, as well as a small quantity of construction equipment pollutants (i.e., usually diesel-fueled vehicles and equipment). However, project construction emissions would be below the BAAQMD's significance thresholds and once the project is constructed, the project would not be a source of substantial emissions. Therefore, sensitive receptors are not expected to be exposed to substantial pollutant concentrations during project construction or operation, and potential impacts would be considered less than significant.

Based on the foregoing, the proposed project would not expose sensitive receptors substantial pollutant contributions. Therefore, this impact would be less than significant, and no mitigation measures would be required.

Impact AQ-5: Implementation of the proposed project would not create objectionable odors affecting a substantial number of people. *(Less-Than-Significant Impact)*

During project construction, some odors may be present due to diesel exhaust. However, these odors would be temporary and limited to the construction period. The proposed project would not include any activities or operations that would generate objectionable odors and once operational, the project would not be a source of odors. Therefore, the proposed project would not create objectionable odors affecting a substantial number of people, and no mitigation is required.

Impact C-AQ-1: The proposed project, in combination with past, present, and reasonably foreseeable future development in the project area would not contribute to a cumulative air quality impact. *(Less-Than-Significant Impact)*

As discussed above, regional air pollution is by its very nature largely a cumulative impact. Emissions from past, present, and future projects contribute to the region's adverse air quality on a cumulative basis. No single project by itself would be sufficient in size to result in regional nonattainment of ambient air quality standards. Instead, a project's individual emissions contribute to existing cumulative adverse air quality impacts. The project-level thresholds for criteria air pollutants are based on levels by which new sources are not anticipated to contribute to an air quality violation or result in a considerable net increase in criteria air pollutants. Therefore, because the proposed project's construction and operational emissions would not exceed the project-level thresholds for criteria air pollutants, the proposed project would not result in a cumulatively considerable contribution to regional air quality impacts. This impact would be less than significant and no mitigation measures would be required.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
7. GREENHOUSE GAS EMISSIONS— Would the project:					
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☒	☐	☐
b) Conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐	☐

Greenhouse gas (GHG) emissions and global climate change represent cumulative impacts. GHG emissions cumulatively contribute to the significant adverse environmental impacts of global climate change. No single project could generate enough GHG emissions to noticeably change the global average temperature; instead, the combination of GHG emissions from past, present, and future projects have contributed and will continue to contribute to global climate change and its associated environmental impacts.

The Bay Area Air Quality Management District (BAAQMD) has prepared guidelines and methodologies for analyzing GHGs. These guidelines are consistent with CEQA Guidelines Sections 15064.4 and 15183.5 which address the analysis and determination of significant impacts from a proposed project's GHG emissions. CEQA Guidelines Section 15064.4 allows lead agencies to rely on a qualitative analysis to describe GHG emissions resulting from a project. CEQA Guidelines Section 15183.5 allows for public agencies to analyze and mitigate GHG emissions as part of a larger plan for the reduction of GHGs and describes the required contents of such a plan. Accordingly, San Francisco has prepared *Strategies to Address Greenhouse Gas Emissions*[40] which presents a comprehensive assessment of policies, programs, and ordinances that collectively represent San Francisco's qualified GHG reduction strategy in compliance with the CEQA guidelines. These GHG reduction actions have

[40] San Francisco Planning Department, *Strategies to Address Greenhouse Gas Emissions in San Francisco*, 2010. This document is available online at: http://www.sf-planning.org/index.aspx?page=2627.

resulted in a 23.3 percent reduction in GHG emissions in 2012 compared to 1990 levels,[41] exceeding the year 2020 reduction goals outlined in the BAAQMD's *Bay Area 2010 Clean Air Plan,* Executive Order (EO) S-3-05, and Assembly Bill (AB) 32 (also known as the Global Warming Solutions Act).[42] Given that the City' has met the State and region's 2020 GHG reduction targets and San Francisco's GHG reduction goals are consistent with, or more aggressive than, the long-term goals established under EO S-3-05[43], EO B-30-15,[44,45] and Senate Bill (SB) 32 [46,47] the City's GHG reduction goals are consistent with EO S-3-05, EO B-30-15, AB 32, SB 32 and the *Bay Area 2010 Clean Air Plan*. Therefore, proposed projects that are consistent with the City's GHG reduction strategy would be consistent with the aforementioned GHG reduction goals, would not conflict with these plans or result in significant GHG emissions, and would therefore not exceed San Francisco's applicable GHG threshold of significance.

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[41] ICF International, *Technical Review of the 2012 Community-wide GHG Inventory for the City and County of San Francisco,* January 21, 2015. Available at http://sfenvironment.org/sites/default/files/fliers/files/icf_verificationmemo_2012sfecommunityinventory_2015-01-21.pdf, accessed March 16, 2015.

[42] Executive Order S-3-05, Assembly Bill 32, and the *Bay Area 2010 Clean Air Plan* set a target of reducing GHG emissions to below 1990 levels by year 2020.

[43] Office of the Governor, Executive Order S-3-05, June 1, 2005. Available at http://www.pcl.org/projects/2008symposium/proceedings/Coatsworth12.pdf, accessed March 16, 2016. Executive Order S-3-05 sets forth a series of target dates by which statewide emissions of GHGs need to be progressively reduced, as follows: by 2010, reduce GHG emissions to 2000 levels (approximately 457 million metric tons of carbon dioxide equivalents ($MTCO_2E$)); by 2020, reduce emissions to 1990 levels (approximately 427 million $MTCO_2E$); and by 2050 reduce emissions to 80 percent below 1990 levels (approximately 85 million $MTCO_2E$). Because of the differential heat absorption potential of various GHGs, GHG emissions are frequently measured in "carbon dioxide-equivalents," which present a weighted average based on each gas's heat absorption (or "global warming") potential.

[44] Office of the Governor, *Executive Order B-30-15,* April 29, 2015. Available at https://www.gov.ca.gov/news.php?id=18938, accessed March 3, 2016. Executive Order B-30-15, issued on April 29, 2015, sets forth a target of reducing GHG emissions to 40 percent below 1990 levels by 2030 (estimated at 2.9 million $MTCO_2E$).

[45] San Francisco's GHG reduction goals are codified in Section 902 of the Environment Code and include: (i) by 2008, determine City GHG emissions for year 1990; (ii) by 2017, reduce GHG emissions by 25 percent below 1990 levels; (iii) by 2025, reduce GHG emissions by 40 percent below 1990 levels; and by 2050, reduce GHG emissions by 80 percent below 1990 levels.

[46] Senate Bill 32 amends California Health and Safety Code Division 25.5 (also known as the California Global Warming Solutions Act of 2006) by adding Section 38566, which directs that statewide greenhouse gas emissions to be reduced by 40 percent below 1990 levels by 2030.

[47] Senate Bill 32 was paired with Assembly Bill 197, which would modify the structure of the State Air Resources Board; institute requirements for the disclosure of greenhouse gas emissions criteria pollutants, and toxic air contaminants; and establish requirements for the review and adoption of rules, regulations, and measures for the reduction of greenhouse gas emissions.

The following analysis of the proposed project's impact on climate change focuses on the project's contribution to cumulatively significant GHG emissions. Because no individual project could emit GHGs at a level that could result in a significant impact on the global climate, this analysis is in a cumulative context, and this section does not include an individual project-specific impact statement.

Impact C-GG-1: The proposed project would generate greenhouse gas emissions, but not at levels that would result in a significant impact on the environment or conflict with any policy, plan, or regulation adopted for the purpose of reducing greenhouse gas emissions. (*Less-Than-Significant Impact*)

Individual projects contribute to the cumulative effects of climate change by directly or indirectly emitting GHGs during construction and operational phases. Direct operational emissions include GHG emissions from new vehicle trips and area sources (natural gas combustion). Indirect emissions include emissions from electricity providers; energy required to pump, treat, and convey water; and emissions associated with waste removal, disposal, and landfill operations.

The proposed project would increase the intensity of use of the site by constructing two residential units on a currently vacant site. Therefore, the proposed project would contribute to annual long-term increases in GHGs as a result of increased vehicle trips (mobile sources) and residential operations that result in an increase in energy use, water use, wastewater treatment, and solid waste disposal. Construction activities would also result in temporary increases in GHG emissions.
The proposed project would be subject to regulations adopted to reduce GHG emissions as identified in the GHG reduction strategy. As discussed below, compliance with the applicable regulations would reduce the project's GHG emissions related to transportation, energy use, waste disposal, wood burning, and use of refrigerants.

Compliance with the City's bicycle parking requirements would reduce the proposed project's transportation-related emissions. These regulations reduce GHG emissions from single-occupancy vehicles by promoting the use of alternative transportation modes with zero or lower GHG emissions on a per capita basis.

The proposed project would be required to comply with the energy efficiency requirements of the City's Green Building Code which would promote energy and water efficiency, thereby reducing the proposed project's energy-related GHG emissions.[48]

The proposed project's waste-related emissions would be reduced through compliance with the City's Recycling and Compositing Ordinance, and Construction and Demolition Debris Recovery Ordinance. These regulations reduce the amount of materials sent to a landfill, reducing GHGs emitted by landfill operations. These regulations also promote reuse of materials, conserving their embodied energy[49] and reducing the energy required to produce new materials.

Compliance with the City's Street Tree Planting requirements would serve to increase carbon sequestration. Other regulations, the Wood Burning Fireplace Ordinance would reduce emissions of GHGs and black carbon, respectively. Regulations requiring low-emitting finishes would reduce volatile organic compounds (VOCs).[50] Thus, the proposed project was determined to be consistent with San Francisco's GHG reduction strategy.[51]

The project sponsor is required to comply with these regulations, which have proven effective as San Francisco's GHG emissions have measurably decreased when compared to 1990 emissions levels, demonstrating that the City has met and exceeded EO S-3-05, AB 32, and the *Bay Area 2010 Clean Air Plan* GHG reduction goals for the year 2020. Other existing regulations, such as those implemented through AB 32, will continue to reduce a proposed project's contribution to climate change. In addition, San Francisco's local GHG reduction targets are consistent with the long-term GHG

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[48] Compliance with water conservation measures reduce the energy (and GHG emissions) required to convey, pump and treat water required for the project.

[49] Embodied energy is the total energy required for the extraction, processing, manufacture and delivery of building materials to the building site.

[50] While not a GHG, VOCs are precursor pollutants that form ground level ozone. Increased ground level ozone is an anticipated effect of future global warming that would result in added health effects locally. Reducing VOC emissions would reduce the anticipated local effects of global warming.

[51] San Francisco Planning Department, *Greenhouse Gas Analysis: Compliance Checklist for 3516-26 Folsom Street*, February 16, 2017

reduction goals of EO S-3-05, EO B-30-15, AB 32, SB 32 and the *Bay Area 2010 Clean Air Plan.* Therefore, because the proposed projects is consistent with the City's GHG reduction strategy, it is also consistent with the GHG reduction goals of EO S-3-05, EO B-30-15, AB 32, SB 32 and the *Bay Area 2010 Clean Air Plan,* would not conflict with these plans, and would therefore not exceed San Francisco's applicable GHG threshold of significance. As such, the proposed project would result in a Less-Than-Significant Impact with respect to GHG emissions. No mitigation measures are necessary.

Topics:	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less-Than-Significant Impact*	*No Impact*	*Not Applicable*
8. WIND AND SHADOW— Would the project:					
a) Alter wind in a manner that substantially affects public areas?	☐	☐	☒	☐	☐
b) Create new shadow in a manner that substantially affects outdoor recreation facilities or other public areas?	☐	☐	☒	☐	☐

Impact WS-1: The proposed project would not alter wind in a manner that substantially affects public areas within the vicinity of the project area. ***(Less-Than-Significant Impact)***

A proposed project's wind impacts are directly related to its height, orientation, design, location and surrounding development context. Based on wind analyses for other development projects in San Francisco, a building that does not exceed 80 feet generally has little potential to cause substantial changes to ground-level wind conditions. The proposed project would construct two 30-foot-tall buildings that would be about the same height as existing adjacent and nearby buildings. The proposed project would also be oriented towards Folsom Street in a similar manner as buildings surrounding the project site. As such, the proposed project would not alter wind in a manner that substantially affects public areas. This impact would be less than significant, and no mitigation measures would be required.

Impact WS-2: The proposed project would not create new shadow in a manner that substantially affects outdoor recreation facilities or other public areas. ***(Less-Than-Significant Impact)***

In 1984, San Francisco voters approved an initiative known as "Proposition K, The Sunlight Ordinance," which was codified as Planning Code Section 295 in 1985. Planning Code Section 295 generally prohibits new structures above 40 feet in height that would cast additional shadows on open space that is under the jurisdiction of the San Francisco Recreation and Park Commission between one hour after sunrise and one hour before sunset, at any time of the year, unless that shadow would not result in a significant adverse effect on the use of the open space. Public open spaces that are not under the jurisdiction of the Recreation and Park Commission as well as private open spaces are not subject to Planning Code Section 295.

Implementation of the proposed project would result in the construction of two 30-foot-tall buildings (including parapets and roof deck railings), which would be similar in size to existing surrounding buildings. The project site is located to the southwest of the Bernal Heights Community Garden. Therefore, a shadow analysis was prepared by the Project Sponsor/Architect. The shadow analysis provides simulations that show that the proposed project would cast new shadow on the Bernal Heights Community Garden, but that shadow would be limited to only certain periods in the winter and summer and the new shadow would only fall on a portion of the southwestern corner of the community garden mainly in the evening after 5:30 pm. In most cases throughout the year, the shadow cast by the proposed project either does not fall on the community garden or is contained within shadow already cast by existing structures on Gates Street.

While the proposed project would cast new shadow on the community garden, it is not expected to substantially affect the use or enjoyment of the Bernal Heights Community Garden such that a significant environmental effect would occur. For these reasons, the proposed project would not create new shadow in a manner that substantially affects outdoor recreation facilities and other public areas. This impact would be less than significant, and no mitigation measures would be required.

Impact C-WS-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects, would not result in a cumulative wind or shadow impacts. *(Less-Than-Significant Impact)*

As discussed above, buildings shorter than 80 feet have little potential to cause substantial changes to ground-level wind conditions. Given that the height limit in the project vicinity is 30 feet, none of the nearby cumulative development projects would be tall enough to alter wind in a manner that substantially affects public areas. The proposed project would not shadow any nearby parks or open spaces such that a significant environmental effect would occur. Therefore, the proposed project would not contribute to any potential cumulative shadow impact on parks and open spaces. For these reasons, the proposed project would not combine with past, present, and reasonably foreseeable future projects in the project vicinity to create a significant cumulative wind or shadow impact.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
9. RECREATION— Would the project:					
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facilities would occur or be accelerated?	☐	☐	☒	☐	☐
b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☐	☐	☒	☐	☐
c) Physically degrade existing recreational resources?	☐	☐	☒	☐	☐

Impact RE-1: The proposed project would not increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facilities would occur or be accelerated. *(Less-Than-Significant Impact Impact)*

The neighborhood parks or other recreational facilities closest to the project site are the Bernal Heights Community Garden (60 feet northeast of the project site) and Bernal Heights Park (120 feet north. The proposed project would increase the population of the project site by about five residents. This residential population growth would increase the demand for recreational facilities. The project residents may use parks, open spaces, and other recreational facilities in the project vicinity. The Bernal Heights Community Garden has a controlled membership and may not be available for use by residents of the proposed project. The additional use of these recreational facilities is expected to be modest based on the size of the projected population increase and would not result in the substantial physical deterioration of recreational facilities. Therefore this impact would be less than significant and no mitigation measures would be required.

Impact RE-2: The proposed project would not include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment. ***(Less-Than-Significant Impact)***

The project site is within walking distance to parks, open spaces, or other recreational facilities, as discussed above. It is anticipated that these existing recreational facilities would be able to accommodate the increase in demand for recreational resources generated by the project residents. For these reasons, the construction of new or the expansion of existing recreational facilities, both of which might have an adverse physical effect on the environment, would not be required. This impact would be less than significant and no mitigation measures would be required.

Impact RE-3: The proposed project would not physically degrade existing recreational resources. ***(Less-Than-Significant Impact)***

The proposed project would not result in the physical alteration or degradation of any recreational resources in the project vicinity or the City as a whole. Project-related construction activities would occur within the boundaries of the project site, which does not include any existing recreational resources. This impact would be less than significant and no mitigation measures would be required.

Impact C-RE-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects, would not result in a cumulative impact on recreational facilities or open space resources. ***(Less-Than-Significant Impact)***

Cumulative development in the project vicinity would result in a minor intensification of land uses and a cumulative increase in the demand for recreational facilities and resources. The City has accounted for such growth as part of the Recreation and Open Space Element of the General Plan. In addition, San Francisco voters passed two bond measures, in 2008 and 2012, to fund the acquisition, planning, and renovation of the City's network of recreational resources. As discussed above, there are open spaces and other recreational facilities within less than 1/4 mile of the project site. It is expected that these existing recreational facilities would be able to accommodate the increase in demand for recreational resources generated by the proposed project and nearby cumulative development projects. For these reasons, the proposed project would not combine with past, present, and reasonably foreseeable future project in the project vicinity to create a significant cumulative impact on recreational facilities or resources. This impact would be less than significant and no mitigation measures would be required.

Topics:	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less-Than-Significant Impact*	*No Impact*	*Not Applicable*
10. UTILITIES AND SERVICE SYSTEMS—Would the project:					
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☒	☐	☐
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☒	☐	☐
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☒	☐	☐
d) Have sufficient water supply available to serve the project from existing entitlements and resources, or require new or expanded water supply resources or entitlements?	☐	☐	☒	☐	☐
e) Result in a determination by the wastewater treatment provider that would serve the project that it has inadequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☒	☐	☐
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☒	☐	☐
g) Comply with federal, State, and local statutes and regulations related to solid waste?	☐	☐	☒	☐	☐

The project site is within an urban area that is served by utility service systems, including water, wastewater and stormwater collection and treatment, and solid waste collection and disposal. The proposed project would add new daytime and nighttime population to the site that would increase the demand for utilities and service systems on the site, but not in excess of amounts expected and provided for in the project area.

Impact UT-1: Implementation of the proposed project would not exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board, would not exceed the capacity of the wastewater treatment provider that would serve the project, and would not require the construction of new or expansion of existing wastewater treatment or stormwater drainage facilities. *(Less-Than-Significant Impact)*

Project-related wastewater and stormwater would flow to the City's combined stormwater/sewer system and would be treated to standards contained in the City's National Pollutant Discharge Elimination System (NPDES) Permit for the Southeast Water Pollution Control Plant prior to discharge into San Francisco Bay. The NPDES standards are set and regulated by the San Francisco Bay Area Regional Water Quality Control Board (RWQCB). Therefore, the proposed project would not conflict with RWQCB requirements related to wastewater discharge.

For the reasons specified above, the proposed project would not generate wastewater or stormwater discharges that have the potential to degrade water quality or contaminate a public water supply. Additionally, the proposed project is required to comply with the Stormwater Management Ordinance, which requires the project to maintain or reduce the existing volume and rate of stormwater runoff at the site by retaining runoff onsite, promoting stormwater reuse, and limiting site discharges before entering the combined sewer collection system.

The proposed project would also be required to comply with requirements of the Construction Site Runoff Ordinance, which regulates the discharge of sediment or other pollutants from construction sites and prevents erosion and sedimentation due to construction activities. Furthermore, before the street improvement permit can be finalized, SFPUC must review and approve the proposed plans.

Therefore, the proposed project would not have significant environmental impacts related to water quality.

For the reasons discussed above, the proposed project would incrementally increase demand for and use of these services, but not in excess of amounts expected and provided for in this area. The proposed project would not exceed any applicable wastewater treatment requirements or otherwise conflict with RWQCB requirements, and the minor population increase associated with the proposed project would not exceed the capacity of the existing wastewater treatment provider or substantially increase the demand for wastewater treatment or stormwater drainage facilities requiring the construction of new facilities or expansion of existing facilities. This impact would be less than significant and no mitigation measures are required.

Impact UT-2: The proposed project would not require expansion or construction of new water supply or treatment facilities. *(Less-Than-Significant Impact)*

The proposed project would add two residential units to the project site, which would increase the demand for water on the site compared to existing conditions, but not in excess of amounts expected and provided for in the project area. Although the proposed project would incrementally increase the demand for water in San Francisco, the estimated increase in demand could be accommodated within anticipated water use and supply for the City.[52] The proposed project would also be designed to incorporate water-conserving measures, such as low-flush toilets and urinals, as required by the San Francisco Green Building Ordinance. The project site is not located within a designated recycled water use area, as defined in the Recycled Water Ordinance 390-91 and 393-94; thus, the project is not required to install a recycled water system. Since the proposed project's water demand could be accommodated by the existing and planned supply anticipated under the San Francisco Public Utilities Commission's (SFPUC's) 2010 Urban Water Management Plan (UWMP), as updated by the

[52] San Francisco Public Utilities Commission, *2010 Urban Water Management Plan*, June 2011. This document is available for review at: www.sfwater.org/Modules/ShowDocument.aspx?documentID=1055.

SFPUC's 2013 Water Availability Study, the proposed project would result in less-than-significant impacts related to water services and no mitigation measures would be required.

Impact UT-3: The proposed project would be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs. ***(Less-Than-Significant Impact)***

In September 2015, the City entered into a landfill disposal agreement with Recology, Inc. for disposal of all solid waste collected in San Francisco at the Recology Hay Road Landfill in Solano County for nine years or until 3.4 million tons have been disposed whichever occurs first. The City would have an option to renew the agreement for a period of six years or until an additional 1.6 million tons have been disposed, whichever occurs first.[53] The Recology Hay Road Landfill is permitted to accept up to 2,400 tons per day of solid waste, at that maximum rate the landfill would have capacity to accommodate solid waste until approximately 2034. At present, the landfill receives an average of approximately 1,850 tons per day from all sources, with approximately 1,200 tons per day from San Francisco; at this rate landfill closure would occur in 2041. The City's contract with the Recology Hay Road Landfill is set to terminate in 2031 or when 5 million tons have been disposed, whichever occurs first. At that point, the City will either further extend the Recology Hay Road Landfill contract or find and entitle another landfill site. The proposed project, which would include construction waste and operational waste associated with the residential use, would generate a minimal amount of solid waste to be deposited at the landfill. Therefore, the proposed project would be served by landfills with sufficient permitted capacity to accommodate its solid waste disposal needs. This impact would be less than significant and no mitigation measures would be required.

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[53] San Francisco Planning Department, *Agreement for Disposal of San Francisco Municipal Solid Waste at Recology Hay Road Landfill in Solano County Final Negative Declaration*, Planning Department Case No. 2014.0653, May 21, 2015. Available online at: sfmea.sfplanning.org/2014.0653E_Revised_FND.pdf.

Impact UT-4: Construction and operation of the proposed project would comply with all applicable statutes and regulations related to solid waste. ***(Less-Than-Significant Impact)***

The California Integrated Waste Management Act of 1989 (AB 939) requires municipalities to adopt an Integrated Waste Management Plan (IWMP) to establish objectives, policies, and programs relative to waste disposal, management, source reduction, and recycling. Reports filed by the San Francisco Department of the Environment showed the City generated approximately 870,000 tons of waste material in 2000. By 2010, that figure decreased to approximately 455,000 tons. Waste diverted from landfills is defined as recycled or composted.[54] San Francisco has a goal of 75 percent landfill diversion by 2010 and 100 percent by 2020. As of 2012 (the most recent year reported), 80 percent of San Francisco's solid waste was being diverted from landfills, indicating that San Francisco met the 2010 diversion target.[55]

In September, 2015, the City approved an Agreement with Recology, Inc., for the transport and disposal of the City's municipal solid waste at the Recology Hay Road Landfill in Solano County. The City began disposing its municipal solid waste at Recology Hay Road Landfill in January, 2016, and that practice is anticipated to continue for approximately nine years, with an option to renew the Agreement thereafter for an additional six years. San Francisco had a goal of 75% solid waste diversion by 2010, which it exceeded at 80% diversion, and has a goal of 100% solid waste diversion or "zero waste" to landfill or incineration by 2020. San Francisco Ordinance No. 27-06 requires mixed construction and demolition debris be transported by a Registered Transporter and taken to a Registered Facility that must recover for reuse or recycling and divert from landfill at least 65% of all received construction and demolition debris. The San Francisco Green Building Code also requires certain projects to submit a Recovery Plan to the Department of the Environment

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[54] CalRecycle, Jurisdiction Diversion/Disposal Rate Detail. Available online at: www.calrecycle.ca.gov/LGCentral/Reports/Viewer.aspx?P=OriginJurisdictionIDs%3d438%26ReportYear%3d2013%26ReportName%3dReportEDRSJurisDisposalByFacility.

[55] San Francisco Department of the Environment, Zero Waste Program, "San Francisco Sets North American Record for Recycling and Composting with 80 Percent Diversion Rate." Available online at www.sfenvironment.org/news/press-release/mayor-lee-announces-san-francisco-reaches-80-percent-landfill-waste-diversion-leads-all-cities-in-north-america.

demonstrating recovery or diversion of at least 75% of all demolition debris. San Francisco's Mandatory Recycling and Composting Ordinance No. 100-09 requires all properties and everyone in the city to separate their recyclables, compostables, and landfill trash.

Therefore, given the above, the construction and operation of the project would result in a Less-Than-Significant Impact regarding compliance with all applicable statutes and regulations related to solid waste and no mitigation measures would be required.

Impact C-UT-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects, would not result in a cumulative impact related to utilities or service systems. *(Less-Than-Significant Impact)*

Cumulative development in the project site vicinity would incrementally increase demand on citywide utilities and service systems, but not beyond levels anticipated and planned for by public service providers. The SFPUC has accounted for such growth in its water demand and wastewater service projections, and the City has implemented various programs to divert 80 percent of its solid waste from landfills. Nearby cumulative development projects would be subject to the same water conservation, wastewater discharge, recycling and composting, and construction demolition and debris ordinances applicable to the proposed project. Compliance with these ordinances would reduce the effects of nearby cumulative development projects to Less Than Significant levels. For these reasons, the proposed project would not combine with past, present, and reasonably foreseeable future projects in the project vicinity to create a significant cumulative impact on utilities and service systems.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
11. PUBLIC SERVICES— Would the project:					
a) Result in substantial adverse physical impacts associated with the provision of, or the need for, new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any public services such as fire protection, police protection, schools, parks, or other services?	☐	☐	☒	☐	☐

The proposed project's impacts on parks and recreation are discussed under **Section H.9, Recreation.** Impacts to other public services are discussed below.

Impact PS-1: The proposed project would not result in a substantial adverse physical impact associated with the provision of police services. *(Less-Than-Significant Impact)*

The project site currently receives police services from the San Francisco Police Department (SFPD). The proposed project would result in the addition of two residential units on the currently unoccupied project site and is unlikely to result in an increase in demand for police service calls in the project area. Police protection is provided by the Ingleside Police Station located at 1 Sgt John V Young Lane, approximately 2.5 miles east of the project site. The Ingleside Station would be able to provide the necessary police services and crime prevention in the area. Meeting the service demand associated with two residential units at the project site would not require the construction of new police facilities that could cause significant environmental impact. As such, the impact would be less than significant, and no mitigation measures would be required.

Impact PS-2: The proposed project would not result in a substantial adverse physical impact associated with the provision of fire services. *(Less-Than-Significant Impact)*

The project site receives fire protection services from the San Francisco Fire Department (SFFD). Fire stations located nearby include Station 32, at 194 Park Street approximately 0.8 miles southwest of the project site; and Station 9 at 2245 Jerrold Avenue approximately 1.5 miles from the project. The proposed project would result in the addition of two residential units on the currently unoccupied project site and is unlikely to result in an increase in demand for fire service calls in the project area. Moreover, the proposed project would be required to comply with all applicable building and fire code requirements, which identify specific fire protection systems, including, but not limited to, the provision of State-mandated smoke alarms, fire alarm and sprinkler systems, fire extinguishers, fire-rated walls, the required number and location of egress with appropriate distance separation, and emergency response notification systems. Compliance with all applicable building and fire codes, would further reduce the demand for Fire Department service and oversight.

Given that the prosed project would not result in a fire service demand beyond the projected growth for the area or the city, the proposed project would not result in the need for new fire protection facilities, and would have no adverse impact on the physical environment related to the construction of new or physically altered fire protection facilities. This impact would be less than significant and no mitigation measures would be required.

Impact PS-3: The proposed project would not result in a substantial adverse physical impact associated with the provision of school services. *(Less-Than-Significant Impact)*

The San Francisco Unified School District (SFUSD) provides public primary and secondary education in the City and County of San Francisco. Junipero Serra Elementary School at 625 Holly Park Circle Street is approximately 0.7 mile southwest of the project site. Willie L Brown Jr Middle School at 2055 Silver Avenue is located approximately 1.5 miles southeast of the site. The nearest high school to the project site is Thurgood Marshall High School at 45 Conkling Street, approximately 1.4 miles southeast of the project site.

Based on a student generation rate employed by SFUSD of 0.203 students per dwelling unit, the two residential units that would be built as part of the proposed project could generate approximately one K-12 student. Similar to other City-wide developments, the proposed project would be assessed $2.42 per gross square foot of residential space as a school impact fee. The estimated one additional new student would not require the construction or expansion of school facilities. It is anticipated that the new student could be accommodated by existing schools under the jurisdiction of the SFUSD since the SFUSD is currently not experiencing high growth rates, and public school facilities throughout the City and County of San Francisco are generally underutilized. The SFUSD is not planning to construct new schools near the project site.

Given that SFUSD has adequate facilities to accommodate growth, the new student generated by the proposed project would not substantially increase demand for school facilities in San Francisco and would not result in a significant impact. In addition, as with all new development, the project sponsor would be required to pay one-time school impact fees under Government Code Section 65995(b)(3), as stated above, which could be used by SFUSD for costs associated with providing facilities for new students.

In addition, The Leroy F. Greene School Facilities Act of 1998, or Senate Bill 50 (SB 50), restricts the ability of local agencies, such as the City of San Francisco, to deny land use approvals on the basis that public school facilities are inadequate. SB 50 establishes the base amount of allowable developer fees for school facilities at $2.24 per square foot of residential construction and $0.21 per square foot of commercial construction as of 2006. These fees are intended to address local school facility needs resulting from new development. Public school districts may, however, impose higher fees provided they meet the conditions outlined in the act.

Based on the foregoing, the proposed project would not result in a substantially increased demand for school facilities, and would not require new or expanded school facilities. Therefore, this impact would be less than significant and no mitigation measures would be required.

Impact PS-4: The proposed project would not result in a substantial adverse physical impact associated with the provision of other public services, such as libraries. *(Less-Than-Significant Impact)*

Implementation of the proposed project would add approximately five residents to the project site which would increase the demand for other public services such as libraries. This increase in demand would not be substantial given the overall demand for library services on a citywide basis. The San Francisco Public Library (SFPL) operates 29 branches throughout the City and it is anticipated that the Bernal Heights Branch Library, which is located 0.4 miles south of the project site, would be able to accommodate the minor increase in demand for library services generated by the proposed project.

For these reasons, the proposed project would not require the construction of new or alteration of existing governmental facilities. This impact would be less than significant and no mitigation measures would be required.

Impact PS-5: The proposed project, in combination with past, present, and reasonably foreseeable projects, would not result in a cumulative impact on public services. *(Less-Than-Significant Impact)*

Cumulative development in the project vicinity would result in a minor intensification of land uses and a cumulative increase in the demand for fire protection, police protection, school services, and other public services. The Fire Department, the Police Department, the SFUSD, SFPL, and other City agencies have accounted for such growth in providing public services to the residents of San Francisco. Nearby cumulative development projects would be subject to many of the same development impact fees applicable to the proposed project. For these reasons, the proposed project would not combine with past, present, and reasonably foreseeable future projects in the project vicinity to create a significant cumulative impact on public services. This impact would be less than significant and no mitigation measures would be required.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
12. BIOLOGICAL RESOURCES— Would the project:					
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☒	☐	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☐	☒
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☒	☐	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒	☐
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or State habitat conservation plan?	☐	☐	☐	☐	☒

The project site is located within a built environment and does not contain riparian habitat or other sensitive natural communities as defined by the California Department of Fish and Wildlife and the United States Fish and Wildlife Service; therefore, Topic 12.b is not applicable to the proposed project. In addition, the project area does not contain wetlands as defined by Section 404 of the Clean Water Act; therefore, Topic 12.c is also not applicable. Finally, there are no adopted Habitat Conservation Plans, Natural Community Conservation Plans, of other approved local, State, or regional habitat conservation plans applicable to the project site. Therefore, implementation of the proposed project could not conflict with the provisions of any such plan and Topic 12.f is not applicable to the proposed project.

Impact BI-1: The proposed project would not have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species, riparian habitat or sensitive natural communities, and would not interfere substantially with any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites. *(Less-Than-Significant Impact)*

The project site is an undeveloped lot in a built urban environment and does not include any candidate, sensitive, or special-status species, any riparian habitat, or other sensitive natural community identified in regional plans, policies, or regulations or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service, nor would it interfere substantially with any native resident or migratory species, or species movement or migratory corridors.

A sensitive plant species, hummingbird sage (*Salvia spathacea*) is present on the northern portion of Public Works' property adjacent to the project site, to the north, along Bernal Heights Boulevard. The proposed stairway between Folsom Street and Bernal Heights Boulevard would be located at least 15 feet downhill from where the plants are located and would not run through or otherwise disturb the existing hummingbird sage. The proposed alignment would both avoid the sensitive species during construction and direct pedestrians along a route that would avoid contact with the plants.

Migrating birds do pass through San Francisco. Nesting birds, their nests, and eggs are fully protected by *California Fish and Game Code* (Sections 3503, 3503.5) and the federal Migratory Bird Treaty Act (MBTA). Although the proposed project would be subject to the MBTA, the site does not contain habitat supporting migratory birds.

San Francisco is within the Pacific Flyway, a major north-south route of travel for migratory birds along the western portion of the Americas. Planning Code Section 139, Standards for Bird-Safe Buildings, establishes building design standards to reduce avian mortality rates associated with bird strikes. This ordinance focuses on location-specific hazards and building feature-related hazards. Location-specific hazards apply to buildings in, or within 300 feet of and having a direct line of sight to, an Urban Bird Refuge, which is defined as an open space "two acres and larger dominated by vegetation, including vegetated landscaping, forest, meadows, grassland, or wetlands, or open water." Although the project site is within 300 feet of an Urban Bird Refuge, Bernal Heights Park, Planning Code Section 139 exempts projects that are less than 45 feet in height and have an exposed façade comprised of less than 50% glass, such as the proposed project, from the requirement to implement birdsafe design standards. Even though the Planning Code deems structures such as the proposed project too small to require birdsafe design, the likelihood of even occasional bird strikes to the proposed project having a substantial adverse impact on candidate, sensitive, or special-status bird species is very low.

Given the above, implementation of the proposed project would not modify any natural habitat and this impact would be Less Than Significant.

Impact BI-2: The proposed project would not conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance. *(No Impact)*

The City's Urban Forestry Ordinance, *Public Works Code* Sections 801 et. seq., requires a permit from San Francisco Public Works to remove any protected trees. There are no existing trees or other vegetation on the project site that would be removed as part of the proposed project, and as previously discussed, the proposed project includes one street tree per unit, and the subsequent street improvement would include the planting of additional street trees, upon approval by Public Works. The proposed project would not conflict with any local policies or ordinances that protect biological resources, and no impact would occur. Also, as mentioned above, a sensitive plant species, hummingbird sage (*Salvia spathacea*) is present on the northern portion of Public Works property adjacent to the north of the project site, along Bernal Heights Boulevard. The proposed stairway between Folsom Street and Bernal Heights Boulevard would be located at least 15 feet downhill from where the plants are located, and would not run through or otherwise disturb the existing hummingbird sage.

Impact C-BI-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects, would not result in a cumulative impact related to biological resources. *(Less-Than-Significant Impact)*

Cumulative development in the project vicinity would result in the construction of multi-story buildings that can injure or kill birds in the event of a collision and would result in the removal of existing street trees or other vegetation. Moreover, while there is a sensitive plant species on a property adjacent to the project site, the property is publically-owned and the proposed project's stairway alignment would be downhill from the plant and would direct future pedestrian traffic around it. No other candidate, sensitive or special-status species, any riparian habitat, or other sensitive natural community in the project vicinity. For these reasons, the proposed project would not combine with past, present, and reasonably foreseeable future projects in the project vicinity to create a significant cumulative impact on biological resources. This impact would be less than significant and no mitigation measures would be required.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
13. GEOLOGY AND SOILS—Would the project:					
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:					
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42.)	☐	☐	☒	☐	☐
ii) Strong seismic ground shaking?	☐	☐	☒	☐	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐	☐
iv) Landslides?	☐	☐	☒	☐	☐
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐	☐
c) Be located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☒	☐	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property?	☐	☐	☒	☐	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☐	☒
f) Change substantially the topography or any unique geologic or physical features of the site?	☐	☐	☒	☐	☐
g) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☒	☐	☐

The project site would be connected to the City's existing sewer system and would not require use of septic systems. Therefore, Topic 13.e would not be applicable to the project site.

The analysis in this section is based, in part, on the Geotechnical Investigations prepared for the proposed project.[56] The project site is underlain by three to four feet of soil overlying chert bedrock. The soil is characterized as very stiff, lean clay at one boring location, and very stiff, silty clayey sand overlying sandy lean clay at another boring location. Groundwater was not encountered at the maximum boring depth of five feet. The proposed project includes a maximum depth of excavation of ten feet for installation of the spread footing foundations for the proposed residences.

Impact GE-1: The proposed project would not result in exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, seismic groundshaking, liquefaction, lateral spreading, or landslides. ***(Less-Than-Significant Impact)***

The project site is not located within an Earthquake Fault Zone as defined by the Alquist-Priolo Earthquake Fault Zoning Act and no known or potentially active fault exists on the site.[57] No active faults have been mapped on the project site by the United States Geological Survey (USGS) or the California Geological Survey (CGS).[58] In a seismically active area, such as the San Francisco Bay Area, the possibility exists for future faulting in areas where no faults previously existed. However, since faults with known surface rupture have been mapped in California, and no evidence of active faulting on the site has been found, the potential for impacts to the proposed project due to fault rupture are less than significant.

However, although the project site is not located within a seismic hazard zone, it may be subject to ground shaking in the event of an earthquake on regional fault lines like the entire San Francisco Bay

[56] H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3516 Folsom Street, San Francisco, California, August 3, 2013. H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3526 Folsom Street, San Francisco, California, August 3, 2013.

[57] California Department of Conservation, California Geological Survey, Alquist-Priolo Fault Zones in Electronic Format, 2010. This document is available for review at www.quake.ca.gov/gmaps/ap/ap_maps.htm

[58] U.S. Geological Survey and California Geological Survey, Quaternary Fault and Fold Database for the United States, 2010. This document is available for review at www.earthquake.usgs.gov/hazards/qfaults .

Area would.[59] The site is located approximately six miles northeast of the San Andreas Fault. The 2007 Working Group on California Earthquake Probabilities estimates that there is a 63 percent chance that a magnitude 6.7 or greater earthquake will occur in the San Francisco Bay Area within 30 years. The Association of Bay Area Governments (ABAG) has classified the Modified Mercalli Intensity Shaking Severity Level of ground shaking in the project vicinity due to an earthquake on the North Golden Gate segment of the San Andreas Fault System as "VIII-Very Strong."[60] Therefore, it is likely that the site would experience periodic minor or major earthquakes associated with a regional fault, resulting in strong to very strong ground shaking.

Ground shaking associated with an earthquake on one of the regional faults around the project site may result in ground failure, such as that associated with soil liquefaction, lateral spreading, and differential compaction. The project site does not lie within a liquefaction potential zone as mapped by the California Division of Mines and Geology, and borings at the site indicate that the liquefaction potential at the site is low. Because the project site's liquefaction potential is low, lateral spreading would be unlikely to occur. Risks associated with liquefaction and differential compaction would be reduced with implementation of standard building engineering and design measures.

As shown on the official State of California Seismic Hazards Zone Map for San Francisco prepared under the Seismic Hazards Mapping Act of 1990,[61] the project site is not located within an area subject to landslides (see Map 5 of the Community Safety Element). Therefore, the proposed project would result in Less Than Significant landslide-related impacts.

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[59] California Division of Mines and Geology, State of California Seismic Hazard Zones, City and County of San Francisco Official Map, November 17, 2000. This document is available for review at gmw.consrv.ca.gov/shmp/download/pdf/ozn_sf.pdf.

[60] Association of Bay Area Governments, Earthquake Shaking Hazard Map, San Francisco Scenario, North Golden Gate Segment of the San Andreas Fault System, 2003. This document is available for review at resilience.abag.ca.gov/earthquakes and at the San Francisco Planning Department, 1650 Mission Street, Suite 400, as part of Case File No. 2015-011274ENV.

[61] The Seismic Hazards Mapping Act was developed to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and from other hazards caused by earthquakes. This Act requires the State Geologist to delineate various seismic hazard zones and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones.

Given the above, the proposed project would not result in exposure of people or structures to potential substantial adverse effects, nor would it aggravate existing seismic hazards, including the risk of loss, injury, or death involving rupture of a known earthquake fault, seismic groundshaking, liquefaction, lateral spreading, or landslides. This impact would be less than significant and no mitigation measures would be required.

Impact GE-2: The proposed project would not result in substantial loss of topsoil or erosion. ***(Less-Than-Significant Impact)***

The proposed project is currently underdeveloped, and is covered with pervious surf top soil. Although excavation would occur as part of the proposed project, compliance with the City's Construction Site Water Pollution Prevention Program[62] would require the project sponsor to prepare and implement an erosion and sediment-control plan subject to review by the City. Compliance with this regulation would reduce and control site runoff during construction activities and reduce the potential for erosion to a Less Than Significant level. No mitigation measures would be required and the effect is Less Than Significant.

Impact GE-3: The proposed project would not be located on a geologic unit that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. ***(Less-Than-Significant Impact)***

The project site and vicinity do not include any hills or cut slopes that could cause or be subject to a landslide. Temporary slopes would be necessary during site excavations. If excavations undermine or remove support from the existing and adjacent structures, it may be necessary to underpin those structures. The final design of the foundation system would be included in a design-level geotechnical investigation that is based on site-specific data in accordance with building code requirements. According to the Geotechnical Investigation, soils at the site are capable of supporting a conventional spread footing foundation in accordance with industry standards and building code requirements. Drilled piers may also be utilized to support the foundation or for shoring and

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[62] San Francisco Municipal Code (Public Works Code) Part II. Chapter 10. Article 4.1. 40 GF Section 403.

underpinning. Excavation activities would require the use of shoring and underpinning in accordance with the recommendations of the geotechnical report and *San Francisco Building Code* requirements. Groundwater is not anticipated to be encountered during excavation and grading activities.

Adherence to San Francisco Building Code requirements would ensure that the project applicant include analysis and avoidance of any potential impacts related to unstable soils as part of the design-level geotechnical investigation prepared for the proposed project; therefore, any potential impacts related to unstable soils would be less than significant and no mitigation measures would be required.

Impact GE-4: The proposed project could be located on expansive soil, as defined in the California Building Code, but would not create substantial risk to life or property. *(Less-Than-Significant Impact)*

Expansive soils expand and contract in response to changes in soil moisture, most notably when near surface soils vacillate between a saturated, low-moisture, and a saturated, high-moisture content condition. The presence of expansive soils is typically determined based on site specific data. As noted above, the site is underlain by firm to very stiff, sandy lean clay as well as firm to hard, lean clay with varying amounts of sand. Expansive soils may be encountered at the site; the San Francisco Building Code includes a requirement that the project applicant include analysis of the potential for soil expansion as part of the design-level geotechnical investigation prepared for the proposed project. Compliance with existing building code requirements (which the design-level geotechnical report would be required to comply with), would ensure that any potential impacts related to expansive soils would be less than significant. No mitigation measures would be required and the effects of the proposed project would be Less Than Significant.

Impact GE-5: The proposed project would not substantially change the topography of the site or any unique geologic or physical features of the site. *(Less-Than-Significant Impact)*

The project site is located on a steep slope of approximately 28 percent. Although minor excavations would be required to support the building foundation, the proposed project would follow the recommendations in the geotechnical report and have Less-Than-Significant Impacts with respect to alterations to topographical features. The hillside would remain intact and the proposed project would be required to follow the City's stormwater management requirements for the new construction and the roadway extension to provide adequate drainage to the site. The proposed project would not include any work that would significantly alter the grade of the hillside or the character of the project site as part of a hillside residential area Structures in the immediate vicinity of the proposed project are similarly built into the hillside. This impact would be less than significant and no mitigation measures would be required.

Impact GE-6: The proposed project would not directly or indirectly destroy a unique paleontological resource or site or unique geologic feature. ***(Less-Than-Significant Impact)***

Paleontological resources include fossilized remains or traces of animals, plants, and invertebrates, including their imprints, from a previous geological period. Collecting localities and the geologic formations containing those localities are also considered paleontological resources as they represent a limited, non-renewable resource and once destroyed, cannot be replaced.

The project site is underlain by fill and sandy to clayey soils on top of chert bedrock. The likelihood of discovery of paleontological resources or unique geological features as a result of the proposed project is low. Therefore, there would be a Less-Than-Significant Impact and no mitigation measures would be required.

Impact C-GE-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects, would not result in a cumulative impact related to geology and soils. ***(Less-Than-Significant Impact)***

The proposed project would result in Less-Than-Significant Impacts related to topographical features and risk of injury or death involving landslides. Impacts related to rupture of an earthquake fault, seismic ground shaking or ground failure, unstable soil, or the loss of top soil would be less than significant. Impacts to paleontological resources and geologic features would also be less than significant. Geology and soils impacts are generally site-specific and localized and do not have cumulative effects with other projects. These impacts are specific to the project and would not combine with similar impacts associated with past, present, and reasonably foreseeable future projects in the site vicinity. These impacts would be less than significant and no mitigation measures would be required.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
14. HYDROLOGY AND WATER QUALITY—Would the project:					
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☒	☐	☐
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☒	☐	☐
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion of siltation on- or off-site?	☐	☐	☒	☐	☐
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on- or off-site?	☐	☐	☒	☐	☐
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☒	☐	☐
f) Otherwise substantially degrade water quality?	☐	☐	☒	☐	☐
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other authoritative flood hazard delineation map?	☐	☐	☐	☐	☒
h) Place within a 100-year flood hazard area structures that would impede or redirect flood flows?	☐	☐	☐	☐	☒

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☐	☒
j) Expose people or structures to a significant risk of loss, injury or death involving inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☐	☒

The project is located well inland from both the San Francisco Bay and the Pacific Ocean, and is not subject to seiche or potential inundation in the event of a levee or dam failure or tsunami occurring along the San Francisco coast (Maps Five, Six and Seven of the Community Safety Element of the General Plan).[63] In addition, the developed area of the project site would not be subject to mudflow. Therefore, Topic 14.j does not apply. The project site is also not located within a 100-year flood hazard area designated on the City's interim floodplain map, and would not place housing or structures within a 100-year flood hazard area that would impede or redirect flood flows.[64] Therefore, Topics 14.g, 14.h, and 14.i are also not applicable.

Impact HY-1: The proposed project would not violate water quality standards or otherwise substantially degrade water quality. *(Less-Than-Significant Impact)*

Wastewater and stormwater flows generated on the project site flow into the City's combined sewer system and into the Southeast Water Pollution Control Plant, where they are treated prior to discharge into San Francisco Bay. Treatment is undertaken consistent with the effluent discharge standards established by the plant's National Pollutant Discharge Elimination System (NPDES) permit. In accordance with the permit, discharges of treated wastewater and stormwater into San Francisco Bay meet the requirements of the Clean Water Act, Combined Sewer Overflow Control

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63 San Francisco, City and County of, *San Francisco General Plan, Community Safety Element,* April 2007. This document is available for review at the Planning Department in Case File No. 2011.0409E.

64 FEMA Preliminary Flood Insurance Rate Map, 2016. Available online at: sfgsa.org/sites/default/files/ Document/SF NE.pdf.

Policy, and associated State requirements in the Water Quality and Control Plan for the San Francisco Bay Basin and do not violate water quality standards.

The construction and operation of two single-family homes, built consistent with the Planning Code and Building Code, in a residential area would not be expected result in wastewater or stormwater flows that would degrade water quality nor violate water quality standards. This impact would be less than significant and no mitigation measures would be required.

Impact HY-2: The proposed project would not substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level. *(Less-Than-Significant Impact)*

The proposed project includes the construction of two single family homes and street improvements to serve those homes. The proposed project does not include any elements that would tap into, or remove, existing ground water. The two residential units would be constructed consistent with the Building Code and any subsequent street improvement would be required to include design elements to minimize impervious surfaces and to not interfere with groundwater recharge. Existing city regulations would ensure that the project would not substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level. This impact would be less than significant and no mitigation measures would be required.

Impact HY-3: The proposed project would not result in altered drainage patterns that would cause substantial erosion or flooding. *(Less-Than-Significant Impact)*

The project site is currently an unimproved hillside and stormwater flows are currently uncontrolled. The proposed project would include drainage elements that would control stormwater runoff and direct it into the City's combined stormwater/sewer system. The proposed project would be required to comply with SFPUC's Stormwater Management Requirements and Design Guidelines, which include meeting specific performance measures for impervious surfaces and stormwater run-off rate, the approval of a Preliminary Stormwater Control Plan before receiving a Site or Building Permit, and the approval of a Final Stormwater Control Plan before receiving the Certificate of Final

Completion.[65] Therefore, the proposed project would not be expected to result in substantial erosion or flooding associated with changes in drainage patterns. This impact would be less than significant and no mitigation measures would be required.

Impact HY-4: The proposed project would not contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. ***(Less-Than-Significant Impact)***

During operation of the proposed project, all wastewater and stormwater runoff from the project site would be treated at the Southeast Water Pollution Control Plant. Treatment would be provided pursuant to the effluent discharge standards contained in the City's NPDES permit for the plant. During construction and operation, the proposed project would be required to comply with all local wastewater discharge and water quality requirements, which would ensure that all stormwater generated by the proposed project is managed on-site such that the project would not contribute additional volumes of polluted runoff to the City's stormwater infrastructure. Therefore, the proposed project would not exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. As such, this impact would be less than significant, and no mitigation measures would be required.

Impact C-HY-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects in the site vicinity, would result in Less Than Significant cumulative impacts to hydrology and water quality. ***(Less-Than-Significant Impact)***

As stated above, the proposed project would result in no impacts or Less-Than-Significant Impacts related to water quality, groundwater levels, alteration of drainage patterns, capacity of drainage infrastructure, 100-year flood zones, failure of dams or levees, and/or seiche, tsunami, and/or mudflow hazards. The proposed project would adhere to the same water quality and drainage control requirements that apply to all land use development projects in San Francisco. Since all development projects would be required to follow the same drainage, dewatering and water quality

[65] San Francisco Public Utilities Commission, *How Do I Comply with the Stormwater Management Requirements*, http://sfwater.org/index.aspx?page=1006. Accessed: May 25, 2017.

regulations, peak stormwater drainage rates and volumes for the design storm would gradually decrease over time with the implementation of new, conforming development projects. Thus, no substantial adverse cumulative effects with respect to drainage patterns, water quality, stormwater runoff, or stormwater capacity of the combined sewer system would occur.

Further, San Francisco's limited use of groundwater would preclude any significant adverse cumulative effects to groundwater levels, and the proposed project would not contribute to any cumulative effects with respect to groundwater. In general, hazards related to 100-year flood zones, failure of dams or levees, and/or seiche, tsunami, and/or mudflows are extremely unusual and are not considered to be substantive impacts in San Francisco such that any cumulative significant impacts would be anticipated, particularly in the interior areas of the city where the project site is located. Given that cumulative impacts are not anticipated since all development projects would be required to follow the same drainage, dewatering and water quality regulations as the proposed project, the proposed project would not contribute to any such cumulative effects. Thus, cumulative hydrology and water quality impacts would be less than significant and no mitigation measures would be required.

Topics:	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less-Than-Significant Impact*	*No Impact*	*Not Applicable*
15. HAZARDS AND HAZARDOUS MATERIALS—Would the project:					
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☒	☐	☐

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☒	☐	☐
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐	☐
h) Expose people or structures to a significant risk of loss, injury or death involving fires?	☐	☐	☒	☐	☐

The project site is not located within an airport land use plan area or in the vicinity of a private airstrip. Therefore, Questions 15.e and 15.f are not applicable.

As discussed above under Impact NO-3, construction of the proposed project would result in ground vibration that could potentially affect the integrity of PG&E's gas Pipeline 109. The discussion above describes those impacts and sets forth vibration-related mitigation measures to reduce those potential impacts to less than significant.

Impact HZ-1: The proposed project would not create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials. ***(Less-Than-Significant Impact)***

Construction activities would require the use of limited quantities of hazardous materials such as fuels, oils solvents, paints, and other common construction materials. The City would require the project sponsor and its contractor to implement Best Management Practices (BMPs) as part of their construction activities, including hazardous materials management measures, which would reduce the hazards associated with short-term construction-related transport, and use and disposal of hazardous materials to Less Than Significant levels.

The proposed project's residential uses would involve the use of relatively small quantities of hazardous materials such as cleaners and disinfectants for routine purposes. These products are labeled to inform users of potential risks and to instruct them in appropriate handling procedures. Most of these materials are consumed through use, resulting in relatively little waste. For these reasons, the proposed project would not create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials. This impact would be less than significant and no mitigation measures would be required.

Impact HZ-2: The proposed project would not create a significant hazard to the public or the environment through reasonably foreseeable conditions involving the release of hazardous materials into the environment. *(Less-Than-Significant Impact)*

The project site is not currently located in a Maher Area, meaning that it is not known or suspected to contain contaminated soils and/or groundwater.[66] Based on mandatory compliance with existing regulatory requirements, the proposed project would not result in a significant hazard to the public or environment from contaminated soil and/or groundwater, asbestos, or lead-based paint, and the proposed project would result in a Less-Than-Significant Impact with respect to these hazards and no mitigation would be required.

[66] San Francisco Planning Department, Expanded Maher Map Area, March 2015. This document is available for review at: www.sf-planning.org/ftp/files/publications_reports/library_of_cartography/Maher%20Map.pdf.

Impact HZ-3: The proposed project would not result in hazardous emissions or in the handling of hazardous or acutely hazardous materials, substances, or waste within 0.25 of a mile of an existing school. ***(Less-Than-Significant Impact)***

There are no schools within a quarter-mile of the project site. As such, the proposed project would have a Less-Than-Significant Impact related to hazardous emissions or the handling of hazardous materials within a quarter mile of a school and this impact would be less than significant.

Impact HZ-3: The project site is not included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5, and the proposed project would create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment. ***(Less-Than-Significant Impact)***

The project site is not included on a list of hazardous materials sites compiled by the California Department of Toxic Substance Control pursuant to Government Code Section 65962.5 and, as previously discussed, the project site is not located in a Maher Area. As such, the proposed project is not included on a list of hazardous materials sites and the proposed project would not result in the accidental release of hazardous materials into the environment. This impact would be less than significant and no mitigation measures would be required.

Impact HZ-4: The proposed project would not impair implementation of, or physically interfere with, an adopted emergency response plan or emergency evacuation plan and would not expose people or structures to a significant risk of loss, injury, or death involving fires. ***(Less-Than-Significant Impact)***

The proposed project would develop residential uses on an existing "paper street' segment of Folsom Street and would not alter the existing street grid. The proposed project would not impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.

The City requires that existing and new buildings meet fire safety standards through compliance with the applicable provisions of the Building Code and Fire Code. Therefore, the proposed project's compliance with Building Code and Fire Code requirements would result in a Less-Than-Significant Impact related to the exposure of persons or structures to fire risks.

Impact C-HZ-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects in the site vicinity, would result in Less Than Significant cumulative impacts related to hazards and hazardous materials. *(Less-Than-Significant Impact)*

Hazards-related impacts are generally site-specific and typically do not combine with impacts from other planned and foreseeable projects to result in significant cumulative impacts. New developments in the vicinity of the project site would be subject to similar regulatory requirements and mitigation measures as the proposed project. Therefore, large, unexpected releases of hazardous materials of the type that would contribute to significant cumulative impacts are not expected. Compliance with existing regulations pertaining to the treatment and management of hazardous materials would ensure that the proposed project would not make a significant cumulative contribution to the release of hazardous materials. Therefore, cumulative hazards impacts would be less than significant and no mitigation would be required.

Topics:	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less-Than-Significant Impact*	*No Impact*	*Not Applicable*
16. MINERAL AND ENERGY RESOURCES—Would the project:					
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the State?	☐	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☐	☒
c) Encourage activities which result in the use of large amounts of fuel, water, or energy, or use these in a wasteful manner?	☐	☐	☒	☐	☐

All land in the City of San Francisco, including the project site, is designated by the CGS as Mineral Resource Zone Four (MRZ-4) under the Surface Mining and Reclamation Act of 1975. The MRZ-4 designation indicates that adequate information does not exist to assign the area to any other MRZ; thus, the area is not designated to have significant mineral deposits. The area surrounding the project site has previously been developed, and future evaluations of the presence of minerals at this site would therefore not be affected by the proposed project. Further, the development and operation of the proposed project would not have an impact on any off-site operational mineral resource recovery sites. Therefore, Topics 16.a and 16.b are not applicable to the proposed project.

Impact ME-1: The proposed project would not encourage activities which would result in the use of large amounts of fuel, water, or energy, or use these in a wasteful manner. *(Less-Than-Significant Impact)*

Development of new residential uses as part of the proposed project would not result in the consumption of large amounts of fuel, water, or energy. As two new buildings in San Francisco, the proposed project is required to conform to energy conservation standards specified by the San Francisco Building Code, including the San Francisco Green Building Ordinance. The measures required by the San Francisco Green Building Ordinance are intended to reduce greenhouse gas emissions associated with new construction and rehabilitation activities, increase energy efficiency, reduce water use, and realize other environmental gains. Compliance with the San Francisco Green Building Ordinance would reduce the use of energy and water by the proposed project.
Based on the above information, the proposed project would not result in the consumption of large amounts of fuel, water, or energy. This impact would be less than significant and no mitigation measures would be required.

Impact C-ME-1: The proposed project, in combination with past, present, and reasonably foreseeable future projects in the site vicinity, would result in Less Than Significant cumulative impacts to minerals and energy. *(Less-Than-Significant Impact)*

As described above, no known mineral resources exist at the project site, and therefore the proposed project would not contribute to any cumulative impacts related to mineral resources. Compliance with current State and local standards regarding energy consumption and conservation, including Title 24 of the California Code of Regulations and the San Francisco Green Building Ordinance, would ensure that the project would not in and of itself require a major expansion of power facilities. Therefore, the energy demand associated with the proposed project would result in a Less Than Significant physical environmental effect. The proposed project would not contribute to cumulatively considerable impacts related to energy and natural resources. Overall, the proposed project would not result in cumulatively considerable impacts related to mineral and energy resources. This impact would be less than significant and no mitigation measures would be required.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
17. AGRICULTURE AND FOREST RESOURCES In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the State's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. **—Would the project:**					
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance, as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☐	☒
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code Section 12220(g)) or timberland (as defined by Public Resources Code Section 4526)?	☐	☐	☐	☐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☐	☒
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland to non-agricultural use or forest land to non-forest use?	☐	☐	☐	☐	☒

The project site is located within an urbanized area of San Francisco. No land in San Francisco County has been designated by the California Department of Conservation's Farmland Mapping and Monitoring Program as agricultural land. The project site does not contain agricultural uses and is not zoned for such uses. As such, the proposed project would not require the conversion of any land designated as prime farmland, unique farmland, or Farmland of Statewide Importance to non-agricultural use. The proposed project would not conflict with any existing agricultural zoning or

Williamson Act contracts and the California Department of Conservation designates the project site as "Urban and Built-Up Land." No land in San Francisco is designated as forest land or timberland by the State Public Resource Code. Therefore, the proposed project would not conflict with zoning for forest land, cause a loss of forest land, or convert forest land to a different use. For these reasons, Topics 17.a, 17.b, 17.c, 17.d, and 17.e are not applicable to the proposed project.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
18. MANDATORY FINDINGS OF SIGNIFICANCE—Would the project:					
a) Have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☒	☐	☐
b) Have impacts that would be individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☐	☐	☒	☐	☐
c) Have environmental effects that would cause substantial adverse effects on human beings, either directly or indirectly?	☐	☒	☐	☐	☐

a) As discussed, the proposed project is anticipated to have Less-Than-Significant Impacts or Less-Than-Significant Impacts with mitigation incorporated on the environmental topics identified in this Initial Study.

b) The proposed project in combination with past, present and foreseeable projects as described in Section E, would not result in cumulative impacts to land use, population and housing, cultural resources, transportation and circulation, noise and vibration, air quality, wind and shadow, GHG emissions, recreation, utilities and service systems, public services, biological resources, geology and soils, hydrology and water quality, hazards and hazardous materials, mineral and energy resources, and agricultural and forest resources.

c) The proposed project with mitigation incorporated, as discussed above, would not result in significant adverse impacts on human beings, either directly or indirectly.

I. MITIGATION MEASURES

The following mitigation measure has been identified to reduce potentially significant environmental impacts resulting from the proposed project to Less-Than Significant levels.

Mitigation Measure M-NO-3, Vibration Management Plan:

The Project Sponsor shall retain the services of a qualified structural engineer to develop, and the Project Sponsor shall adopt, a vibration management and continuous monitoring plan to cover any construction equipment operations performed within 20 feet of PG&E Pipeline 109. The vibration management and monitoring plan shall be submitted to PG&E and Planning Department staff for review and approval prior to issuance of any construction permits. The vibration management plan shall include:

- **Vibration Monitoring:** Continuous vibration monitoring throughout the duration of the major structural project activities to ensure that vibration levels do not exceed the established standard.
- **Maximum PPV Vibration Levels:** Maximum PPV vibration levels for any equipment shall be less than 2 inches per second (in/sec). Should maximum PPV vibration levels exceed 2 in/sec, all construction work shall stop and PG&E shall be notified to oversee further work.
- **Standby Inspection:** A PG&E Gas Transmission Standby Inspector must be present during any demolition or construction activity within 10 feet of the gas pipeline(s). This includes all grading, trenching, gas line depth verifications (potholes), asphalt or concrete demolition/removal, removal of trees, signs, light poles, etc. This inspection would be coordinated through the Underground Service Alert (USA) service at **811 or 1-800-227-2600**. A minimum notice of 48 hours is required.
- **Grading/Excavation:** Any excavations, including grading work, above or around Pipeline 109 must be performed with a PG&E inspector present. This includes all laterals, subgrades, and gas line depth verifications (potholes). Work in the vicinity of Pipeline 109 must be completed consistent with PG&E Work Procedure TD-4412P-05 "Excavation Procedures for Damage Prevention." Any plans to expose and support Pipeline 109 across an open excavation must be approved by PG&E Pipeline Engineering in writing prior to performing the work. Any grading or digging within two (2) feet of Pipeline 109

shall be dug by hand. Water jetting to assist vacuum excavating must be limited to 125 pounds per square inch gage (psig).

- **Pipeline Markers:** Prior to the commencement of project activity, pipeline markers must be placed along the pipeline route. With written PG&E approval, any existing markers can be temporarily relocated to accommodate construction work, but must be reinstalled once construction is complete.
- **Fencing:** No parallel fencing is allowed within 10 feet of Pipeline 109 and any perpendicular fencing shall require 14 foot access gates to be secured with PG&E corporation locks.
- **Structures:** Permanent structures must be located a minimum distance of 10 feet from the edge of Pipeline 109. A total width of 45 feet shall be maintained for pipeline maintenance. No storage of construction or demolition materials is permitted within this 45 foot zone.
- **Construction Loading:** To operate or store any construction equipment within 10 feet of Pipeline 109 that exceeds the half-axle wheel load (half axle weight is the gross weight upon any one wheel, or wheels, supporting one end of an axle) in the table below, approval from a PG&E gas transmission pipeline engineer is required. Pipeline 109 may need to be potholed by hand in to confirm the depth of the existing cover. These weight limits also depend on the support provided by the Pipeline's internal gas pressure. If PG&E's operating conditions require the Pipeline to be depressurized, maximum wheel loads over the pipeline will need to be further limited. For compaction within two feet of Pipeline 109, walk-behind compaction equipment shall be required. Crane and backhoe outriggers shall be set at least 10 feet from the centerline of Pipeline 109. Maximum PPV vibration levels for any equipment shall be less than 2 in/sec.

Depth of Cover to Top of Pipe (ft.)	Maximum Half-Axle Wheel Loading (lbs)
2	4,580
3	6,843
4	7,775
5	7,318

J. PUBLIC NOTICE AND COMMENT

This Mitigated Negative Declaration has been prepared by the Planning Department pursuant to the Department's rescinding of a July 8, 2016 Categorical Exemption determination to allow for further analysis of potential environmental impacts. The Categorical Exemption was rescinded prior to a scheduled CEQA appeal hearing before the Board of Supervisors in December 2016. The Appellants included individual neighbors and nearby neighborhood organizations, and supporters of the appeal included dozens of individuals, the Sierra Club, and the Bernal Heights Democratic Club. The proposed project was also the subject of Discretionary Review requests by nine individuals and two neighborhood organizations, with the support of neighbors and organizations similar to those supporting the CEQA appeal.

In the course of both the Discretionary Review process and the appeal filed on the July 2016 Categorical Exemption, public comments included concerns about the appropriateness of a Categorical Exemption for the proposed project due to the unique nature of the project site; concerns about cumulative impacts of the development of the remaining lots; concerns about the integrity and safety of PG&E Pipeline 109; emergency access; traffic; and public vistas.

As a result of these public comments, the Planning Department decided to rescind the Categorical Exemption and issue a Mitigated Negative Declaration for the proposed project to ensure that potential environmental impacts to these and other resource areas are properly analyzed, and mitigations instituted, if appropriate.

K. DETERMINATION

On the basis of this Initial Study:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☒ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, no further environmental documentation is required.

Jessica Range for

Lisa Gibson
Environmental Review Officer
for
John Rahaim
Director of Planning

DATE 7/11/2017

L. INITIAL STUDY PREPARERS

REPORT AUTHORS

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PROJECT SPONSOR

Bluorange Designs

Project Sponsor: Fabien Lannoye

EXHIBIT 2

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Mitigated Negative Declaration Appeal

3516-3526 Folsom Street

DATE:	September 5, 2017
TO:	Angela Calvillo, Clerk of the Board of Supervisors
FROM:	Lisa Gibson, Acting Environmental Review Officer – (415) 558-9032 Joy Navarrete, Senior Environmental Planner – (415) 575-9040 Justin Horner, Environmental Coordinator – (415) 575-9023
RE:	Planning Case No. 2013-1383ENV Appeal of Mitigated Negative Declaration for 3516-26 Folsom Street
HEARING DATE:	September 12, 2017

PROJECT SPONSOR:	Fabian Lannoye, Bluorange Designs, 415- 533-0415
APPELLANT:	Zacks, Freeman and Patterson, on behalf of Bernal Heights South Slope Organization, Bernal Safe & Livable, Neighbors Against the Upper Folsom Street Extension, Gail Newman and Ann Lockett

INTRODUCTION

This memorandum is a response to the letter of appeal to the Board of Supervisors (the "Board") regarding the Planning Department's (the "Department") issuance of a Mitigated Negative Declaration under the California Environmental Quality Act ("CEQA Determination") for the proposed project at 3516-3526 Folsom Street (the "proposed project").

The Department, pursuant to Title 14 of the CEQA Guidelines, issued a Preliminary Mitigated Negative Declaration for the Project on April 26, 2017 finding that the proposed project would not have a significant impact on the environment with the incorporation of mitigation measures.

The decision before the Board is whether to uphold the Department's decision to issue a Mitigated Negative Declaration and deny the appeal, or to overturn the Department's decision to issue a Mitigated Negative Declaration and return the project to the Department for additional environmental review.

SITE DESCRIPTION & EXISTING USE

The project site consists of two vacant lots located on the west side of the unimproved ("paper street") segment of Folsom Street between Chapman Street and Bernal Heights Boulevard in the Bernal Heights neighborhood. The project site does not have vehicular or pedestrian access as the portion of Folsom Street providing access to the project site is unimproved. The project lots are both 25-feet-wide and 70-feet-deep and total 1,750 square feet in size. The project site has an approximately 32 percent slope to the north. To the south of the project site is a vacant lot and a two-story, single-family residence at 3574 Folsom Street (constructed in 1925). To the east of the project site are four vacant lots and a two-story, single-family residence at 3577 Folsom Street that also fronts on Chapman Street (constructed in 1925). There is a concrete driveway that leads from Chapman Street to the 3574 Folsom Street and 3577 Folsom Street residences. To the north of the project site is the Bernal Heights Community Garden, and Bernal Heights Park is located farther to the north across Bernal Heights Boulevard. Residential structures in the project vicinity are primarily two to three stories and are either single-family or two-family dwellings. The surrounding parcels are zoned either RH-1 (to the south of the project site) or Public (to the north of the project site). There is a PG&E gas transmission pipeline beneath Folsom Street that extends from Bernal Heights Boulevard to Alemany Boulevard.

PROJECT DESCRIPTION

An Environmental Evaluation Application (2013.1383E) for the proposed project at 3516 and 3526 Folsom Street (Assessor's Block 5626, Lots 013 and 014) was filed by Fabien Lannoye on September 25, 2013 for a proposal to construct two single-family residences and the construction of the connecting segment of Folsom Street to provide vehicle and pedestrian access to the project site in the Bernal Heights neighborhood in the City and County of San Francisco. The project site is on a block bounded by Bernal Heights Boulevard to the north, Gates Street to the west, Powhattan Avenue to the south and Folsom Street to the east.

The project site is approximately 6,500 square feet in size (two contiguous lots of 2,230 sf each and a street improvement of approximately 2,000 sf). The project site is currently vacant and undeveloped.

The proposed project involves the construction of two single-family residences on two of the vacant lots along the west side of the unimproved portion of Folsom Street, the construction of the connecting segment of Folsom Street to provide vehicle and pedestrian access to the project site, and the construction of a stairway between Folsom Street and Bernal Heights Boulevard. Each single-family home would be 27 feet tall, two stories over-garage with two off-street vehicle parking spaces accessed from a twelve-foot-wide garage door.

The 3516 Folsom Street building would be approximately 2,230 square feet in size with a side yard along its north property line. The 3526 Folsom Street building would be approximately 2,210 square feet in size with a side yard along its south property line. The proposed buildings would include roof decks and full fire protection sprinkler systems. The proposed buildings would be supported by a shallow building foundation using mat slabs with spread footings.

The proposed Folsom Street extension improvements would include an approximately 20-foot-wide road with an approximately 10-foot-wide sidewalk on the west side of the street, adjacent to the proposed residences with a stairway leading up to Bernal Heights Boulevard, subject to Public Works approval.

BACKGROUND

The Planning Department published a Preliminary Mitigated Negative Declaration ("PMND") for the proposed project on April 26, 2017. On May 16, 2017, Kathy Angus, for the Bernal Heights South Slope Organization, filed a letter appealing the PMND. The PMND appeal was heard before a publically-noticed hearing of the City Planning Commission on June 15, 2017. The commission denied the appeal, and finalized the PMND ("MND"). On July 17, 2017, Zacks, Freeman and Patterson, on behalf of Bernal Heights South Slope Organization, Bernal Safe & Livable, Neighbors Against the Upper Folsom Street Extension, Gail Newman and Ann Lockett ("Appellants") filed a letter appealing the MND ("Appeal Letter").

CEQA GUIDELINES

In determining the significance of environmental effects caused by a project, CEQA Guidelines Section 15064(f) states that the decision as to whether a project may have one or more significant effects shall be based on substantial evidence in the record of the lead agency. If the lead agency determines there is no substantial evidence that the project may have a significant effect on the environment, the lead agency shall prepare a negative declaration. CEQA Guidelines Section 15604(f) offers the following guidance: "(4) The existence of public controversy over the environmental effects of a project will not require preparation of an EIR if there is no substantial evidence before the agency that the project may have a significant effect on the environment, and (5) Argument, speculation, unsubstantiated opinion or narrative, or evidence that is clearly inaccurate or erroneous, or evidence that is not credible, shall not constitute substantial evidence. Substantial evidence shall include facts, reasonable assumption predicated upon facts, and expert opinion supported by facts."

APPELLANT ISSUES AND PLANNING DEPARTMENT RESPONSES

The concerns of the Appeal Letter focused on the adequacy of the MND's vibration-related mitigation measure, cumulative impacts, the adequacy of the geotechnical report and a variety of other issues related to traffic, views, shadows and public safety. The concerns from the Appeal Letter are summarized and listed below, and are followed by the Department's responses.

CONCERN 1: The Appellant asserts that the MND violates CEQA because it does not reduce the risk of a catastrophic PG&E gas transmission pipeline accident to a level that is "clearly insignificant;" that there is substantial evidence that a risk of catastrophic impacts still exists; that vibration level threshold used in the MND to determine environmental effects is not supported by data, sufficient analysis, or justification; and that the mitigation measure is inadequate because it

does not provide independent oversight of the vibration plan and it does not include a safety or evacuation plan.

RESPONSE 1: The MND vibration mitigation measure complies with CEQA requirements by ensuring that project construction would not have a significant effect on PG&E Pipeline 109. The required Vibration Management Plan includes oversight from both PG&E and the Planning Department, independent of the project sponsor. The MND uses a 2 inches/second peak particle velocity (PPV) threshold, consistent with PG&E. The 2 in/s PPV level is significantly lower than thresholds used for other projects adjacent to pipelines and was selected as a highly conservative performance standard in the assessment of environmental effects for this project. The San Francisco Department of Emergency Management (DEM) is responsible for leading disaster response efforts within the City and County of San Francisco.

CEQA Guidelines Section 15370 states that "mitigation" includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

CEQA Guidelines Section 15126.4 also provides the following guidance:

- "Mitigation measures must be fully enforceable through permit conditions, agreements, or other legally binding instruments;"
- "Mitigation measures are not required for effects which are not found to be significant;"
- "There must be an essential nexus (i.e. connection) between the mitigation measure and a legitimate government interest. *Nolan v. California Coastal Commission,* 483 US 825 (1987);"
- "The mitigation measure must be 'roughly proportional' to the impacts of the project *Dolan v. City of Tigard,* 512 US 374 (1994);"
- "Formulation of mitigation measures should not be deferred until some future time."

The MND (pages 60-62) includes a mitigation measure (Mitigation Measure M-NO-3: Vibration Management Plan) to ensure that project construction would not have a significant vibration effect on PG&E Pipeline 109 during construction. The mitigation measure requires monitoring of vibration levels, and includes limitations on materials storage and construction activity on or near Pipeline 109, as well as the development of a Vibration Monitoring Plan, and its approval by PG&E and the Planning Department prior to the issuance of any building permits. The mitigation measure applies to "any construction equipment operations performed within 20 feet of PG&E Pipeline 109," be it related to the two homes or the improvements to the road.

Enforcement of the mitigation measure is the responsibility of the Planning Department and the Department of Building Inspection. Both are public agencies required to share information related to implementation and enforcement of mitigation measures. The appellants have not provided any evidence that either Department is unqualified or otherwise unable to enforce the mitigation measure as written, or how the oversight of the two Departments, both independent of the project sponsor, is insufficient to address potential vibration impacts.

The Appeal Letter states that "[the Planning Department and the Department of Building Inspection] are not in a position to adequately analyze additional fatigue to be exerted on the pipeline, and a speculative after-the-fact plan which might be developed by PG&E is clearly inadequate." While the Appellants do not provide any evidence to support the assertion that such a plan would be inadequate, the Department concurs with Rune Storesund, the Appellant's own expert on pipeline safety, that PG&E is the foremost authority regarding the integrity of the pipeline. In his letter of June 5, 2017 (included with the Appeal letter), Storesund states:

> "*PG&E is the only organization* in a position to analyze the additional fatigue expected to be exerted on the pipeline from the bedrock excavation activity and certify that no appreciable degradation will occur." [Emphasis added]

In the case of *Ocean View Estates Homeowners Assoc. v. Montecito Water District* (2004)[1] the court held that mitigation measures stated in an MND need not specify precise details of design. Having recognized a significant environmental impact and having determined that mitigation measures reduce the impact to insignificance, the MND may leave the details to engineers.

In the case of the proposed project, the Department consulted with, and followed the guidance and recommendations of, PG&E pipeline engineers in the design of the MND's mitigation measure and the threshold used to determine the potential for a significant impact. In addition to the mitigation measure included in the MND, the proposed project, which includes two homes, a street improvement and the creation of stairs to Bernal Heights Boulevard, would be reviewed and approved by PG&E engineers, and be subject to its regulations concerning work in proximity to a pipeline, after it has received its land use entitlements and the street improvement permit is approved by Public Works.

The Appeal Letter asserts that statements made in a June 14, 2017 letter from Rune Storesund of Storesund Consulting (included in Appeal packet) constitute substantial evidence of a significant effect on the environment. The Planning Department respectfully disagrees.

The MND analyzed potential vibration effects of the proposed project (p. 56-62). Given the proposed project's proximity to PG&E Pipeline 109, a construction vibration analysis was

[1] Court of Appeal, Second District, Division 6, California. *Ocean View Estates Homeowners Association Inc v. Montecito Water District*, Decided: March 2, 2004,

performed for the proposed project to assess any potential adverse impact on the Pipeline from vibration due to construction-related equipment and work.[2] The report evaluated vibratory impacts related to excavation of the site for the purposes of developing a proper foundation for the buildings, digging trenches for utilities to the residences, and the extension of Folsom Street for access to the residences.

To determine the potential for an adverse impact to the PG&E Pipeline 109, the analysis compared the highest estimated Peak Particle Velocity (PPV) for each piece of equipment at its nearest proximity to the pipe during project work. The criteria for damage to a pipeline due to vibration cover a wide-range of PPV, as documented by Caltrans.[3] For example, a PPV value of 25 inches/sec associated with an "explosive near [a] buried pipe" resulted in no damage, as did PPV values for "explosive[s] near [a] buried pipe" of 50-150 PPV. The analysis prepared for the proposed project utilized a conservative 12 inches/second, a value based on the West Roxbury Lateral Project in Massachusetts, as the criteria for potential damage to the pipe.[4]

Although the vibration assessment for the proposed project is based on a damage criterion of 12 in/sec, PG&E has evaluated the proposed project and, through its regulatory authority for work in proximity to its pipeline, set a PPV standard of 2 in/sec for this section of Pipeline 109.[5] While the Storesund letter suggests that the vibration analysis simply infers a PPV standard of 2 in/sec is an acceptable threshold, this is incorrect. The MND clearly establishes that the PPV standard is highly conservative in that it is a factor of 10 lower (more stringent) than the already conservative damage criteria used in the vibration assessment. The Storesund letter does not present substantial evidence that the use of the very conservative 2 in/sec PPV standard results in a new or more severe environmental effect than disclosed in the MND.

The Storesund letter also questions whether the vibration analysis included in the MND takes into account all possible factors affecting pipeline integrity. However, the letter does not explain how these factors warrant a more conservative PPV threshold than that included in the MND's vibration analysis. The Storesund letter does not provide substantial evidence that the MND has not adequately described the nature of that significant effect; it merely asserts that the vibration analysis is inadequate and, therefore, that "a reasonable possibility of a significant effect still exists." The MND already concludes that the proposed project may result in a significant vibration impact; this is not a disputed fact.

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[2] Illingworth and Rodkin, Inc., *Construction Vibration Evaluation for 3516 and 3526 Folsom Street*, March 24, 2017.

[3] California Department of Transportation, *Transportation and Construction Vibration Guidance Manual*, September 2013, page 76.

[4] The analysis notes that buried pipes can withstand higher PPV because they are constrained and do not amplify ground motion, like freestanding structures, like historic buildings, do. According to the Caltrans report cited in the analysis, PPV values as high as 150 have been shown to not harm underground pipes.

[5] PG&E Gas Transmission Pipeline Services—Integrity Management, 3516/26 Folsom Street, March 30, 2017.

The MND includes a very conservative threshold for determining a possibility for a significant vibration effect, discloses that potential effect, and includes a feasible mitigation measure crafted in consultation with PG&E, acknowledged by Storesund himself in a June 5, 2017 letter as "the only organization in a position to analyze the additional fatigue expected to be exerted on the pipeline," to reduce that environmental effect to a less-than-significant level.

The Appellant questions the reliability of PG&E and its ability to comply with regulatory requirements. PG&E's prior mishandling of pipeline safety is well documented and is not disputed by the Planning Department. Nonetheless, the contention that PG&E therefore would be negligent in their regulation of the proposed project is unsupported speculation. Similarly, it is speculative of the Appellant to assert that indirect environmental effects would occur as a result of such hypothetical negligence. As such indirect effects are not reasonably foreseeable effects of the proposed project, they are not required to be analyzed under CEQA.[6]

Individual project sponsors are not responsible, nor qualified, to develop emergency response plans. Emergency preparedness and response are the responsibility of the San Francisco Department of Emergency Management, the San Francisco Police Department, the San Francisco Fire Department, and other local, state, and federal agencies.

Per CEQA Guidelines Section 15063(b), an Environmental Impact Report (EIR) must be prepared if there is substantial evidence that a project either individually or cumulatively may cause a significant adverse effect on the physical environment. The appellants do not provide substantial evidence that the proposed project would have a significant impact on the environment, necessitating the preparation of an EIR. The MND provides an accurate characterization of the proposed project as required by CEQA, and provides substantial evidence that the proposed project would not result in significant impacts to the environment. Therefore, preparation of an EIR is not required.

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[6] CEQA Guidelines Section 15064(d)(3): Determining the Significant of the Environmental Effects Caused By a Project: ...(d) In evaluating the significance of the environmental effect of a project, the Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project....(3) An indirect physical change is to be considered only if that change is a reasonably foreseeable impact which may be caused by the project. A change which is speculative or unlikely to occur is not reasonably foreseeable.

CONCERN 2: The MND did not adequately analyze the cumulative impacts of the proposed project. The MND did not analyze the environmental impacts of development on the four other undeveloped lots near the project site.

The Appeal Letter states:

> "The MND errs in not individually listing 'part, present and probable future projects that might result in related impacts' despite acknowledging that 'improvements proposed by the development would facilitate future development' of four lots." - p. 7

RESPONSE 2: The MND did properly consider cumulative impacts with respect to the four undeveloped parcels. The project as proposed is two homes and a street improvement, and does not include development of the adjacent lots. Nevertheless, the MND considered the entirety of the project, including installation of utilities for the four adjacent lots, and concluded that the project would not result in significant cumulative environmental impacts.

Pursuant to CEQA, the Department analyzed the project as proposed in the Environmental Evaluation Application which was for the construction of two single-family residences on two vacant lots located on the "paper street" segment of Folsom Street. The adjacent lots are all under different ownership than the project lots. Any future development proposals on the adjacent lots would require further environmental review, including consideration of cumulative impacts, and City approval.

As required by CEQA, the MND analyzed cumulative impacts for all resource areas. Since the 3516 and 3526 Folsom Street project is the first proposed development on the "paper street" segment of Folsom Street, the project sponsor would be required by Public Works' Subdivision Regulations to construct pedestrian, vehicular, and utility access to this segment of Folsom Street as part of any street improvement. At this time, it is unknown whether utilities would come from Bernal Heights Boulevard to the north or from Chapman Street to the south. This would be determined by PG&E and SFPUC once the project is entitled. It is anticipated that utility lines would run under the entire length of the street extension, which would reduce or avoid the need for future utility-related construction activities should development occur on the adjacent lots. SFPUC has indicated that if the proposed street improvement is not accepted by Public Works, it would object extending utilities up the hill.[7]

CEQA prohibits piecemeal environmental review of large projects into many little projects, which each have minimal potential to impact the environment, but cumulatively could have significant impacts. The project application does not constitute piecemeal development under CEQA for the following reasons: the proposed project does not involve subdivision or creation of new lots as the six vacant lots along the "paper street" segment of Folsom Street have existed since at least 1935; the project sponsor is not the owner of the adjacent lots; and as previously stated, the Department has not received any applications from the other property owners to

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[7] Project sponsor notes from meeting with SFPUC, December 4, 2015.

construct projects on their properties, thus there is no larger project from which this one is being separated. It is Department practice to consider a project "reasonably foreseeable" when the Department has received a completed Environmental Evaluation Application for the proposed project. Testimony from property owners that they are planning on developing their property is not sufficient be considered "reasonably foreseeable" for the purposes of cumulative environmental impact analysis under CEQA. Analysis of the impacts of theoretical projects would be speculative.

Any subsequent development would be required to comply with the same regulations as the proposed project including, but not limited to, compliance with the San Francisco Building Code and PG&E regulations for work in proximity to their pipeline. The appellants do not provide any evidence to support the claim that implementation of the proposed project would result in significant cumulative impacts.

Finally, the project as described in the MND includes installation of utilities for the four vacant lots located on the "paper street" segment of Folsom Street. Thus, any potential impacts from the installation of these utilities, and the reasonably foreseeable consequence that these other lots may be developed in the future, is both acknowledged and analyzed in the MND. Because no development is currently proposed for these other vacant lots, any further analysis of such future projects would be speculative at this point.

The appellants do not provide substantial evidence that would indicate that the proposed project would result in a significant and unavoidable cumulative impact; therefore the preparation of an EIR is neither warranted nor required under CEQA.

CONCERN 3: The geotechnical report prepared for the project is incomplete; the soils report does not include the street in its survey; the MND inadequately analyzed landslide risk; and the MND does not adequately analyze stormwater.

The Appeal Letter states:

> "The geotechnical report dated August 3, 2013 focuses solely on the footprint sites of the two proposed houses, with no acknowledgment of the 'revised' Project scope." - p. 8
>
> "The current 'incomplete' geotechnical report raises the following concerns: uncertainties regarding slope stability…no mention of backfill soil over pipeline…significant risk...discrepancies…earthquakes and landslides…site drainage." - p. 8-9
>
> "Given that a steep hillside will be graded and a new street introduced—and that retaining walls will not be allowed over a gas transmission pipeline which runs under

the project site—the City must evaluate the landslide risks involved and how they will be mitigated." – p. 9

"There is a question as to the validity of the Seismic Hazards Map indication that the site is not located in an area subject to landslide." –p. 13

"The stormwater is currently absorbed into the hillside. Once the street is in, it will be flowing down the street, causing significant change in drainage." - p. 13

RESPONSE 3: The geotechnical report for the project was completed by a California Registered Engineer, consistent with state requirements for a geotechnical report. Subsequent to the publication of the MND, a separate soils report was prepared for the proposed street and utility improvements. The proposed project is not in an area subject to the Slope Protection Act and is not in a Landslide Hazard Area. The project site is subject to SFPUC's 2016 Stormwater Management Requirements and Design Guidelines. Stormwater flows on the project site are currently uncontrolled; the proposed project and street improvements would be required to direct stormwater into the City's combined stormwater/sewer system, avoiding significant drainage impacts.

The soils and geotechnical studies for the proposed project were prepared by H. Allen Gruen, a California Registered Professional Engineer. The appellants do not provide any evidence to challenge or contradict the findings of the soils and geotechnical studies. Geotechnical, soils and vibration studies were prepared for the CEQA analysis of the proposed project. In addition, more detailed geotechnical analyses will be required for the issuance of building permits and the construction of the two single family homes, and the design and construction of the improvements to the "paper street" section of Folsom Street.

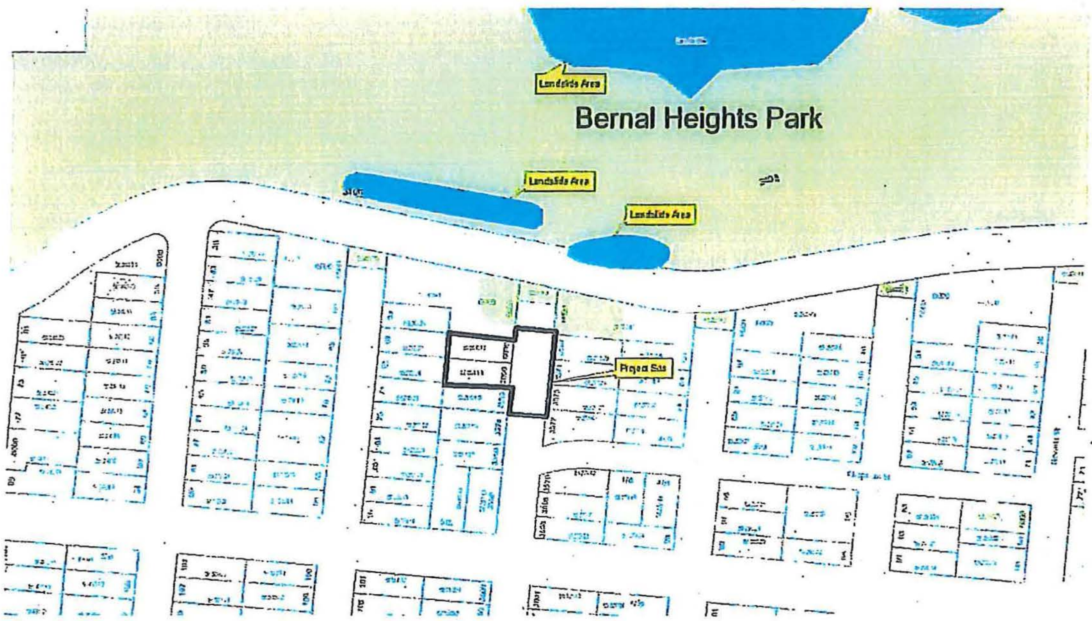
Subsequent to the publication of the PMND, a geotechnical investigation has been prepared for the proposed street and utility improvements.[8] The investigation included site reconnaissance, review of existing geotechnical studies and one test boring to practical refusal at a depth of 6-1/2 feet below ground surface. The investigation found that the primary geotechnical concerns were situating the roadway and utility improvements in competent earth materials and seismic shaking and related effects during earthquakes. The investigation concluded that the project site "is suitable for support of the proposed improvements." The investigation recommended a conventional spread footing foundation for the improvements and adherence with existing building codes to minimize the effects of earthquake shaking.

The MND (pages 94-100) analyzes potential geological and geotechnical impacts of the proposed project. For purposes of CEQA, the Department utilizes the Seismic Hazard Zones

[8] H. Allen Gruen, *Report Geotechnical Investigation, Planner Street and Utility Improvements at 3516 and 3526 Folsom Street San Francisco, California*, July 6, 2017.

Map included in the Community Safety Element of the General Plan, which is the official State of California Seismic Hazards Zone Map for San Francisco prepared under the Seismic Hazards Mapping Act of 1990,[9] to determine geotechnical impacts. As shown below in Figure 1, neither the project site nor the "paper street" section of Folsom Street are considered Landslide Hazard Zones. Areas not designated as Landslide Hazard Zones are not subject to the Slope Protection Act.[10]

Figure 1, Project Site, Right-of-Way and Landslide Hazard Areas



While the appellants assert that there is "a question as to the validity" of the Seismic Hazards Map because there was a landslide in the vicinity of the project site, it should be noted that the presence of a landslide in the vicinity of the project site does not equate to the presence of a Landslide Hazard at the project site. This does not mean that there will be no measures taken to avoid potential geotechnical impacts; only that the site is not located in a Landslide Hazard Area, which is a factor used in assessing whether there are certain geotechnical impacts under CEQA. The geotechnical report prepared for the proposed project indicates that the

[9] The Seismic Hazards Mapping Act was developed to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and from other hazards caused by earthquakes. This Act requires the State Geologist to delineate various seismic hazard zones and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones.

[10] San Francisco Department of Building Inspection, *Information Sheet Errata in 2016 SFBC and SFBC Structural Provisions*, January 1, 2017. "Properties are subject to these requirements where any portion of the property lies within the areas of "Earthquake Induced Landslide" in the Seismic Hazard Zone Map, released by the California Department of Conservation, Divisions of Mines and Geology, dated November 17, 2000 or amendments thereto.

geotechnical engineer did not find any evidence of active slope instability at the project site. In addition, as stated in the MND (page 98), "[a]dherence to San Francisco Building Code requirements would ensure that the project applicant include analysis and avoidance of any potential impacts related to unstable soils as part of the design-level geotechnical investigation prepared for the proposed project."

The appellants do not provide any substantial evidence that the proposed project is in a Landslide Hazard Area or in an area subject to the Slope Protection Act or that a significant impact would occur with respect to geology. Therefore the preparation of an EIR is neither warranted nor required under CEQA.

The MND (p. 100-104) discusses stormwater and drainage impacts from the proposed project. The analysis indicates that, while the project site is currently an unimproved hillside where stormwater flows are currently uncontrolled, the proposed project would include drainage elements that would control stormwater runoff and direct it into the City's combined stormwater/sewer system. While the proposed project would increase impervious surfaces on the project site, the proposed project would also improve drainage by installing drainage controls to direct run-off into the combined sewer system. Public Works' Subdivision Regulations require proposed streets to "remove sewage and storm water from each lot or parcel of land, and to remove storm water from all roads, streets, and sidewalks."[11] The proposed project would also be required to comply with SFPUC's Stormwater Management Requirements and Design Guidelines, which include meeting specific performance measures for impervious surfaces and stormwater run-off rate, the approval of a Preliminary Stormwater Control Plan before receiving a Site or Building Permit, and the approval of a Final Stormwater Control Plan before receiving the Certificate of Final Completion.[12] Therefore, the proposed project would not be expected to result in substantial erosion or flooding associated with changes in drainage patterns.

Per CEQA Guidelines Section 15063(b), an EIR is prepared if there is substantial evidence that a project either individually or cumulatively may cause a significant effect on the environment. The analysis in the MND indicates that the proposed project would not cause a significant impact with respect to stormwater. The appellants do not provide substantial evidence that would indicate that the proposed project would have a significant stormwater or drainage impact. Therefore, preparation of an EIR is not required.

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[11] *Ibid.* Page 68.

[12] San Francisco Public Utilities Commission, *How Do I Comply with the Stormwater Management Requirements*, http://sfwater.org/index.aspx?page=1006. Accessed: May 25, 2017

CONCERN 4: The Appellant maintains that the project would result in potential hazards and nuisances related to project construction, including pedestrian access along Bernal Heights Boulevard, emergency access, traffic and parking. The Appellant also questions the opportunities for public input into, and monitoring of, the construction management plan.

RESPONSE 4: The MND analyzes the physical environmental impacts of the proposed project, and includes a mitigation measure for vibration-related impacts. To address street and sidewalk-related issues during construction, the project sponsor will be required to adhere to all regulations on building construction from the Department of Building Inspection, the San Francisco Municipal Transportation Agency, Public Works, and other agencies. The extent of public input into the Construction Plan is not a CEQA issue.

The MND is a document prepared pursuant to CEQA to analyze the physical environmental effects of a proposed project, disclose any significant environmental effects, and identify mitigation measures to reduce those effects to a less-than-significant level. The MND for the proposed project found a potential environmental impact related to vibration and provided a mitigation measure to reduce that impact.

The MND does not regulate the construction of the proposed project. As indicated in the MND, construction of the proposed project must comply with the San Francisco Noise Ordinance, the Construction and Demolition Debris Recovery Ordinance, and the Construction Site Runoff Ordinance, among other regulations. Construction work that requires the use and/or closure of city streets and sidewalks is subject to the San Francisco Municipal Transportation Agency's "Regulations for Working in San Francisco Streets," also known as the Blue Book, which "establishes rules and guidance so that work can be done both safely and with the least possible interference with pedestrians, bicycle, transit and vehicular traffic."[13] Construction work in San Francisco is routinely coordinated among a number of City agencies.

The extent of public input and oversight of any construction management plan is outside the scope of CEQA. Any perceived lack of public participation in the construction management plan process does not in itself constitute an environmental impact under CEQA, and the appellants have provided no evidence that a lack of public input would lead, directly or indirectly, to an adverse environmental effect. Public participation in the construction management plan is a matter addressed by DBI, Public Works, the project sponsors and the parties concerned. Therefore, the preparation of an EIR is neither warranted nor required under CEQA.

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13 SFMTA, *Regulations for Working in San Francisco Streets*, https://www.sfmta.com/services/streets-sidewalks/construction-regulations. Accessed: May 30, 2017.

CONCERN 5: The MND does not include analysis of the shadow impacts of the fence/railing on the community garden.

The Appeal Letter states:

> "How does the addition of the fence/railing on the roof deck affect the shadow on the Community Garden or other property?" - p. 12

RESPONSE 5: The MND adequately assesses the shadow impacts of the proposed project on the community garden and correctly concludes that the impact would be less than significant. The appellants have not provided substantial evidence that the railings would have significant shadow effects.

The MND (on page 77) discusses shadow impacts of the proposed project. The MND states that the proposed project "would cast new shadow on the community garden," but that the new shadow is "not expected to substantially affect the use or enjoyment of the Bernal Heights Community Garden such that a significant environmental effect would occur." The railing on for the roof deck is indicated to be three-and-a-half feet tall and would be effectively transparent for purposes of shadow analysis. The appellants have not provided substantial evidence that this railing could substantially affect the use or enjoyment of Bernal Heights Community Garden beyond what is discussed in the MND. Therefore the preparation of an EIR is neither warranted nor required under CEQA.

CONCERN 6: The MND does not analyze how garbage, compost and recycling would be handled.

The Appeal Letter states:

> "No plan has been put forth to accommodate garbage, compost, and recycling needs." – p. 12

RESPONSE 6: Recycling, garbage and compost would be handled in the same manner as for neighboring residential properties.

In San Francisco, residents, employees and waste management personnel routinely transport waste receptacles along public streets and sidewalks, and waste management vehicles are routinely stopped or parked in front of existing residences and buildings as part of regular service. The appellants have not provided substantial evidence of any particular significant adverse impacts that these same activities would have if performed at this particular location, nor how the proposed project would create circumstances dissimilar to waste collection practices elsewhere in San Francisco. Therefore the preparation of an EIR is not warranted.

CONCERN 7: If the subdivision of the area around the project site were to happen today, the subdivision would be subject to CEQA. The Bernal Heights Slope Guidelines have not been followed.

The Appeal Letter states:

> "If the Folsom Street extension and the six remaining lots along the 'paper street' were subdivided today, they would automatically be subject to an environmental impact analysis." – p. 7
>
> "The Bernal Heights East Slope Guidelines were not followed for this project." – p. 11

RESPONSE 7: Neither concern is germane to the MND for the proposed project. The project site consists of current lots of record. The Planning Department has determined that the proposed project is consistent with the Bernal Heights Slope Guidelines.

While it is true that subdivisions are subject to CEQA, the proposed project does not include a subdivision. The proposed project includes the construction of two single-family homes, one on each of two legal lots of record, and the improvement of a public right-of-way. The PMND correctly analyzes the physical environmental effects of the proposed project, and not of the subdivision that occurred prior to 1935.

The Bernal Heights East Slope Guidelines establish design standards for development on the eastern slope of Bernal Heights, which includes the project site. As part of its building permit application review, the proposed project has been found by the Planning Department to be consistent with the Bernal Heights Slope Guidelines. The appellants have not provided any evidence in support of the contention that the proposed project is inconsistent with the Guidelines or how any such inconsistency would constitute a significant environmental effect under CEQA. Therefore the preparation of an EIR is neither warranted nor required under CEQA.

CONCERN 8: The proposed improvement to the paper street section of Folsom Street would result in a hazardously steep street.

The Appeal Letter states:

> "The proposed steep street presents a significant threat to residents and drivers. It will be among the steepest streets in SF…The proposed street plans contain dangerous break-over angles and unclear plans for garage access to current residents." – p. 7

RESPONSE 8: The MND analyzed the proposed street improvement and found that it did not constitute a hazard. The proposed street improvements are subject to Public Works review and approval.

The MND (p. 41-42) analyzes the proposed road and determines that it would not substantially increase hazards due to particular design features. The proposed project would not result in roadway design changes that would include sharp curves or other roadway design elements that would create dangerous conditions, and the improved street section would not be a through street; that is, the improved section would not be used by the general public but would typically be limited to the residents of the proposed project. The improved section would not include any on-street parking facilities.

The MND analyzes the road, as proposed, and does not make a determination as to whether PW would, or should, approve the road. Approval of the road is subject to PW's review of the sponsor's Street Improvement Permit application, which will be reviewed after the proposed project receives its entitlements.

The appellants have not provided any evidence in support of the contention that the proposed street improvements would constitute a significant environmental effect under CEQA. Therefore the preparation of an EIR is neither warranted nor required under CEQA.

CONCERN 9: The additional traffic to and from two additional residences would increase traffic volumes significantly.

The Appeal Letter states:

> "...[T]he additional traffic to and from two additional residences potentially increases existing traffic volumes significantly." – p. 10

RESPONSE 9: The Planning Commission has determined that automobile delay shall no longer be considered a significant impact under CEQA. The additional traffic volume would not result in a significant impact under CEQA.

The MND (p. 36-38) discusses recent changes to the Planning Department's analysis of transportation impacts; namely, that the Planning Commission has found that automobile delay, as described solely by level of service or similar measures of vehicular capacity or traffic congestion, shall no longer be considered a significant impact on the environment pursuant to CEQA, because it does not measure environmental impacts and therefore it does not protect environmental quality. The MND provides trip generation data for informational purposes only. That said, the appellants do not provide substantial evidence as to how the addition of 20 person trips per day, which includes two PM peak hour trips, constitutes a significant environmental effect under CEQA. Therefore the preparation of an EIR is neither warranted nor required under CEQA.

CONCERN 10: The MND dismisses the significant impacts of the project on the public vista from Bernal heights Park and Bernal Heights Boulevard.

The Appeal Letter states:

> "The Planning Department uses inaccurate and misleading data to dismiss the significant impacts on the public vista from Bernal Heights Park and Bernal Heights Blvd." – p. 10

RESPONSE 10: Views from Bernal Heights Boulevard are not considered significant views under CEQA; views from Bernal Heights Park would not be impacted.

The appellants assert that the proposed project would block significant public vistas from Bernal Heights Boulevard that would constitute a significant environmental impact. Neither Bernal Heights Boulevard nor any other nearby street is a designated state scenic highway.

The project site is located downhill from Bernal Heights Park and Bernal Heights Boulevard. The Urban Design Element of the General Plan includes three maps relevant to the proposed project: 1) *Street Areas Important to Urban Design and Views*, 2) *Quality of Street Views*, and 3) *Plan to Strengthen City Pattern through Visually Prominent Landscaping*. Neither Bernal Heights Boulevard nor Folsom Street is included on the map *Street Areas Important to Urban Design and Views*. Bernal Heights Boulevard, Folsom Street and Chapman Street in the area of the proposed project are designated as having Average views on the *Quality of Street Views* map. Bernal Hill is identified as an Important Vista Point to be protected on the *Plan to Strengthen City Pattern Through Visually Prominent Landscaping* map.

The proposed project (two buildings reaching a height of approximately 30 feet) would not obstruct views from Bernal Heights Park. The Bernal Heights East Slope Design Guidelines include roof treatment guidelines to minimize or avoid obscuring views, and the north elevation of the proposed project would comply with the Bernal Heights East Slope Design Guidelines. Furthermore, the proposed roofs of the two buildings would sit below the elevation of Bernal Heights Boulevard.[14] Therefore, the two proposed buildings would not result in a substantial demonstrable adverse effect to any scenic views or resources.

The Appellants have not provided any evidence in support of the contention that the proposed project would constitute a significant view impact under CEQA. Therefore the preparation of an EIR is neither warranted nor required under CEQA.

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[14] According to the project sponsor, the sidewalk elevation at Bernal Heights Boulevard is +325". The roof elevation of the proposed project is +324.5" and the proposed top of parapet is +328".

CONCLUSION

Staff recommends that the Board of Supervisors adopt the motion to uphold the MND. No substantial evidence supporting a fair argument that a significant environmental effect may occur as a result of the project has been presented that would warrant preparation of an EIR.

EXHIBIT 3

Spectra Energy Partners

ALGONQUIN INCREMENTAL MARKET PROJECT

Analysis of the West Roxbury Crushed Stone Operations on Construction and Operation of the West Roxbury Lateral

March 31, 2014

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

Algonquin Gas Transmission, LLC ("Algonquin") has completed a comprehensive evaluation of: (1) the potential impacts on the West Roxbury Crushed Stone Quarry ("Quarry") associated with the proposed AIM Project West Roxbury Lateral and meter and regulating ("M&R") station; and (2) the potential impacts of Quarry operations on the construction and operation of the West Roxbury Lateral and M&R station.

With regard to the potential impact on the Quarry's operations, Algonquin has discussed the anticipated schedule and logistics associated with constructing the West Roxbury Lateral and M&R station with the owners of the Quarry. No direct conflicts were identified that would inhibit the construction of the West Roxbury Lateral and M&R station or the continued day-to-day operation of the Quarry. Algonquin has committed to continue to consult with the Quarry owners to establish traffic management measures that will be implemented during construction. As was outlined in Resource Report 5 of Algonquin's formal certificate application filed with the FERC on February 28, 2014, a detailed Traffic Management Plan is in development for the West Roxbury Lateral. Algonquin expects to file the Traffic Management Plan with the FERC on or before May 30, 2014. Once construction is complete, Algonquin does not anticipate any further impact on the Quarry from the operation and maintenance of the West Roxbury Lateral and M&R station.

In order to evaluate the potential impacts to the proposed pipeline and M&R station from the blasting operations at the Quarry, Algonquin retained the services of a local third-party geotechnical firm, GZA GeoEnvironmental, Inc. ("GZA"). Algonquin tasked GZA with analyzing the effects of current and potential future Quarry blasting operations. GZA's report is provided in Attachment A. A description of the current operation as well as the limits of future Quarry expansion is included in the GZA report. In order to ensure that the report reflected a conservative approach in estimating possible impacts on Algonquin's facilities, GZA assumed, hypothetically, that such future blasting within the Quarry would occur up to five feet from the Quarry property line along Grove Street, thereby minimizing the setback distance between Algonquin's facilities and the Quarry's blasting. The GZA report determined that the current or future blasting operations at the Quarry will not affect the safe operation and integrity of the pipeline or M&R station.

As described in detail in the report in Attachment A, studies have been performed and published discussing the resistance of buried pipelines to blast-induced vibrations. Calculations to evaluate the reserve strength within pipelines to resist the applied energy from blasts allow designers to analyze the site-specific and project-specific tolerance of a pipeline to stresses caused by vibrations. Assuming that hypothetical aggressive set of circumstances where the Quarry might extend its operation to within 5 feet of Grove Street, the GZA report determined that the proposed West Roxbury Lateral pipeline will be subject to vibrations well within pipeline design, with a minimum factor of safety of 10 to 20 times for the proposed gas pipeline. Thus, the GZA report concluded that ground vibrations from future blasting at the Quarry will not damage the proposed pipeline.

The proposed West Roxbury Lateral pipeline will be installed by specialized pipeline construction contractors using proven industry practices. The pipeline will be buried to a depth from the top of the pipe of at least 3 to 5 feet below existing ground surface and will consist of externally coated high strength steel with welded connections. The pipe will be installed within an excavation and enveloped in an engineered backfill consisting of either compacted sand or flowable fill (a low density concrete sand mixture) extending a minimum of 8 inches below the pipe, a minimum of 6 inches on both sides of the pipe and a minimum of 6 inches over the pipeline. This engineered backfill is designed to support the pipe evenly while maintaining the integrity of the pipe's protective coating. The flowable fill layer will also provide a warning barrier to protect the pipe from third-party contractors.

The M&R station buildings will be engineered pre-fabricated pre-cast concrete structures designed for industrial use and will not contain large exterior glass windows, or finishes susceptible to cracking. The in-line tool receivers/launchers and the heaters will be above-grade, steel construction, and are not considered especially sensitive to vibrations. The M&R station facilities are all bolted onto foundations and well supported. The GZA report concluded that the components of the M&R station, which will be located further away from the Quarry than the pipeline in Grove Street, are not considered to be any more sensitive to vibration disturbance or damage than the below-grade pipeline and that ground vibrations from future blasting at the Quarry will not be disruptive or damaging to the M&R station.

After review, the GZA report states that based on the location of the proposed M&R station relative to the Quarry, the probability of a projectile stemming from a blast operation at the Quarry (i.e., fly-rock) landing on the M&R station site is highly unlikely, potentially in the range of 10,000,000 to 1, with the probability of such a rock inflicting a direct strike on a segment of the limited amount of exposed pipe much lower still. Based on its analysis, the GZA report concludes that fly rock does not pose a concern for interruption of service or the release of natural gas at the M&R station.

Algonquin would also note that blasting in proximity to a natural gas pipeline is not an unusual occurrence along its pipeline system. Algonquin utilizes industry-wide recognized procedures for ensuring the safety and integrity of steel pipelines adjacent to blasting activity. The integrity of Algonquin's pipelines are therefore protected by well-established criteria on blasting vibrations, based upon extensive research by the Pipeline Research Committee International, blasting consultants, the United States Bureau of Mines, and through Algonquin's own direct observation of existing blasting operations near its existing in-service pipelines. Furthermore, Algonquin currently owns and operates a pipeline that runs through the active Riverdale Quarry near Pompton Lakes, New Jersey. In that location, Algonquin is notified prior to each blast and its facilities are then monitored during blasting operations to ensure that no harm is done to the safety and integrity of the pipeline. The same monitoring by Algonquin personnel will occur as necessary during blasting operations conducted by the West Roxbury Crushed Stone Quarry.

Spectra Energy Partners

ATTACHMENT A

GZA GEOENVIRONMENTAL, INC.
GEOTECHNICAL REVIEW OF QUARRY BLASTING

MEMORANDUM

TO: Michael Stellas, Spectra Energy Transmission, LLC

FROM: Gary R. McAllister, P.E.

DATE: March 28, 2014

FILE NO.: 09.025818.00

RE: Geotechnical Review of Quarry Blasting
Proposed West Roxbury Lateral M&R Station and Pipeline
Algonquin Incremental Market (AIM) Project
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GZA GeoEnvironmental, Inc. (GZA) is pleased to submit this memorandum summarizing our review of the potential impacts of nearby blasting from an active quarry on the operation of the proposed West Roxbury Lateral metering and regulating (M&R) station and pipeline. This service was performed at the request of Spectra Energy Transmission, LLC on behalf of Algonquin Gas Transmission, LLC (Algonquin). References and sources used in preparation of this review are listed at the end of this memorandum. This memorandum was prepared with the assistance of Mr. James Cleveland, P.E., Mr. Bradford Roberts, P.E., and Mr. Andrew Blaisdell, and is subject to the Limitations in **Appendix A.**

To complete this scope of work, GZA completed the following steps:

- Background information describing the Quarry and the proposed M&R station and pipeline project was compiled. The results of the potential effects of the West Roxbury Crushed Stone Company (Quarry) and its operations on the M&R station and pipeline are summarized herein.
- Industry reference documents regarding quarry blasting and vibrations were researched. This is summarized and presented in **Appendix B.**
- Industry reference documents specific to protection of pipelines from blasting vibrations were researched. This is summarized and presented in **Appendix C.**
- The Quarry blast records over the last four years were reviewed. This is summarized and presented in **Appendix D.**
- The potential effects of blasting ground vibrations, if blasting is performed proximate to the proposed pipeline, were evaluated. This is summarized and presented in **Appendix E.**
- The potential effect of airborne rock (a.k.a., fly rock), if created from the blasting operations, on the above-ground portion of the M&R station were evaluated. This is summarized and presented in **Appendix F.**
- Based on the research, evaluations and review performed above, conclusions regarding the potential impacts of nearby blasting from the active Quarry on the operation of the proposed West Roxbury Lateral metering and regulating (M&R) station and pipeline were developed and summarized herein.

BACKGROUND

Algonquin is proposing the construction and operation of a new natural gas pipeline and M&R station on Grove Street in West Roxbury, Massachusetts. A quarry that actively performs rock blasting is also located on Grove Street. The blasting operations occur at the Quarry located at 10 Grove Street, West Roxbury, Massachusetts. The location of the Quarry and the proposed locations of the M&R station and pipeline are illustrated on **Figure 1.**

QUARRY

The approximate area of the Quarry, as measured along the crest (top) of the Quarry excavation, is approximately 33 acres. According to the Quarry General Manager, the base of the Quarry is currently approximately 420 feet below the elevation of the Quarry entrance on Grove Street. Based on MassGIS elevation data (referencing North American Vertical Datum 1988), the base of the Quarry excavation would therefore be at approximately elevation -300 feet below mean sea level. The topography surrounding the Quarry to the east is approximately 40 feet higher than the Quarry entrance, resulting in a Quarry side slope as high as 460 feet on its east side. Aerial photography indicates that the Quarry side slopes are configured of varying slope angles with benches (plateaus) to facilitate working areas and to carry the vehicular access road to the base of the excavation.

The geologic setting in the area of the Quarry and proposed M&R station and pipeline is characterized by relatively shallow bedrock, which can be observed at the ground surface along the sides of Grove Street. The bedrock lithology is mapped as Dedham Granite within the Avalon terrain, a series of related rock formations (Mass GIS). Dedham Granite is a fine-grained to very coarse-grained, alkali-feldspar granite, granite, quartz-monzonite, and granodiorite which is pink, pink and light-green, and light gray in color (Kaye, 1980).

Since 2010, the Quarry blasting has been performed by A-1 Drilling & Blasting Company (A-1). According to A-1, blasting at the Quarry is performed under a permit issued by the City of Boston Fire Department, which specifies a limit on the allowable blast-induced vibration magnitude (e.g., amplitude or peak particle velocity, PPV) at any abutting property of 1.0 inch per second (ips).

M&R STATION AND PIPELINE

Based on GZA's review of the project plans, and Spectra's standard construction specifications, the project is planned to consist of a 16-inch-diameter natural gas pipeline entering the south side of the M&R station, and a 24-inch-diameter natural gas pipeline exiting the north side of the M&R station. Both sections of the pipe are planned to be constructed within Grove Street, at a depth of approximately 5 feet below pavement grade. The pipeline will consist of high strength Grade X-52 steel with welded connections. The pipe will be installed within an excavation and be enveloped in an engineered backfill (e.g., compacted sand or cementitous fill (a.k.a., flowable fill)) extending a minimum of 8 inches below the pipe and minimum of 6 inches on both sides of the pipe. The engineered backfill is designed to support the pipe evenly, and protect the pipe's corrosion-protection coating.

The M&R station is planned to consist of two (2) internal inspection tool (pig) barrels (one launcher, one receiver), a metering building, two exterior gas heaters, a regulating building, and above-ground and underground gas pipelines. All above-ground components will be enclosed in a security fence. The two buildings will be engineered, single-level structures with minimum 4-inch thick reinforced concrete walls and 4- to 6-inch thick reinforced concrete roof. The exterior above-ground structures, pipes, and supports will be steel construction. The buildings, pig barrels and heaters will be supported on concrete foundations.

The piping and associated facilities are required to undergo quality control and testing during manufacturing and construction. Algonquin's quality assurance / quality control includes having its inspectors at the manufacturing facilities and on-site during all welding, coating, and backfill operations. All welds for the pipeline are required to be tested (non-destructively) by a third-party radiographic inspection company. After construction is complete, and prior to being commissioned for service, the pipeline and its associated facilities are then hydrostatically tested to pressures at least 1.5 times the planned operating pressure for eight (8) hours.

RELATIVE PROXIMITY OF EXISTING AND PROPOSED STRUCTURES TO QUARRY

The proposed M&R station will be located on the opposite (west) side of Grove Street approximately across from the main entrance to the Quarry, as shown on **Figure 1**. The proposed M&R station property is approximately 2.5 acres in area, and situated at approximately elevation 120 feet. The proposed pipeline will be located beneath Grove Street, which ranges between approximately elevation 120 feet and 150 feet in the general area of the Quarry.

The future extent of the Quarry excavation is not known at this time. However, for the purpose of evaluating the potential effect on the proposed facilities, a scenario was developed and evaluated, which conservatively assumes that future rock blasting could theoretically occur adjacent to Grove Street, at the nearest location on the Quarry property to the proposed pipeline.

Other existing features considered in this evaluation included the existing underground utilities located within the Grove Street right-of-way. As shown of **Figure 2**, multiple underground utilities are currently located within the Grove Street right-of-way between the Quarry and the M&R Station. Two existing water lines and one existing gas line are located between the proposed natural gas pipeline and the Quarry. The closest of these three existing utilities to the Quarry is a 12-inch-diameter water line, which ranges in distance between approximately 10 and 20 feet from the Quarry property line.

POTENTIAL EFFECTS OF QUARRY BLASTING ON THE M&R STATION AND PIPELINE

In general, the potentially negative effects of Quarry blasting to surrounding receptors (i.e., structures, humans, natural resources, etc.) include ground vibrations, air vibrations, hydro-geologic disturbance, and projectiles (e.g., fly rock). Air vibrations (i.e., noise or overpressure) at higher frequencies can be audibly disturbing to humans and animals, and at lower frequencies can cause rattling of walls and windows. These conditions can be a nuisance to the building occupants; however, audible disturbance is not anticipated to pose an operational concern to the proposed M&R station or pipeline. Hydro-geologic disturbance (i.e., changes in rock fracture and joint opening size and chemical/sediment content) can change water supply well yield and quality; however, the M&R station will not have an on-site water supply well.

The various structural components of the proposed M&R Station will be constructed of reinforced concrete and steel. These components are not considered more sensitive to blast-related ground vibrations than the underground piping. The proposed pipeline is closer to the Quarry than the M&R Station. Therefore, the focus of this analysis is toward the potential for ground vibrations to impact the proposed underground natural gas pipeline. The underground natural gas pipeline will be constructed approximately 5 feet below grade, and as such the discussion of fly rock is limited to the potential effects on the above-ground components of the project. The subject of ground vibrations is discussed and presented in **Appendices B through E**. The subject of fly rock is presented in **Appendix F**.

CONCLUSIONS

Based on our evaluations, which are presented in **Appendices B through F,** we have concluded the following:

- The vibration peak particle velocity (PPV) limit promulgated by the City of Boston under the current blasting permit at the Quarry is 1.0 ips, and is considered conservative in the protection of residential buildings.
- Underground pipelines are significantly more tolerable to vibrations than residential buildings, and at a minimum, the proposed gas pipeline can tolerate a vibration PPV of 12 ips.
- Vibrations recorded during the last four years of Quarry blasting were observed to correlate well with calculated vibration levels.
- From the blast data, we have derived site-specific scaling relations with statistical basis to obtain the relationship between PPV and blast energy.
- Quarry blasting is required by regulation to consider the protection of residences, as well as all utilities. Several utilities currently exist beneath Grove Street including a water line, which is located closer to the Quarry property than the proposed gas pipeline.
- The existing water line is closer in proximity to the Quarry than the proposed natural gas pipeline, and represents the nearest receptor to the blast for vibrations. A theoretical scenario of blasting within 5 feet of the Grove Street right-of-way would result in PPV levels 33% to 67% higher at the existing water line than at the proposed gas pipeline.
- Under this theoretical scenario and assuming a conservative set of circumstances, the vibrations at the proposed natural gas pipeline would be 1.2 ips. The resulting PPV of 1.2 ips is equal to $1/10^{th}$ of the proposed gas pipeline's tolerable PPV of 12 ips, resulting in a factor of safety of 10. Other potential scenarios were considered, and would result in factors of safety of greater than 10. Ground vibrations from future blasting at the Quarry are therefore not anticipated to be disruptive or damaging to the proposed pipeline and M&R station.
- Fly rock was reported to have landed on property located on Centre Lane to the north of the Quarry in 2009. Due to the location of the proposed M&R station relative to the Quarry, and changes to the blasting operations as a result of the 2009 incident, fly-rock is not anticipated to land on the M&R station parcel. However, an analysis was made to evaluate the potential effects of a similar rock fragment striking the proposed above-ground portions of the M&R Station. Based on this analysis, a fly rock scenario similar to that reported in 2009 would potentially result in minor chipping of the concrete building exterior and minor denting of the exposed pipe resulting in some repair. However the fly rock does not pose a concern for interruption to service or release of natural gas.
- Based on our evaluation, the nearby Quarry blasting is not anticipated to have a significant negative impact on the operation of the proposed West Roxbury Lateral metering and regulating (M&R) station and pipeline.

APPENDIX A – LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in GZA's Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report, as appropriate, to reflect the unanticipated changed conditions .

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

Subsurface Conditions

4. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs.

5. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.

6. Water level readings have been made in test holes (as described in the Report) at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water table encountered in the course of the work may differ from that indicated in the Report.

7. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.

8. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

Compliance with Codes and Regulations

9. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

Cost Estimates

10. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

Additional Services

11. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

APPENDIX B – QUARRY BLASTING AND VIBRATIONS

DISCUSSION – BLAST-INDUCED VIBRATIONS

Ground vibrations and the effects on structures are well studied and documented based on extensive research of nuclear explosions and seismic events. These studies have identified the major types of ground vibrations, and their respective propagation and attenuation rates through and along the surfaces of soil and rock, and the effects of these vibrations at various magnitudes and frequencies on structures over long distances from the energy source. Rock blasting is typically comprised of a series of blasts separated by delays to split and pulverize the rock in a controlled manner. The resulting vibration from rock blasting and the distances the vibrations travel are a function of the individual blast energies per delay rather than the total blast energy. The resulting shear and compressive body waves and Raleigh surface waves created by quarry blasting travel shorter distances, and are not as easily distinguished and evaluated to the same degree as nuclear or seismic events. However, extensive observational data has been compiled, which provides guidance in predicting rock-blasting-induced vibrations as a function of explosive charge and distance from the blast (Dowding, 1996).

The resulting vibration intensity at any distance from a blast is generally a function of the blast energy per delay, radial distance from the blast, and site-specific subsurface conditions in the area. These variables affect how vibrations transmit, attenuate, and reflect to various degrees before reaching the location of concern. Rock-blasting-induced vibrations are therefore practically and commonly measured and evaluated simply on the basis of vibration magnitude (e.g., amplitude or peak particle velocity or PPV) measured in inches per second (ips), and dominant frequency measured in cycles per second (Hertz, Hz.). The monitoring equipment commonly used to measure the vibrations is a seismograph. For rock blasting, the seismograph instrument is typically capable and set up to be triggered by the vibrations, to record the vibration time history, and to report the "peak component" PPV and associated dominant frequency in the three principal directions (X, Y, and Z, or longitudinal, transverse, and vertical components).

The empirical relationships of observed building damage were established on the "peak component" PPV (Dowding, 1996) and therefore the "peak component" PPV reported in the seismograph reports are referenced herein when describing PPV. The peak "true vector sum" of the three component PPV levels can also be used to quantify vibration intensity; however, deriving the "true vector sum" can be a time-intensive and iterative exercise. The "maximum vector sum" is sometimes used for quantifying vibrations for regulatory purposes. The "maximum vector sum" combines the peak component PPVs for ease of use; however neglects that the peak component PPVs typically occur at different times on the vibration time history, and are therefore inaccurate and not recommended for use in evaluating vibrations.

Blast-induced PPV is typically controlled by designing the blast based on scaling relations relative to the nearest sensitive receptor(s), (i.e., typically buildings and/or utilities), and/or monitoring the vibrations during the blast at the receptor location(s). Scaling relations take into account the charge per delay and distance from the blast and degree of confidence in estimating the maximum PPV. In addition to the charge per delay and distance from the blast, vibration PPV induced by rock blasting can also be a function of a number of other components of the blast design (i.e., total charge, blast pattern, stemming depth, hole spacing, etc.), overburden, bedrock geology, and topography, all of which are unique to each blast. Accordingly, the site-specific scaling relationship can be evaluated using blast vibration data specific to each site, and the site-specific relationship is well-suited to predict PPV from future blasts at the same general location. This evaluation was performed as part of this study and the findings are presented in **Appendix D**.

Publications and industry guidelines present scaling relations, which in conjunction with the blaster's experience, provide a predictive methodology for determining the maximum charge per delay based upon the allowable PPV and distance to the sensitive receptor at each blast location (Hopler, 1998). The published scaling relations are based upon statistical analysis of thousands of recorded quarry blast vibrations. The scaling relation takes the form:

$$PPV = A\ (R/\sqrt{W})^B$$

Where:

PPV = Allowable peak particle velocity at the sensitive receptor (inches per second)
A = Variable based upon scaling relation referenced.
R = Radial distance between blast and sensitive receptor (feet)
W = Charge weight per delay (pounds)
B = Variable based upon scaling relation referenced.

The term $(R/\sqrt{W})$ is known as the "scaled distance".

The variable A is a function of the site specific conditions, as well as the desired degree of confidence that the resulting PPV is equal to or below the calculated PPV. The upper bound value of "A" based on the last year of blast reports, is presented in **Appendix D**. The variable B is taken as -1.6 based on a majority of publications on the subject (Siskind, et al., 1980; Konya, 1991).

DISCUSSION – IMPLICATIONS OF GROUND VIBRATIONS

The level of vibration a receptor (e.g., building, structure, utility, etc.) can tolerate is a function of the PPV, frequency, and duration of the vibrations, along with the definition of "tolerable" for that receptor. The total duration of rock-blast-induced vibrations is typically not longer than one second, and the maximum peak PPV is often not repeated, such that duration is typically not considered in rock-blast-induced vibrations.

The U.S. Bureau of Mines (USBOM 8507) proposed vibration PPV levels relative to the protection of residential dwellings from coal mine blasting as a function of vibration frequency (Siskind, et al., 1980). The term "protection" refers to controlling the racking or shifting of a timber-framed residential building, based on observed cracking of concrete and interior and exterior finishes. The USBOM 8507 criteria do not address other types of buildings or above- and below-ground infrastructure. However, USBOM 8507 is widely accepted by practitioners and regulatory authorities as guidance for evaluating the magnitude of blast-induced vibrations for buildings in general (527 CMR 13).

> *"Allowable limits of airblast and ground vibrations [USBOM 8507] are based, with a conservative factor of safety, upon extensive government, university, and engineering research which has established the amount and character of vibration so as to prevent damage and to insure the safety of the public and protection of property adjacent to the blast area."*(527 CMR 13.09(a))

The Office of Surface Mining (OSM) limit for residences near long-term, large-scale surface mine operations at distances of 300 to 5,000 feet (Hopler, 1998) is 1.0 ips, for any frequency. According to A-1 Drilling and Blasting, the Quarry's blasting operations are permitted by the City of Boston, with a PPV limit of 1.0 ips for any frequency similar to the OSM limit. This PPV limit of 1.0 ips is more restrictive than the USBOM 8507 limits within the majority range of blast-induced frequencies. The USBOM 8507 (527 CMR 13) limits and the OSM (Quarry permit) limits are illustrated on **Figure D1.**

Table B1 provides a compilation of vibration limits obtained from a variety of references to help illustrate the range of tolerances to vibrations by structures, materials, and humans (Bender, 2007).

Table B1

In order to provide some idea of what various PPV intensities represent, their effect on various structures and materials is contained in the following listing. These have been documented by researchers and organizations as referenced. Because of the many variables that could be encountered in the field, this listing should not be used to establish limits or be considered as the absolute point where the effect will always occur. To do so would also require consideration of frequencies. PPV units are inches per second.

PPV	Application	Effect	Reference
600	Explosive inside concrete	Mass blowout of concrete	j
375	Explosive inside concrete	Radial cracks develop in concrete	j
200	Explosive inside concrete	Spalling of loose/weathered concrete skin	j
> 100	Rock	Complete breakup of rock masses	a
100	Explosive inside concrete	Spalling of fresh grout	j
100	Explosive near concrete	No damage	l
50 - 150	Explosive near buried pipe	No damage	n
25 - 100	Rock	Tensile and some radial cracking	a
40	Mechanical equipment	Shafts misaligned	d
25	Explosive near buried pipe	No damage	o
25	Rock	Damage can occur in rock masses	c
10 - 25	Rock	Minor tensile slabbing	a
24	Rock	Rock fracturing	b
15	Cased drill holes	Horizontal offset	d
> 12	Rock	Rockfalls in underground tunnels	b
12	Rock	Rockfalls in unlined tunnels	g
< 10	Rock	No fracturing of intact rock	a
9.1	Residential structure	Serious cracking	b
8.0	Concrete blocks	Cracking in blocks	d
8.0	Plaster	Major cracking	h
7.6	Plaster	50% probability of major damage	g
7.0 - 8.0	Cased water wells	No adverse effect on well	m
> 7.0	Residential structure	Major damage possible	e
4.0 - 7.0	Residential structure	Minor damage possible	e
6.3	Residential structure	Plaster and masonry walls crack	b
5.44	Water wells	No change in well performance	k
5.4	Plaster	50% probability of minor damage	g
4.5	Plaster	Minor cracking	h
4.3	Residential structure	Fine cracks in plaster	b
> 4.0	Residential structure	Probable damage	f
2.0 - 4.0	Residential structure	Plaster cracking (cosmetic)	e
2.8 - 3.3	Plaster	Threshold of damage (from close-in blasts)	g
3.0	Plaster	Threshold of cosmetic cracking	h
1.2 - 3.0	Residential structure	Equals stress from daily environmental changes	i
2.8	Residential structure	No damage	b
2.0	Residential structure	Plaster can start to crack	d
2.0	Plaster	Safe level of vibration	g
< 2.0	Residential structure	No damage	e
< 2.0	Residential structure	No damage	f
0.9	Residential structure	Equivalent to nail driving	i
0.5	Mercury switch	Trips switch	d
0.5	Residential structure	Equivalent to door slam	i
0.1 - 0.5	Residential structure	Equates to normal daily family activity	i
0.3	Residential structure	Equivalent to jumping on the floor	i
0.03	Residential structure	Equivalent to walking on the floor	i

Table B1 (cont.)

List of References Used:

a) Bauer, A., & Calder, P.N. (1978), Open Pit and Blast Seminar, Kingston, Ontario, Canada.

b) Langefors, Ulf, Kihlstrom, B., & Westerberg, H. (1948), Ground Vibrations in Blasting.

c) Oriard, L.L., (1970), Dynamic Effect on Rock Masses From Blasting Operations, Slope Stability Seminar, Univ. of Nevada.

d) Bauer, A., & Calder, P.N., (1977), Pit Slope Manual, Canmet Report 77-14.

e) Nicholls, H.R., Johnson, C.F., & Duvall, W.I., (1971), Blasting Vibrations and Their Effects on Structures, Bureau of Mines Bulletin 656.

f) Edwards, A.T., & Northwood, T.D., (1960), Experimental Studies of the Effects of Blasting on Structures. The Engineer, September 1960.

g) Blasters' Handbook, (1977), E. I. du Pont de Nemours & Co.

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APPENDIX C – VIBRATIONS AND PIPELINES

The various structural components of the proposed M&R Station will be constructed of reinforced concrete and steel, and not considered more sensitive to blast-related ground vibrations than the underground piping. The proposed pipeline is approximately 100 feet closer to the Quarry than the M&R Station. Therefore, the focus of this analysis is toward the potential for ground vibrations to impact the proposed underground natural gas pipeline.

PROPOSED PIPELINE

The proposed pipeline will be installed according to Spectra standard details. We understand this includes a minimum of 6 inches of bedding material laterally between the piping and trench sidewalls and a minimum of 8 inches of bedding material between the piping and base of the trench. Bedding material beneath and around the pipe will consist of either sand or controlled density fill.

EXISTING UTILITIES

The proposed gas pipeline will be installed along Grove Street. Within the length of Grove Street that abuts the Quarry, the proposed gas pipeline will be located approximately 30 feet from the Quarry property line. There are multiple existing utilities beneath Grove Street, including a water main line and a sanitary sewer line, both of which are closer to the Quarry property line than the proposed gas pipeline in this area. The existing water line is closest to the Quarry, ranging between 5 and 20 feet away from the Quarry property line. The age, condition, depth, and material of the existing utilities are not known.

PEAK PARTICLE VELOCITY AND VIBRATION IN PIPELINES

Historically, pre-blast prediction and subsequent measurement of PPV has been the primary tool to predict and measure vibrations from a blast. The PPV can be easily measured by portable seismographs. Several references have been reviewed that correlate PPV to buried pipelines. The available references and corresponding PPV values are presented in the table below.

Table C1
Pipeline PPV Limits

PPV (ips)	Application / Effect	Reference
50-150	Explosive near a buried pipe with no damage	Siskind, D.E. & Stagg, 1993 *(Compiled in Bender, 2007)*
25	Explosive near a buried pipe with no damage	Oriard, 1980 *(Compiled in Bender, 2007)*
>12-15	Predicted PPV of an explosive near buried pipe that resulted in no damage	Bender, 1981
12	Vibration limit of pipeline trench parallel to existing high-pressure gas lines	ISEE Handbook
10	Blasting 50' from buried pipe with no loss of pipe integrity	US Bureau of Mines (Siskind, 1994)
5-10	Any steel buried pipe under any conditions or use the calculations for allowable PPV based on the allowable stress of pipe	Pipeline Engineering Journal, 2009 pg. 260-262

PIPE STRESSES AND VIBRATIONS

Studies have been performed and published describing the resistance of buried pipelines to blast-induced vibrations. These studies provide correlations between scaled distance with pipe bending and hoop stresses. The studies have concluded that pipe stresses are more accurately predicted based upon scaled distance than indirectly through PPV (Esparza, 1991). A scaled distance of 10, which corresponds to a PPV of 12.5 to 15 ips, has been considered conservative for buried pipelines.

Calculations to evaluate the reserve strength within pipelines to resist the applied energy from blasts allow designers to analyze site-specific and project-specific tolerance of a pipeline to stresses caused by vibrations. The project-specific variables include pipe properties (diameter, wall thickness, and yield strength), operating pressure, blasting energy, and the blast distance from the pipe. Based on the equation proposed by Esparza, 1981, the reserve strength within the 16-inch-diameter transmission gas pipeline operating at full pressure is 35,000 psi. This amount of reserve strength within the pipe can resist the stresses induced by ground vibrations in excess of 100 ips.

Based on the above references, and understanding the details of the pipe construction, installation, and operating pressure, we consider 12 ips to be a conservative PPV limit for the protection of the proposed West Roxbury Lateral pipeline.

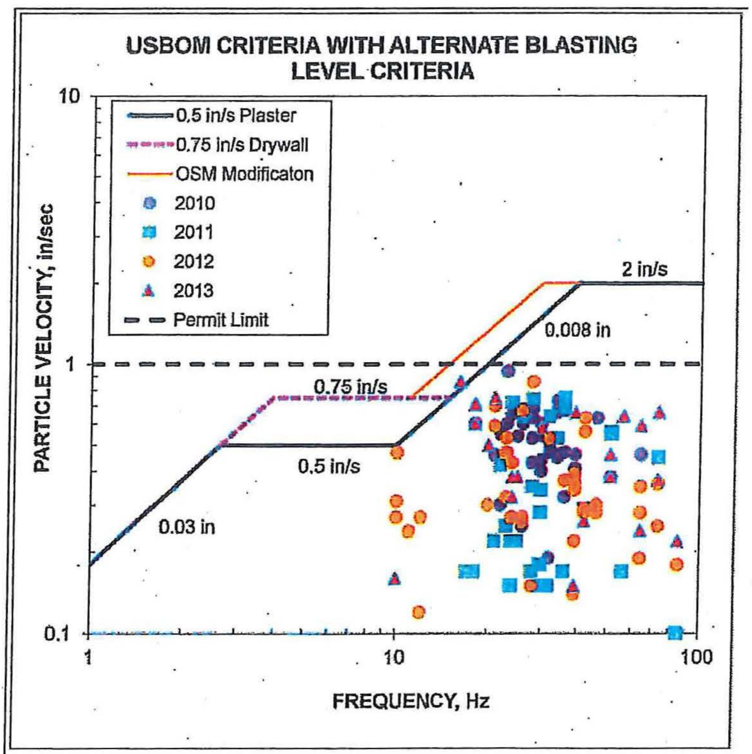
APPENDIX D – REVIEW OF QUARRY BLAST REPORTS

As part of this study, GZA evaluated the historical documented blast designs and levels of blast-induced vibrations at the Quarry. GZA obtained 139 blast reports from the Quarry spanning March 10, 2010 through December 12, 2013. The blast reports describe the blast design details and vibrations recorded at nearby residential areas. Due to the amount of blast data, GZA reviewed of the 139 blast vibration results and more closely evaluated the most recent 12 months of blast reports, comprising 26 blasts.

LAST FOUR YEARS OF BLAST DATA

GZA reviewed the maximum vibration monitoring results of the 139 blasts performed between 2010 and 2013. GZA compared the maximum recorded PPV for each blast to the Quarry's permitted allowable peak particle velocity (PPV) limit of 1.0 ips and the U.S. Bureau of Mines suggested vibration limits for buildings (USBOM 8507). The reported PPV levels represent the maximum recorded PPV and associated frequency per blast. A-1 monitored the blast vibrations using a seismograph that recorded the vibration time history, peak component PPV, and associated frequency for each of the X, Y, and Z directions. These 139 peak component PPVs are shown below.

Figure D1



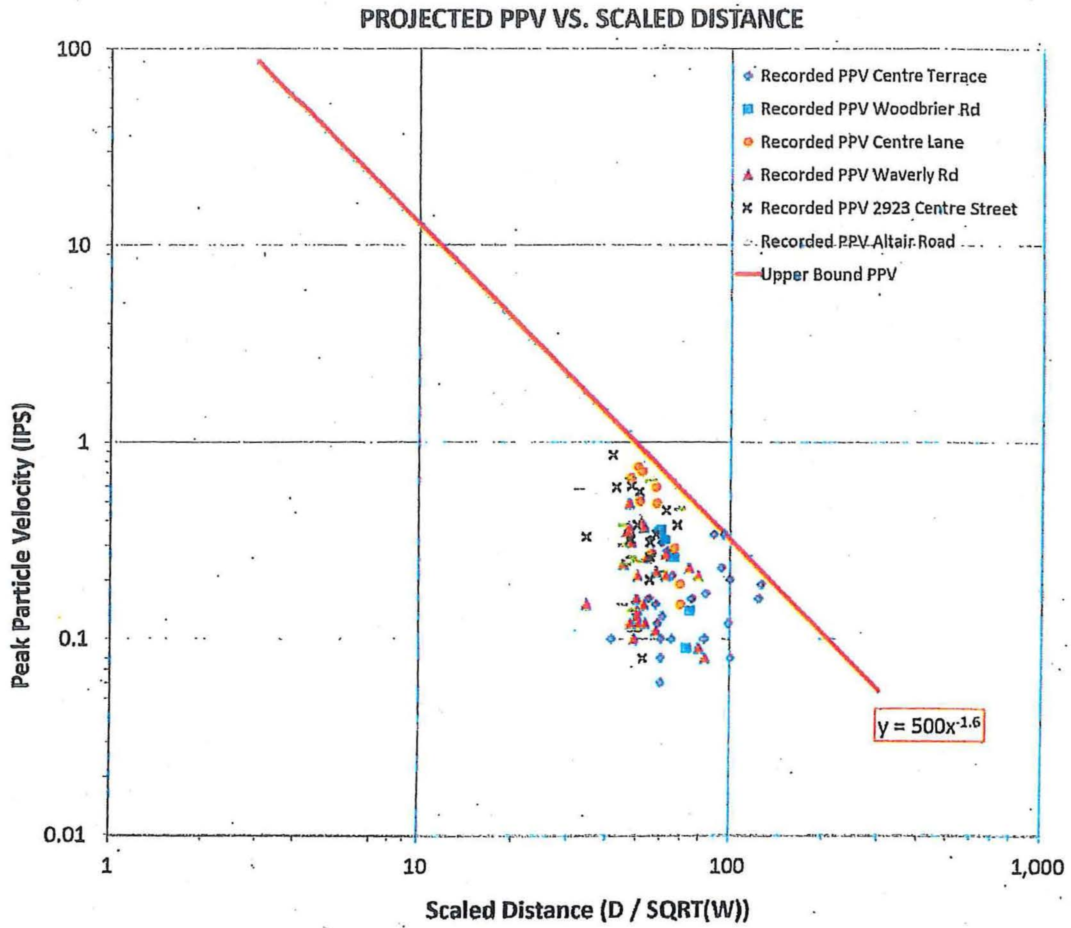
The maximum PPV of each of the 139 blasts spanning 2010 to 2013 fell within the permitted PPV limit of 1.0 ips. All but one of the 139 recorded peak PPVs were also within the USBOM 8507 criteria. The blast in question, Blast # 08-1, occurred June 26, 2013 and is among the blasts more closely reviewed in the followed paragraphs. This review suggests that the Quarry blasting vibrations have been effectively maintained within the permitted and limit over the last four years.

LAST 12 MONTHS OF BLAST DATA

GZA evaluated the most recent 12 months of A-1's reports of the Quarry blasting and made the following observations:

- Blast 08-1 resulted in a recorded vibration of 0.86 ips at 16 Hz. This recorded vibration was within the permitted limit of 1.0 ips. Blast 08-1 was the only blast with a recorded maximum vibration level that exceeded the USBOM 8507 criteria of 0.84 ips for that frequency.
- A-1 calculated the scaled distance and maximum energy per delay for each blast based on the nearest residence to the blast. The scaled distances of the 26 blasts ranged between 32 and 70, averaging 49. It is our opinion that the scaling relations method in conjunction with vibration monitoring remains the generally accepted industry standard for predicting and controlling the magnitude of rock-blasting-induced vibrations.
- A site-specific scaled distance plot is presented below for all of the recorded PPV data in the last year. The red line represents the upper bound limit of PPV based on the measured data. The correlated A-value upper bound limit for the last 12 months of blast vibration results is 500.
- Review of the last 12 months of blast energies and respective measured PPVs and distances illustrate that the Quarry geology propagates and attenuates blast-induced vibrations consistent with the published "scaled distance" equations at other quarry operations.

Figure D2


PROJECTED PPV VS. SCALED DISTANCE
Peak Particle Velocity (IPS)
100
10
1
0.1
0.01
1
10
100
1,000
Scaled Distance (D / SQRT(W))
Recorded PPV Centre Terrace
Recorded PPV Woodbrier Rd
Recorded PPV Centre Lane
Recorded PPV Waverly Rd
Recorded PPV 2923 Centre Street
Recorded PPV Altair Road
Upper Bound PPV
y = 500x-1.6

APPENDIX E – BLASTING PROXIMATE TO THE PROPOSED PIPELINE

The portion of the proposed pipeline route closest to the Quarry is along a section of Grove Street shown on **Figure 2.** That portion of the Quarry is currently used as a haul road and stockpile area. For the purposes of this evaluation, we have considered a scenario that the Quarry will move the stockpile and haul road and blast along the property line abutting Grove Street. Under such a scenario, we further assumed that the blasting would take place as close as 5 feet from the property line in this area. This 5-foot setback is conservative in that it only leaves room to walk around the Quarry, and does not factor any regulatory setback requirements that may be imposed by the City of Boston, the Mine Safety and Health Administration, Occupational Safety and Health Administration, or other operational considerations by the Quarry operator (i.e., to maintain vehicular access to the rear of the Quarry property, etc.). any of which would likely require more than a 5-foot setback.

Assuming blasting did take place near Grove Street, the nearest sensitive receptor would be the existing water line. Massachusetts State Regulation 527 CMR 13.09(o) requires that prior to blasting in the vicinity of utility lines or rights-of-way, the blaster shall notify the appropriate utilities in advance of blasting, and obtain a Dig-Safe number. In doing so the blaster would find the water line markings in the road and be required under 527 CMR 13.09(k) to conduct a blast analysis. The blast analysis shall include all of the overall factors affecting the blasting operations, considering adjacent area structure(s), building(s), utilities, including gas and water supply lines within 250 feet of the center of the blast site and other underground objects that might be damaged by the effects of a blast.

Per 527 CMR 13, the blaster is required to maintain blast vibrations below the USBOM 8507 or 1.0 ips limits. This scenario assumes that the blaster based his blast design around a maximum allowable PPV of 2.0 ips (USBOM 8507 limits, above 40 Hz) at the water line:

Location along Grove Street where the proposed gas pipeline would be closest to the Quarry (pipeline station 218+50).

Blast is designed using the scaled distance approach based on the nearest structure / utility (e.g., the existing water line)

Distance from blast to water line: 25 feet

- Maximum allowable PPV at water line: 2.0 ips (assume using highest PPV limit on the USBOM 8507 curve, rather than the currently permitted PPV limit of 1.0 ips)
- Scaled distance for blast design: 31
- Maximum charge / delay: 0.66 Lb.

Resulting PPV at water line: 2.0 ips

Distance blast to the proposed gas pipeline: 35 feet
Resulting upper bound PPV at the proposed gas pipeline: 1.2 ips

Conservative upper bound PPV for the proposed West Roxbury gas pipeline = 12 ips (Refer to Appendix C).
Minimum Factor of Safety for the proposed Gas Pipeline (12 / 1.2) = 10.

If the water line is subject to the City of Boston permitted PPV limit of 1.0 ips, the resulting upper bound PPV at the proposed gas pipeline would be 0.6 ips, resulting in a minimum factor of safety of 20 for the proposed gas pipeline.

This scenario concludes that if future blasting occurs adjacent to Grove Street, the proposed gas pipeline will be subject to only nominal vibrations, with a conservative factor of safety of at least 10.

The water line is located approximately 20 feet from the Quarry property line along the stretch of Grove Street in the above scenario. The existing water line is closer to the Quarry property line and the proposed gas pipeline is further away from the property line at other locations along this stretch of Grove Street. Other theoretical blast scenarios at other locations near Grove Street would therefore conclude with lower ground vibrations being experienced at the proposed gas pipeline.

APPENDIX F – POTENTIAL EFFECTS OF FLY ROCK TO THE PROPOSED M&R STATION

The underground natural gas pipeline will be constructed approximately 5 feet below grade, and as such the discussion of fly rock is limited to the potential effects on the above-ground components of the project.

Blasting is fundamentally intended to split, pulverize and mobilize the rock mass in a controlled fashion. When performed properly, the resulting rock particles move horizontally, away from the rock face resulting in a stockpile at the base of the rock face. There is no benefit to the Quarry in spreading the blast rock over a large area, as this will result in a loss of rock and require greater effort collecting the blast rock for processing.

All of the rock faces of the Quarry point inward to the Quarry property. In the event that blast rock particles are projected beyond the intended collection area at the base of the rock face, the blast rock will still be contained within the Quarry. There are rare circumstances where blast rock will be projected in a steep angle. This is often caused by inadequate blast design and improper stemming. In such an instance, the resulting blast rock will still be primarily directed within the Quarry.

In the very rare event that blast rock is projected to the side or behind the rock face, the rock could theoretically leave the Quarry property. It is our understanding that such an event was reported in 2009 by the property owner of 19 Centre Lane (Ertischek, 2009). The property at 19 Centre Lane abuts the Quarry. Based on aerial photography and Mass GIS, the shared property line is located 200 feet from the nearest Quarry face. According to one news report, blasting was taking place in the northwest portion of the Quarry at the time. The article reported that the fly rock created imprints in the lawn and dislodged rocks from a landscape wall.

It is our understanding that immediately following this reported event, the Quarry implemented modifications in the blasting operations to reduce the potential for fly rock, and since incorporating these changes, fly rock has not been reported by abutters.

The M&R station is planned to consist of two (2) internal inspection tool (pig) barrels (one launcher, one receiver), a metering building, two exterior gas heaters, a regulating building, and above-ground and underground gas pipelines. All above-ground components will be enclosed in a security fence. The buildings will be engineered, single-level structures with minimum 4-inch thick reinforced concrete walls and 4- to 6-inch thick reinforced concrete roof. The exterior above-ground structures, pipes, and supports will be steel construction. The buildings, pig barrels and heaters will be supported on concrete foundations. All sensitive M&R Station piping, instruments and components will be located inside of the reinforced concrete buildings.

A fly rock scenario was evaluated at the proposed M&R station parcel with respect to the building and the exposed above-ground piping. Information produced by the U.S. Naval Ship Research and Development Center (CIRIA/UEG, 1989) provides the results of test missiles similar to the size, mass and velocity estimated from the 2009 reported fly rock event. The missiles were observed to cause chipping of less than 1 inch deep in the concrete face, with no damage to the back side of the concrete.

The same dynamic forces were used to evaluate the potential of above-ground piping to dent or puncture the exposed portions of the pipeline. Calculations based on the pipe diameter, thickness, and steel strength, indicate that a dent may be formed on the order of 2 inches in depth or less.

However, the pipe's resistance to puncture is over 10 times the applied force of the fly rock. (Fuglem, 2001).

Based on this analysis, a fly rock scenario similar to that reported in 2009, would potentially result in minor chipping of the concrete building exterior and minor denting of the exposed pipe resulting in some repair. However the fly rock does not pose a concern for interruption to service or release of natural gas.

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http://maps.massgis.state.ma.us/map_ol/oliver.php, "Bedrock Lithology, Group B Detailed"

T:\Clients\office_PORTLAND\SpectraEnergy\Figure1\Figure1.mxd, 3/28/2014, 10:19:01 AM, patrick.finnerty

NOTES:
1. IMAGE COURTESY OF (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
2. THIS SKETCH REFERENCES "CITY OF BOSTON PARCEL DATA, 2013" WWW.CITYOFBOSTON.GOV/MAPS AND APPROXIMATE PIPELINE ALIGNMENT PROVIDED BY SPECTRA ENERGY.
3. THIS SKETCH AND THE FEATURES ADDED HERON ARE CONSIDERED NOT TO SCALE.

ALOGONQUIN INCREMENTAL MARKET (AIM) PROJECT
PROPOSED M&R STATION AND PIPELINE
WEST ROXBURY, MASSACHUSETTS

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
SPECTRA ENERGY TRANSMISSION

LOCATION OF ADJACENT WEST ROXBURY CRUSHED STONE (QUARRY)

PROJ MGR: GRM	REVIEWED BY: GRM	CHECKED BY: GRM	FIGURE
DESIGNED BY: GRM	DRAWN BY: ADM	SCALE: 1 in = 400 ft	
DATE: 03/28/2014	PROJECT NO. 09.0025818.00	REVISION NO.	1

NOTES:
1. IMAGE COURTESY OF (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
2. THIS SKETCH REFERENCES "CITY OF BOSTON PARCEL DATA, 2013" WWW.CITYOFBOSTON.GOV/MAPS AND APPROXIMATE PIPELINE ALIGNMENT PROVIDED BY SPECTRA ENERGY.
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LOCATION OF ADJACENT WEST ROXBURY CRUSHED STONE (QUARRY) ALIGNMENT SHEET

PROJ MGR: GRM	REVIEWED BY: GRM	CHECKED BY: GRM	FIGURE
DESIGNED BY: GRM	DRAWN BY: PCF	SCALE: 1 in = 60 ft	2
DATE: 03/28/2014	PROJECT NO. 09.0025818.00	REVISION NO.	

EXHIBIT 4

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September 1, 2017

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VIA HAND DELIVERY

President London Breed
c/o Angela Calvillo, Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place
City Hall, Room 244
San Francisco, CA 94102

RE: Appeal of CEQA Mitigated Negative Declaration ("MND")
Planning Case No. 2013.1383ENV
Building Permit Application Nos. 2013.12.16.4318 and 2013.12.16.4322
3516-3526 Folsom Street ("Project Site")

Dear President Breed and Honorable Members of the Board of Supervisors:

This firm represents two couples, Fabien Lannoye and Anna Limkin, and James and Patricia Fogarty (collectively, the "Project Sponsors"), who are the owners respectively of two vacant lots zoned for residential use located at 3516 and 3526 Folsom Street, upon which they propose to build two single-family homes and construct the adjacent 145 foot long "paper street" segment of Folsom Street to provide vehicular and pedestrian access to the site (collectively, the "Project"). The two lots are located at the Chapman Street terminus of Folsom Street in the Bernal Heights neighborhood. The Project Sponsors applied for building permits almost four years ago.

For the reasons set forth below, the Project Sponsors respectfully request that the Board reject the referenced appeal and uphold the Planning Department's decision to adopt the MND.

I. History of the CEQA Challenges

In response to the Planning Department's Section 311 Notice posted on August 17, 2015, 19 Requests for Discretionary Review of the Project were filed. When the consolidated DR requests were unanimously rejected by the Planning Commission in May 2016, the DR Requestors (also referred to herein as "Appellants") then turned their attention to the California Environmental Quality Act ("CEQA") and challenged the Planning Department's determination that the Project was categorically exempt under CEQA. Previously, on March 26, 2014, the Environmental Review Officer ("ERO") of the Planning Department issued a Certificate of

Determination: Exemption from Environmental Review finding that the Project was categorically exempt from CEQA review under Class 3: New Construction or Conversion of Small Structures (CEQA Guidelines Section 15303) (the "2014 Determination"). Guidelines Subsection 15303(a) allows the construction of up to three single-family residences in urbanized areas. Subsection 15303(d) allows the construction of water mains, sewage, electrical, gas and other utility extensions, including street improvements, of reasonable length to serve the construction of the small structures. The 2014 Determination also concluded that the Project Site was not located in a particularly sensitive or hazardous area and that there were no unusual circumstances involved with the proposed Project that suggested a reasonable possibility that it would cause a significant environmental effect.

Prior to the Board of Supervisor's hearing on the CEQA appeal scheduled for July 19, 2016, the Planning Department determined that the 2014 Determination should be withdrawn and a new Categorical Exemption should issue, which the Planning Department did on July 8, 2016 (the "2016 Determination"). The 2016 Determination again concluded that the Project qualified for a Class 3 categorical exemption, and that none of the exceptions to the categorical exemption applied. The withdrawal of the 2014 Determination required the Planning Commission to rehear the DR requests, which it did on October 13, 2016, and again unanimously approved the Project by not taking DR.

Some of the DR Requestors then appealed the 2016 Determination. Before being heard by the Board of Supervisors, the Planning Department in December 2016 determined that the 2016 Determination should be withdrawn to allow for further analysis of potential environmental impacts. Subsequently, with the agreement of the Project Sponsors, the Planning Department prepared a MND in order to better address the DR Requestors' concerns regarding potential construction impacts on the nearby PG&E pipeline. The Planning Department issued a notice of determination of its intent to adopt the MND on April 26, 2017. The MND was appealed by Appellants on May 16, 2017. The Planning Commission unanimously rejected the appeal and approved the MND on June 15, 2017. Appellants now appeal the MND, based on the same arguments that have been presented, and rejected, time and time again by the Planning Department and the Planning Commission.

II. <u>Standard of Review</u>

The Board must affirm the Planning Commission's adoption of a mitigated negative declaration if it finds that the mitigated negative declaration conforms to the requirements of CEQA and that the record, considered in its entirety, contains no substantial evidence to support a fair argument that the project may have a significant effect on the environment that has not been avoided or mitigated to a less than significant level by mitigation measures or project modifications agreed to by the project sponsor or incorporated into the project. See San Francisco Administrative Code Section 21.16 (c)-(e).

Under CEQA, "Argument, speculation, unsubstantiated opinion or narrative, evidence which is clearly erroneous or inaccurate, or evidence of social or economic impacts which do not contribute to or are not caused by physical impacts on the environment does not constitute substantial evidence." (See CEQA Guidelines Section 15384(a) (defining "substantial evidence")). CEQA Guidelines Section 15384(b) further states, "Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts."

III. Appellants Have Failed To Carry Their Burden of Proof.

Appellants have failed to carry their burden under CEQA and the Administrative Code. First, Appellants do not contend that the MND does not conform with CEQA. Second, Appellants have failed to demonstrate that there is substantial evidence, in light of the whole record, supporting a "fair argument" that the Project may have a significant, adverse, unmitigated effect on the environment, which would thus require the preparation of an EIR. See Public Resources Code Section 21064.5; San Francisco Administration Code Section 31.16(4).

A. Appellants Have Provided No Substantial Evidence That The Project, As Mitigated, Would Cause A Potentially Significant Impact.

1. Appellants' Purported Expert Evidence Does Not Withstand Scrutiny.

The Appellants' assert that the "adequacy and feasibility of the proposed mitigation actions are very much in question," but the MND fully evaluates the integrity of PG&E Pipeline 109. This particular pipeline runs under other residences in the neighborhood, and throughout many other residential neighborhoods in the City's southeastern areas, and does not pose any imminent threat to the Project. The issue has been thoroughly discussed in the MND. (MND, pp. 54-60).

The statement attributed to Professor Bea alleging identical concerns with Pipeline 109 and the San Bruno Pipeline 132 explosion is based upon incorrect and misleading facts provided to Professor Bea by one of the Appellants. In fact, as previously communicated to Appellants in writing by PG&E Expert Customer Impact Specialist, Austin Sharp, "Line 109 near 3516 and 3526 Folsom Street is not equivalent to the pipe in San Bruno that failed. The pipeline in San Bruno that failed was PG&E natural gas transmission pipeline L-132, which had a diameter of 30 inches, was installed in 1956, and had an MAOP of 400 psig. As described in the responses above, L-109 in your area is a 26-inch diameter pipeline, was installed in 1981, and operates at an MAOP of 150 psig." See Exhibit A, attached hereto, Response to Question 9. Appellants further mislead the Board with their groundless assertions that PG&E Pipeline 109 was installed in 1932. In fact, it was installed in 1981, and it has been regularly inspected by PG&E since its installation. See Exhibit A, Response to Question 8. It operates at 150 pounds per square inch (PSI) pressure, less than 20% of its engineered and specified minimum yield strength, which provides a substantial margin of safety. See Exhibit A, Response to Question 3. In fact, Appellants previously submitted to the Planning Commission a gas line pipe safety chart prepared by Professor Bea, as shown on the attached Exhibit B. At 150 PSI, PG&E Pipeline 109 falls well within Professor Bea's "Safe" quadrant. Similarly, the alleged statement made in 1989 by some unidentified person at DPW that the Project site was "too dangerous" to ever develop is just hearsay; it does not constitute substantial evidence.

Appellants' heavy reliance on Professor Storesund as a "qualified pipeline safety expert" appears misplaced. While he presents an impressive 30-page resume listing his qualifications and completed engineering projects and consultations, of the 167 projects he lists, none involves gas transmission pipeline analysis. The closest apparently he has ever come to analyzing gas transmission pipelines is in only 2 of his 167 projects: one working on an enlarged access road and maintenance pad for a new PG&E maintenance access facility (PG&E Line 131 Digging Project, Alameda County), and one involving trench backfill observation of a landfill methane gas recovery pipeline at the base of a levee (Newby Island Gas Transmission Pipeline, Milpitas). (Storesund Resume attached as Exhibit G to Appellants' Appeal dated July 17, 2017, p.13).

Professor Storesund's June 5th letter suggesting that there is a reasonable possibility that a significant effect still exists and that this segment of pipeline should be replaced is based upon errors and speculation that do not rise to substantial evidence. First, he cites to PG&E pipeline engineer, John Dolcini's, memo to the Planning Department dated March 17, 2017 (attached hereto as Exhibit C) as evidence that PG&E's "minimum of 36 inches of soil cover is very likely violated at this location, with a PG&E-estimated 24 inches of soil cover" when in fact, Mr. Dolcini indicated that "PG&E requires a minimum of existing grade or 36 inches of cover over gas lines (whichever is less)." Second, relying on his intentional misrepresentation of the PG&E policy, he continues by speculating that "it would not be surprising if a site-specific assessment will find additional deviations to be discovered that reveal a lower actual pipeline integrity vs an assumed pipeline integrity." Third, he states that most pipelines are horizontal in utility trenches; but this is certainly not true in San Francisco. Finally, based on his assumption of "additional deviations," he suggests that PG&E should replace the entire segment of pipeline prior to project construction. Such an approach would have very serious policy considerations for PG&E and the City suggesting that all future excavation and construction activities near gas transmission pipelines would require concurrent pipeline replacement. Professor Storesund's June 14, 2017, letter was not even presented to the Planning Commission for its hearing on the appeal, so has obviously been added by Appellants after they lost the appeal.

2. <u>The Project Incorporates All Required Mitigation Measures.</u>

The proposed construction vibration mitigation measure is robust, and the Project incorporates its safety measures. As indicated in the MND, the Project Sponsors intend to stage the Project construction from Bernal Heights Boulevard. (MND, p. 51). No construction or demolition materials will be stored within the required 45-foot zone for pipeline maintenance. In addition, the stairs from the proposed new sidewalk to Bernal Heights Boulevard, which were not part of the Project plans submitted by the Project Sponsors to the City and which were requested as a project addition by the City, can be constructed in such a manner that they do not violate PG&E's requested 10-foot clearance from the pipeline, or they could be eliminated altogether if PG&E insists, in which case the neighbors will lose an excellent potential neighborhood amenity. This issue is no different from the issue related to the planting of street trees for the Project: the City has required them consistent with City policy, and PG&E will likely prohibit them entirely because of their proximity to Pipeline 109. (See Exhibit C attached hereto, paragraph 4).

3. <u>Mitigation Measure M-NO-3 Incorporates Robust Standards that Adequately Addresses Appellants' Concerns.</u>

The Appellants' contention that "There is no data, analysis, or justification for using a PPV vibration standard of 2in/sec," ignores all relevant evidence to the contrary in the record. Illingworth and Rodkin, Inc., prepared a Construction Vibration Evaluation for the Project on March 24, 2017. This, along with the PG&E memo dated March 30, 2017, from John Dolcini, form the basis for Mitigation Measure M-NO-3. (MND, p. 58-60). The mitigation measure requires monitoring of vibration levels, and includes limitations on materials storage and construction activity on or near Pipeline 109, as well as the development of a Vibration Monitoring Plan, and its approval by PG&E and the Planning Department prior to the issuance of any building permits. See Planning Department Response to Appeal of PMND dated June 8, 2017, p. 10. Although many regulatory bodies use more lenient PPV vibration standards, Mitigation Measure M-NO-3 is based upon the most stringent standard of any. Mitigation

Measure M-NO-3 requires continuous vibration monitoring throughout Project construction and requires all construction work to stop if at any time vibration levels exceed 2 inches/second. See Agreement to Implement Mitigation Measures dated April 26, 2017, attached hereto as Exhibit D. This standard set by PG&E is a very conservative standard at a factor of 10 lower than the Construction Vibration Evaluation, which based its estimates of proposed project construction equipment on an already conservative damage criteria of 12 in/sec. (MND, pp. 56-57). This should assuage the Appellants' concerns of vibration impacts on the pipeline because the mitigation measure is based on the potential for construction equipment to operate beyond the significantly lower threshold of 2in/sec. Appellants provide no substantial evidence that the Project, as mitigated, would cause a potentially substantial environmental impact.

Project construction will be well-monitored. The Project Sponsors have consulted with multiple City agencies to ensure that construction of the proposed Project will comply with various regulations and City ordinances. Appellants have provided no substantial evidence that the lack of public participation in the construction management plan will lead to an adverse environmental effect under CEQA. Mitigation Measure M-NO-3: Vibration Management Plan adequately addresses the Project's construction such that the vibration effects on PG&E Pipeline 109 will be less than significant, as concluded in the MND, and as further detailed above. Enforcement of the mitigation measure is the responsibility of the Planning Department and the Department of Building Inspection. Both are public agencies that are independent of the Project Sponsors, and which are required to share information related to implementation and enforcement of mitigation measures. Emergency preparedness and response are the responsibility of the San Francisco Department of Emergency Management, the San Francisco Police Department, the San Francisco Fire Department, and other local, state, and federal agencies. Construction protocols must also follow PG&E safety measures.

4. <u>Appellants' Speculation Is Not Substantial Evidence.</u>

Appellants' repeated speculation that the construction of the Project will result in an explosion that will destroy the neighborhood is simply that—speculation. For example, Appellants' reference to a PG&E's "acknowledgment" that a pipeline failure would result in significant environmental damage, repeated references to PG&E's "recent track record", and references to the San Bruno explosion are all unrelated to the Project and do not constitute substantial evidence. In their effort to make every conceivable argument in opposition to the Project, Appellants contradict themselves. For example, while Appellants repeatedly bad mouth PG&E, Appellants' consultant, Professor Storesund, stated in his June 5, 2017, letter, which is not quoted by Appellants' legal counsel, that "PG&E is the only organization in a position to analyze the additional fatigue expected to be exerted on the pipeline from the bedrock excavation activity and certify that no appreciable degradation will occur." And Appellants will always demand yet one more test or study for the Project in their efforts to delay or kill the Project. See <u>Association of Irritated Residents v. County of Madera</u> (2003) 107 Cal.App.4th 1383, 1390-1391 ("Analysis of environmental effects need not be exhaustive, but will be judged in light of what was reasonably feasible.").

B. The MND Adequately Analyzes Cumulative Impacts of the Project.

Appellants argue that the MND errs in its environmental analysis of cumulative impacts because it does not assess the cumulative impacts of the "paper street" and the potential development of four additional houses on adjacent vacant lots for which utilities will be stubbed in as part of the Project. Once again, this is not true. In the MND Project Description, the Project is described as "the construction of two single-family residences on two of the vacant lots along the west side of the unimproved portion of Folsom Street, and the construction of the connecting segment of Folsom Street to provide vehicle and pedestrian access to the project site." (MND, p. 1). The potential environmental impacts of the "paper street" are analyzed throughout the MND, as stated in Response 1 of the Planning Department Response to Appeal of PMND dated June 8, 2017. The Project only involves the construction of two single-family homes on two small lots zoned for residential use and the 145-foot extension of Folsom Street. As discussed above, there are four other vacant lots zoned for residential use on the portion of Folsom Street that would be extended as part of the Project. The Project Sponsors have no ownership or control of these other lots. The rule in San Francisco has long been that a project is not considered reasonably foreseeable for cumulative impact analysis under CEQA until an application has been filed for environmental review. See <u>San Franciscans for Reasonable Growth v. City & Cty. Of San Francisco</u> (1989), 209 Cal.App.3d 1502, 1526-27. In this case, Planning Department staff have confirmed that no applications for environmental review for any of the four other lots have been filed with the City. (MND, at pp. 25-26).

Even if other applications had been filed, Appellants have provided no substantial evidence that significant cumulative impacts would occur. See <u>Hines v. California Coastal Commission</u> (2010) 186 Cal.App.4th 830, 857 (speculation that significant cumulative impacts will occur simply because other projects may be approved in the same area is insufficient to trigger the cumulative impact exception to reliance on categorical exemptions).

The MND analyzed the cumulative setting and states, "There are no active planning applications for any adjacent properties or for the other four lots on this unimproved section of Folsom Street." Subsequently, the MND was revised to include the residence under construction at the southeast corner of Chapman and Folsom, and the Planning Department Staff Response dated June 8, 2017, indicated that this addition did not modify the conclusions in the MND regarding lack of cumulative impacts (MND, p. 17). The MND's evaluation of cumulative environmental effects concluded that the Project would not result in a considerable contribution to any cumulative environmental impacts. Finally, the MND notes that any subsequent development would be required to undergo environmental review in accordance with CEQA and would be required to comply with the same regulations as the Project.

Appellants' contention that the development of six residences would automatically require preparation of an EIR is both factually incorrect and devoid of any legal authority. Similarly, Appellants' reliance on <u>Laurel Heights Improvement Association v. Regents of the University of California</u> (1988) 47 Cal.3d. 376, is misplaced. In <u>Laurel Heights</u>, the Regents acquired a 354,000 square foot building with the intent to ultimately use the entire building for UC purposes, but the Regents prepared an EIR analyzing only the use of approximately 100,000 square feet of the building. Here, the Project Sponsors have no ownership or control of the other four vacant lots, so this is not a "phased project" like the Regents' use of the Laurel Heights building.

C. Appellants Provide No Evidence to Challenge or Contradict the Findings in the Geotechnical Report.

Appellants do not provide any evidence to support their claim that the Geotechnical Report dated August 3, 2013, is "incomplete." In fact, as Appellants well know, the

Geotechnical Report was updated on November 30, 2016, and the updated report, as well as the Planned Street and Utility Improvements Geotechnical Investigation dated July 2017, are part of the administrative record. Appellants repeated references to the "revised project" are a smokescreen; while the Project has been revised since its initial configuration in 2013, the Project scope has been reduced to address Planning Department suggestions and community concerns. The analysis presented in the Geotechnical Report thus already covers the reduced scope of the Project. Second, Appellants' comments regarding soil stability, backfill soil over the PG&E Pipeline, and lateral and overhead earth movement from excavation activities are addressed in Mitigation Measure M-NO-3 and will be further addressed by more detailed, project-specific geotechnical analysis when the Project Sponsors process their building permits. The Project, like other building projects in San Francisco, will thus undergo further review with the Department of Building Inspection to analyze and avoid any potential impacts related to soils, and conduct design-level geotechnical investigations based on site-specific data.

Appellant's claim that the MND violates Planning Code Section 101.1 because it does not maximize earthquake preparedness by imposing earthquake hazard mitigation is completely meritless. The MND acknowledges the Appellants' concerns about earthquakes and landslides, and recognizes the reality that while the "project site is not located within a seismic hazard zone, it may be subject to ground shaking in the event of an earthquake on regional fault lines like the entire San Francisco Bay Area would." (MND, pp. 92-93). As further stated in the MND, the Project Site is not located within an area subject to landslides. Appellants' anecdote about a recent landslide from an unspecified location in "close proximity to the proposed project site" does not constitute substantial evidence. The MND appropriately concludes that the proposed Project will have less-than-significant landslide related impacts and that any risks associated with liquefaction and differential compaction would otherwise be reduced with implementation of standard building engineering and other design measures. (MND, p. 93). Appellants present no evidence to the contrary.

Other issues raised by Appellants, such as those regarding fertilizer runoff onto the PG&E Pipeline are nonsensical and do not impact this particular section of the PG&E Pipeline any more than water run-off on any other pipeline segment in San Francisco. And as indicated in the MND, the entire City, not just the Project Site, is located in a High Consequence Area.

D. Other Issues Raised by Appellants Fail for Lack of Substantial Evidence, Are Clearly Erroneous, Or Are Outside the Scope of CEQA.

1. Appellants Argue Without Any Evidence That Construction of the Project Will Result in a Significant Danger to Residents and Drivers Because of the Steepness of the Folsom Street Extension.

This is untrue and raises no CEQA issues. The street extension will require review and approval by San Francisco Public Works and is consistent with the City's Subdivision Regulations. (MND, p.40). The Project will comply with Fire Code Section 503.1.1. (MND, p. 40). The Project Sponsors have offered to work with the two existing neighbors to ensure that the final design of the Folsom Street extension preserves access to their garages and have offered to improve the existing driveways while paying all costs for design, permitting and construction. Access to existing driveways and the Project's driveways will be further ensured with the City's Street Design Advisory Team's recent approval of a 20' street width and a two-foot increase in curb cut lengths to 12 feet. (MND, p. 14). The fact that the Folsom Street extension will be steep and will not contain on-street parking does not mean that delivery trucks cannot access the new residences or existing residences. The nine estimated daily vehicle trips generated by the Project will hardly cause a "significant increase in existing traffic volumes" at the Folsom/Chapman intersection. See San Francisco Planning Department, Transportation Calculations for 3516-3526 Folsom Street, June 20, 2016.

Appellants have presented no evidence that drainage will be significantly affected by the introduction of the proposed street extension or the two new residences. Rather, installation of new storm water collection systems, including permeable planters along the Folsom Street extension, will improve drainage in the vicinity. (MND, pp. 79-80).

Appellants have presented no evidence that garbage, recycling and compost pick up will be adversely affected at either the intersection of Chapman and Powhattan or within two blocks of that intersection. The Project Site is no different from many other sites in San Francisco that are adequately serviced by waste management companies.

2. The Planning Department and the MND Concluded Appropriately that the Project Will Not Cause a Significant View Impact or Cast Significant New Shadows.

Photomontages reviewed by the Planning Department's staff demonstrate that the Project will not cause any significant view impacts from public areas as the Project does not obstruct views from Bernal Heights Park or Bernal Heights Boulevard. See Planning Department Discretionary Review – Full Analysis dated June 8, 2017, p. 10. Appellants fail to make a fair argument that the addition of the fence/railing on the roof decks of the Project will cause a significant shadow impact on the Bernal Heights Community Garden. Shadow studies submitted to the Planning Department demonstrate that the Project will cast minimal shadows on the Bernal Heights Community Garden, limited to only certain periods in the winter and summer, and the new shadow would only fall on a portion of the southwestern corner of the Bernal Heights Community Garden in the evening after 5:30pm. (MND, p.75). The addition of the fence/railing would not impact the shadow analysis.

3. Appellants Raise Non-CEQA Issues.

Construction trucks drive over City streets above gas pipelines, including Pipeline 109, everyday; there is nothing unusual about this. The Planning Department found that the Project satisfies the Bernal Heights East Slope Guidelines. See Planning Department Response to Appeal of PMND dated June 8, 2017, p. 15. The Project Site and Folsom Street extension are outside the boundaries of the Slope Protection Act because areas not designated as Landslide Hazards Zones are not subject to the Slope Protection Act. See Planning Department Response to Appeal of PMND dated June 8, 2017, p. 11. The Project is required to comply with the Stormwater Management Ordinance, but a Project-specific stormwater management plan is not required. (MND, p. 79). Construction impacts of the Project will be short-term and temporary.

* * * * *

San Francisco has a severe housing shortage. The California Supreme Court has held repeatedly that "rules regulating the protection of the environment must not be subverted into an instrument for the oppression and delay of social, economic, or recreational development and advancement." Citizens of Goleta Valley v. Board of Supervisors (1990) 52 Cal.3d 553, 576. As Appellants have utterly failed to meet their legal burden to provide substantial evidence demonstrating that the Project would cause a significant environment impact, the Project Sponsors respectfully request that the Board reject this appeal and uphold the Planning Department's adoption of the MND. Four years after the Project Sponsors purchased these two lots and approximately 45 months after they filed for environmental review, it is past time to put an end to this ordeal and allow the Project Sponsors to construct these two single-family homes.

Sincerely,

Carolyn Lee on behalf of Charles Olson

Charles R. Olson

CRO

cc: Fabien Lannoye and Anna Limkin
James Fogarty and Patricia Fogarty
Joy Navarrete, Planning Department, Environmental Planner
Justin Horner, Planning Department, Environmental Planner

EXHIBIT A
[PG&E Guidelines]

Hi Deborah, Herb, and Fabien,

Please see below for the response to the questions that Deborah submitted to me. Herb, I will have the additional questions sometime next week. I will also be attending your design review board meeting tonight, so if you have any PG&E related questions I will be available to answer them. Look forward to seeing you there.

Background: Lot 13 and Lot 14, Block 5626; 3516 Folsom St.; 3526 Folsom St. Concerned neighbors require explicit information about Pipeline 109. Thus we are sending the following request for information to the developer and to you as a representative of PG&E. As the owner of the above listed lots, in the vicinity of Pipeline #109 in Bernal Heights, we, concerned neighbors, are asking you to provide the following information:

QUESTION(S) 1: Where exactly is pipeline 109?; identify the longitude and latitude coordinates.
RESPONSE(S) 1: Please see attachment "*L109_Folsom_Street.pdf*" for the location of Line 109 near 3516 and 3526 Folsom Street, San Francisco. PG&E does not provide latitude and longitude of natural gas pipelines to outside parties (other than its regulators) for security reasons. To have PG&E identify the location of the gas lines in your street, please call USA, the Underground Service Alert, at 811.

QUESTION(S) 2: How deeply is #109 buried?
RESPONSE(S) 2: Gas transmission pipelines are typically installed with 36 to 48 inches of cover. However, the depth may vary as cover over the lines may increase or decrease over time due to land leveling and construction. Without digging and exposing the line, it is not possible to determine the exact depth.

QUESTION(S) 3: What is Pipeline #109 composed of?
RESPONSE(S) 3: Line 109 is a steel pipeline. In your neighborhood, this pipeline has a maximum allowable operating pressure (MAOP) of 150 pounds per square inch gage (psig), which is 19.8% of the pipe's specified minimum yield strength (SMYS). This provides a considerable margin of safety, since it would take a pressure of at least 750 psig to cause the steel in the pipe to begin to deform.

QUESTION(S) 4: How old is Pipeline #109?
RESPONSE(S) 4: Line 109 in this area was installed in 1981 and was strength tested at the time of installation.

QUESTION(S) 5: How big in diameter is Pipeline #109? What is the composition of the pipeline?
RESPONSE(S) 5: Line 109 in your vicinity is a 26-inch diameter steel pipeline.

QUESTION(S) 6: How/with what are the pipe seams welded?
RESPONSE(S) 6: Line 109 near 3516 and 3526 Folsom Street is constructed of API 5L-Grade B steel pipe, and has a double submerged arc weld along the longitudinal seam.

QUESTION(S) 7: How much gas runs through Pipeline #109?
RESPONSE(S) 7: Line 109 has a variable flow rate that is dependent on system operations and San Francisco area gas customer consumption. As points of reference, however, Line 109 observed flow rates of 1.55 – 2.375 million standard cubic feet per hour (MMSCFH) through the flow meter at Sullivan Avenue in Daly City on May 27, 2014.

QUESTION(S) 8: When were the last 3 inspections? Would you produce the documentation for these inspections.
RESPONSE(S) 8: PG&E has a comprehensive inspection and monitoring program to ensure the safety of its natural gas transmission pipeline system. PG&E regularly conducts patrols, leak surveys, and cathodic protection (corrosion protection) system inspections for its natural gas pipelines. Any issues identified as a threat to public safety are addressed immediately. PG&E also performs integrity assessments of certain gas transmission pipelines in urban and suburban areas.

Patrols: PG&E patrols its gas transmission pipelines at least quarterly to look for indications of missing pipeline markers, construction activity and other factors that may threaten the pipeline. Line 109 through the neighborhood was last patrolled in May 2014 and everything was found to be normal.

Leak Surveys: PG&E conducts leak surveys at least annually of its natural gas transmission pipelines. Leak surveys are generally conducted by a leak surveyor walking above the pipeline with leak detection instruments. Line 109 was last leak surveyed in April 2014 and no leaks were found.

Cathodic Protection System Inspections: PG&E utilizes an active cathodic protection (CP) system on its gas transmission and steel distribution pipelines to protect them against corrosion. PG&E inspects its CP systems every two months to ensure they are operating correctly. The CP systems on Line 109 in your area were last inspected in May 2014 and were found to be operating correctly.

Integrity Assessments: There are three federally-approved methods to complete a transmission pipeline integrity management baseline assessment: In-Line Inspections (ILI), External Corrosion Direct Assessment (ECDA) and Pressure Testing. An In-Line Inspection involves a tool (commonly known as a "pig") being inserted into the pipeline to identify any areas of concern such as potential metal loss (corrosion) or geometric abnormalities (dents) in the pipeline. An ECDA involves an indirect, above-ground electrical survey to detect coating defects and the level of cathodic protection. Excavations are performed to do a direct examination of the pipe in areas of concern as required by federal regulations. Pressure testing is a strength test normally conducted using water, which is also referred to as a hydrostatic test.

PG&E performed an ECDA on Line 109 in this area in 2009 and no issues were found. PG&E plans to perform the next ECDA on L-109 in this area in 2015. PG&E also performed an ICDA (Internal Corrosion Direct Assessment) on L-109 near 3516 and 3526 Folsom Street in 2012, and no issues were found.

Unfortunately, PG&E cannot provide the documentation from these inspections because they contain confidential information that PG&E only provides to its regulators.

QUESTION(S) 9: Is this pipeline equivalent in type to the exploded pipeline in San Bruno?
RESPONSE(S) 9: Line 109 near 3516 and 3526 Folsom Street is not equivalent to the pipe in San Bruno that failed. The pipeline in San Bruno that failed was PG&E natural gas transmission pipeline L-132, which had a diameter of 30 inches, was installed in 1956, and had an MAOP of 400 psig. As described in the responses above, L-109 in your area is a 26-inch diameter pipeline, was installed in 1981, and operates at an MAOP of 150 psig.

Thanks,

Austin

Austin Sharp I Expert Customer Impact Specialist
Pacific Gas and Electric Company
Phone: 650.598.7321
Cell: 650.730.4168
Email: awsd@pge.com

EXHIBIT B

[Exhibit from Professor Bea's Email dated May 5, 2014, which was included as Attachment E-6 in a DR Requestor's Application]

Pipeline Integrity Management

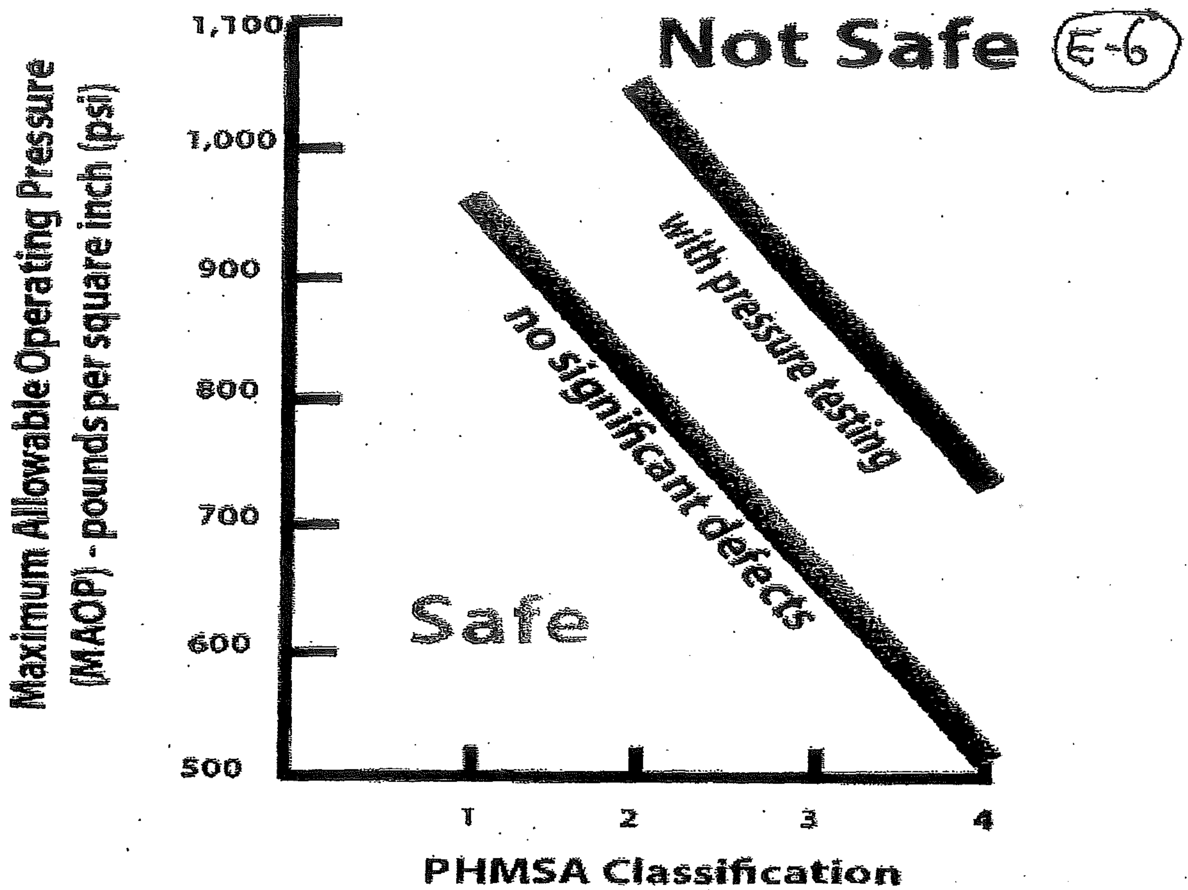

EXHIBIT C

[Memo from John Dolcini to San Francisco Planning Department dated March 30, 2017]

Pacific Gas and Electric Company®

Date: MARCH 30, 2017

To: JOY NAVARRETE – SAN FRANCISCO PLANNING DEPARTMENT

From: PG&E GAS TRANSMISSION PIPELINE SERVICES – INTEGRITY MANAGEMENT

Subject: 3516/3526 FOLSOM ST.

Dear Joy,

Thank you for making us aware that you plan to do grading work near the PG&E gas transmission pipeline located near 3516 and 3526 Folsom St. As you are aware, it has been confirmed that an active 26" PG&E gas transmission pipeline L-109 is routed through this location. It is imperative that any proposed demolition or construction work not impair the safety of the gas lines. This not only includes any immediate safety risk to the pipeline during demolition or construction activities, but also long-term public safety with respect to this critical piece of infrastructure. PG&E requires adequate access at all times to patrol, survey, excavate, inspect, test, and otherwise maintain the pipeline(s) on a continuous basis in accordance with PG&E Utility Standard TD-4490S "Gas Pipeline Rights-of-Way Management."

Please be aware that this letter is being sent to address PG&E gas transmission facilities only. This letter is not intended to address PG&E gas distribution or PG&E electric facilities.

If any changes are made to the site plans as discussed via previous email, PG&E will need to re-evaluate before site development begins. Considering any comments/feedback we may have, an ideal time to send us any plan changes would be during the design phase of the project, to allow the possibility of modifying the design as necessary before launching into the construction phase.

1. Standby Inspection: **A PG&E Gas Transmission Standby Inspector must be present during any demolition or construction activity within 10 feet of the gas pipeline(s).** This includes all grading, trenching, gas line depth verifications (potholes), asphalt or concrete demolition/removal, removal of trees, signs, light poles, etc. This inspection can be coordinated through the Underground Service Alert (USA) service at **811 or 1-800-227-2600.** A minimum notice of 48 hours is required. This is absolutely required for your grading project.

2. Grading/Excavation: PG&E requires a minimum of existing grade or 36 inches of cover over gas lines (whichever is less), and a maximum of 7 feet cover. Current records show that the depth of cover (top of grade to top of pipe) could be as shallow as 24", however potholing would be required to confirm this. Any excavations, including grading work, above or around the gas transmission facilities must be performed while a PG&E inspector is present. This includes all laterals, subgrades, gas line depth verifications (potholes), etc. Please follow PG&E Work Procedure TD-4412P-05 "*Excavation Procedures for Damage Prevention*" when working in the vicinity of the gas transmission pipeline. Any plans to expose and support a PG&E gas transmission pipeline across an open excavation need to be approved by PG&E Pipeline Engineering in writing **PRIOR** to performing the work. **Any grading or digging within 2 feet of a gas pipeline must be dug by hand.** Water jetting to assist vacuum excavating must be limited to 125 psig.

3. Pipeline Markers: PG&E requires pipeline markers be placed along the pipeline route in order to ensure public awareness of the presence of the pipeline. Any existing markers can be temporarily relocated to accommodate construction work (with written PG&E approval), however markers must be reinstalled once construction is complete. It is unknown at this time how accurate the pipeline marker locations are at this specific site. As stated above, please coordinate an inspection through the Underground Service Alert (USA) service at **811 or 1-800-227-2600.**

4. Landscaping: Trees or deep rooted shrubs shall not be located within 10 feet of edge of pipe (pipe zone). Trees less than 12 inches in diameter with non-intrusive root structures can be placed outside of the 10 foot pipe zone. This is in accordance with PG&E Utility Standard TD-4490S "Gas Pipeline Rights-of-Way Management" Section 2. Removal of trees is acceptable, given the stumps are not removed. If stumps/roots are being removed, further evaluation will be required to ensure that removal will not interfere with the pipelines.

5. Fencing: Care must be taken to ensure the safety and accessibility of the pipelines. No parallel fencing will be allowed within 10 ft. of the pipeline, and any perpendicular fencing will require 14 foot wide access gates to be secured with PG&E corporation locks.

6. Structures: Permanent structures must be located a minimum distance of 10 ft. from edge of pipe. Additionally, for pipeline maintenance, future construction, emergency response provisions, etc., we need a total width of 45 ft. to access the location. Do not stockpile or store demolition/construction material or equipment within this distance. PG&E cannot compromise on the ability to safely access, operate and maintain our facilities, especially when considering emergency situations.

7. Construction Loading: Please refer to chart below for approved construction loading as applicable to this project. To prevent damage to the buried gas pipelines, there are weight limits that must be enforced whenever any equipment gets within 10 feet of traversing a pipeline. Due to the weight variability of tracked equipment, cranes, vibratory compactors, etc., **do not allow any construction equipment within 10 ft. of the gas pipeline(s) without approval from the PG&E gas transmission pipeline engineer.** Wheel loading calculations will need to be determined, and the pipeline may need to be potholed by hand in a few areas to confirm the depth of the existing cover. These weight limits also depend on the support provided by the pipeline's internal gas pressure. If PG&E's operating conditions require the pipeline to be depressurized, maximum wheel loads over the pipeline will need to be further limited. For compaction, please use walk-behind compaction equipment if within 2 feet of the pipeline. Crane and backhoe outriggers must be set at least 10 feet from the centerline of the gas pipeline. **Specific to this project, please ensure max PPV vibration levels are less than 2in/sec.**

   Referencing the chart below, for wheeled equipment only (excludes tracked equipment and vibratory rollers), for a depth of cover of 2ft over top of the 26" pipeline, the pipe may be subjected to a maximum half-axle wheel load of 4580 lbs. **Specific to this project, the 17,500 lb Takeuchi TB175 excavator and 8,000 lb Bobcat Excavator are approved for use.** If any equipment is planned to be operated within 10 ft. of the pipeline that exceeds the half-axel weight specified below, please contact the gas transmission pipeline engineer for approval. Half axle weight is the gross weight upon any one wheel, or wheels, supporting one end of an axle.

Depth of Cover (ft. to Top of Pipe)	Max. Half-Axle Wheel Loading (lbs.)
2	4580
3	6843
4	7775
5	7318

Feel free to contact me if there are any questions or concerns.

John Dolcini
Pipeline Engineer - Gas Transmission
Pacific Gas and Electric Company
Email: J7DP@pge.com

EXHIBIT D

[Agreement to Implement Mitigation Measures dated April 26, 2017]

SAN FRANCISCO
PLANNING DEPARTMENT

1650 Mission St.
Suite 400
San Francisco,
CA 94103-2479

Reception:
415.558.6378

Fax:
415.558.6409

Planning
Information:
415.558.6377

Agreement to Implement Mitigation Measure(s)

Date:	April 26, 2017
Case No.	**2013.1383ENV**
Project Title.:	3516 and 3526 Folsom Street
Project Sponsor:	Fabien Lannoye, Bluorange Designs
Project Address:	**3516 and 3526 Folsom Street**
Block/Lot:	5626/013 and 014
City and County:	San Francisco

MITIGATION MEASURE(S):

Mitigation Measure M-NO-3, Vibration Management Plan:
The Project Sponsor shall retain the services of a qualified structural engineer to develop, and the Project Sponsor shall adopt, a vibration management and continuous monitoring plan to cover any construction equipment operations performed within 20 feet of PG&E Pipeline 109. The vibration management and monitoring plan shall be submitted to PG&E and Planning Department staff for review and approval prior to issuance of any construction permits. The vibration management plan shall include:

- Vibration Monitoring: Continuous vibration monitoring throughout the duration of the major structural project activities to ensure that vibration levels do not exceed the established standard.
- Maximum PPV Vibration Levels: Maximum PPV vibration levels for any equipment shall be less than 2 inches per second (in/sec). Should maximum PPV vibration levels exceed 2 in/sec, all construction work shall stop and PG&E shall be notified to oversee further work.
- Standby Inspection: A PG&E Gas Transmission Standby Inspector must be present during any demolition or construction activity within 10 feet of the gas pipeline(s). This includes all grading, trenching, gas line depth verifications (potholes), asphalt or concrete demolition/removal, removal of trees, signs, light poles, etc. This inspection would be coordinated through the Underground Service Alert (USA) service at 811 or 1-800-227-2600. A minimum notice of 48 hours is required.
- Grading/Excavation: Any excavations, including grading work, above or around Pipeline 109 must be performed with a PG&E inspector present. This includes all laterals, subgrades, and gas line depth verifications (potholes). Work in the vicinity of Pipeline 109 must be completed consistent with PG&E Work Procedure TD-4412P-05 "Excavation Procedures for Damage Prevention." Any plans to expose and support Pipeline 109 across an open excavation must be approved by PG&E Pipeline Engineering in writing prior to performing the work. Any grading or digging within two (2) feet of Pipeline 109 shall be dug by hand. Water jetting to assist vacuum excavating must be limited to 125 pounds per square inch gage (psig).

- Pipeline Markers: Prior to the commencement of project activity, pipeline markers must be placed along the pipeline route. With written PG&E approval, any existing markers can be temporarily relocated to accommodate construction work, but must be reinstalled once construction is complete.
- Fencing: No parallel fencing is allowed within 10 feet of Pipeline 109 and any perpendicular fencing shall require 14 foot access gates to be secured with PG&E corporation locks.
- Structures: Permanent structures must be located a minimum distance of 10 feet from the edge of Pipeline 109. A total width of 45 feet shall be maintained for pipeline maintenance. No storage of construction or demolition materials is permitted within this 45 foot zone.
- Construction Loading: To operate or store any construction equipment within 10 feet of Pipeline 109 that exceeds the half-axle wheel load (half axle weight is the gross weight upon any one wheel, or wheels, supporting one end of an axle) in the table below, approval from a PG&E gas transmission pipeline engineer is required. Pipeline 109 may need to be potholed by hand in to confirm the depth of the existing cover. These weight limits also depend on the support provided by the Pipeline's internal gas pressure. If PG&E's operating conditions require the Pipeline to be depressurized, maximum wheel loads over the pipeline will need to be further limited. For compaction within two feet of Pipeline 109, walk-behind compaction equipment shall be required. Crane and backhoe outriggers shall be set at least 10 feet from the centerline of Pipeline 109. Maximum PPV vibration levels for any equipment shall be less than 2 in/sec.

Depth of Cover to Top of Pipe (ft.)	Maximum Half-Axle Wheel Loading (lbs)
2	4,580
3	6,843
4	7,775
5	7,318

I agree to implement the above mitigation measure(s) as a condition of project approval.

Project Sponsor Signature

4/27/17
Date

EXHIBIT 5

EXHIBIT A
[PG&E Guidelines]

Hi Deborah, Herb, and Fabien,

Please see below for the response to the questions that Deborah submitted to me. Herb, I will have the additional questions sometime next week. I will also be attending your design review board meeting tonight, so if you have any PG&E related questions I will be available to answer them. Look forward to seeing you there.

Background: Lot 13 and Lot 14, Block 5626; 3516 Folsom St.; 3526 Folsom St. Concerned neighbors require explicit information about Pipeline 109. Thus we are sending the following request for information to the developer and to you as a representative of PG&E. As the owner of the above listed lots, in the vicinity of Pipeline #109 in Bernal Heights, we, concerned neighbors, are asking you to provide the following information:

QUESTION(S) 1: Where exactly is pipeline 109?; identify the longitude and latitude coordinates.

RESPONSE(S) 1: Please see attachment "*L109_Folsom_Street.pdf*" for the location of Line 109 near 3516 and 3526 Folsom Street, San Francisco. PG&E does not provide latitude and longitude of natural gas pipelines to outside parties (other than its regulators) for security reasons. To have PG&E identify the location of the gas lines in your street, please call USA, the Underground Service Alert, at 811.

QUESTION(S) 2: How deeply is #109 buried?

RESPONSE(S) 2: Gas transmission pipelines are typically installed with 36 to 48 inches of cover. However, the depth may vary as cover over the lines may increase or decrease over time due to land leveling and construction. Without digging and exposing the line, it is not possible to determine the exact depth.

QUESTION(S) 3: What is Pipeline #109 composed of?

RESPONSE(S) 3: Line 109 is a steel pipeline. In your neighborhood, this pipeline has a maximum allowable operating pressure (MAOP) of 150 pounds per square inch gage (psig), which is 19.8% of the pipe's specified minimum yield strength (SMYS). This provides a considerable margin of safety, since it would take a pressure of at least 750 psig to cause the steel in the pipe to begin to deform.

QUESTION(S) 4: How old is Pipeline #109?

RESPONSE(S) 4: Line 109 in this area was installed in 1981 and was strength tested at the time of installation.

QUESTION(S) 5: How big in diameter is Pipeline #109? What is the composition of the pipeline?

RESPONSE(S) 5: Line 109 in your vicinity is a 26-inch diameter steel pipeline.

QUESTION(S) 6: How/with what are the pipe seams welded?

RESPONSE(S) 6: Line 109 near 3516 and 3526 Folsom Street is constructed of API 5L-Grade B steel pipe, and has a double submerged arc weld along the longitudinal seam.

QUESTION(S) 7: How much gas runs through Pipeline #109?

RESPONSE(S) 7: Line 109 has a variable flow rate that is dependent on system operations and San Francisco area gas customer consumption. As points of reference, however, Line 109 observed flow rates of 1.55 – 2.375 million standard cubic feet per hour (MMSCFH) through the flow meter at Sullivan Avenue in Daly City on May 27, 2014.

QUESTION(S) 8: When were the last 3 inspections? Would you produce the documentation for these inspections.

RESPONSE(S) 8: PG&E has a comprehensive inspection and monitoring program to ensure the safety of its natural gas transmission pipeline system. PG&E regularly conducts patrols, leak surveys, and cathodic protection (corrosion protection) system inspections for its natural gas pipelines. Any issues identified as a threat to public safety are addressed immediately. PG&E also performs integrity assessments of certain gas transmission pipelines in urban and suburban areas.

Patrols: PG&E patrols its gas transmission pipelines at least quarterly to look for indications of missing pipeline markers, construction activity and other factors that may threaten the pipeline. Line 109 through the neighborhood was last patrolled in May 2014 and everything was found to be normal.

Leak Surveys: PG&E conducts leak surveys at least annually of its natural gas transmission pipelines. Leak surveys are generally conducted by a leak surveyor walking above the pipeline with leak detection instruments. Line 109 was last leak surveyed in April 2014 and no leaks were found.

Cathodic Protection System Inspections: PG&E utilizes an active cathodic protection (CP) system on its gas transmission and steel distribution pipelines to protect them against corrosion. PG&E inspects its CP systems every two months to ensure they are operating correctly. The CP systems on Line 109 in your area were last inspected in May 2014 and were found to be operating correctly.

Integrity Assessments: There are three federally-approved methods to complete a transmission pipeline integrity management baseline assessment: In-Line Inspections (ILI), External Corrosion Direct Assessment (ECDA) and Pressure Testing. An In-Line Inspection involves a tool (commonly known as a "pig") being inserted into the pipeline to identify any areas of concern such as potential metal loss (corrosion) or geometric abnormalities (dents) in the pipeline. An ECDA involves an indirect, above-ground electrical survey to detect coating defects and the level of cathodic protection. Excavations are performed to do a direct examination of the pipe in areas of concern as required by federal regulations. Pressure testing is a strength test normally conducted using water, which is also referred to as a hydrostatic test.

PG&E performed an ECDA on Line 109 in this area in 2009 and no issues were found. PG&E plans to perform the next ECDA on L-109 in this area in 2015. PG&E also performed an ICDA (Internal Corrosion Direct Assessment) on L-109 near 3516 and 3526 Folsom Street in 2012, and no issues were found.

Unfortunately, PG&E cannot provide the documentation from these inspections because they contain confidential information that PG&E only provides to its regulators.

QUESTION(S) 9: Is this pipeline equivalent in type to the exploded pipeline in San Bruno?

RESPONSE(S) 9: Line 109 near 3516 and 3526 Folsom Street is not equivalent to the pipe in San Bruno that failed. The pipeline in San Bruno that failed was PG&E natural gas transmission pipeline L-132, which had a diameter of 30 inches, was installed in 1956, and had an MAOP of 400 psig. As described in the responses above, L-109 in your area is a 26-inch diameter pipeline, was installed in 1981, and operates at an MAOP of 150 psig.

Thanks,

Austin

Austin Sharp I Expert Customer Impact Specialist
Pacific Gas and Electric Company
Phone: 650.598.7321
Cell: 650.730.4168
Email: awsd@pge.com

EXHIBIT 6

Part 192 – Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

New Format

For future versions of this manual, changes to the regulations will show a highlight for deletions and an underline for additions.

Amendment Table of Section Revisions for This Version of Part 192

Part 192 Amendment Number	Effective Date of Amendment	Paragraph Impact	In Refference to:
192-[108]*	01/23/09	192.121, .123	PA-11 Design Pressures
192-[109]*	02/17/09	192.7, .727, .949, .951	Administrative Procedures, Address Updates, and Technical Amendments
192-[110]*	04/21/09	192.7	Incorporation by Reference Update: American Petroleum Institute (API) Standards 5L and 1104
192-111	01/29/10	192.112, .121, .620	Editorial Amendments to the Pipeline Safety Regulations.
192-112	02/01/10	192.3, .605, .615, .631	Control Room Management/ Human Factors
192-112c	02/01/10	192.631	Correction
192-113	02/02/10	192.383, Subpart P	Integrity Management Program for Gas Distribution Pipelines
192-113c	02/12/10	192.383	Correction
192-114	10/01/2010	192.3, .7, .63, .65, .121, .123, .145, .191, .281, .283, .465, .711, .923, .925, .931, .935, .939, Appendix B	Periodic Updates of Regulatory References to Technical Standards and Miscellaneous Edits
192.115	11/26/2010	192.945, 951;	Updates to Liquefied Natural Gas Reporting Requirements
192.116	02/01/11	192.383, .1001, .1007, .1009	Pipeline Safety: Mechanical Fitting Failure Reporting Requirements
192.117	06/06/11	192.631	Pipeline Safety: Control Room Managment/Human Factors
192.118	09/25/13	192.603	Pipeline safety, Fire prevention, Security measures

192.119	03/06/15	192.7, .11, .55, .59, .63, .65, .112, .113, .123, .145, .147, .153, .163, .165, .177, .189, .191, .225, .227, .229, .241, .281, .283, .485, .735, .903, .923, .925, .931, .935, .939, APPENDIX B	TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE: MINIMUM FEDERAL SAFETY STANDARDS
192.120	03/11/15	192.3,.9,.65,.112,.153,.165, .225,.227,.229,.241,.243,.285,.305,.503,.505,.620,.805 ,.925,.949	TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE: MINIMUM FEDERAL SAFETY STANDARDS

*OPS quit numbering their new amendments for a period of time. For the purposes of tracking, TQ is maintaining a numbering system.

Copies of 49 CFR Parts 190 through 199 and Part 40 are available for download at: http://www.phmsa.dot.gov.

Subpart D–Design of Pipeline Components

Subpart E–Welding of Steel in Pipelines

Subpart F–Joining of Materials Other Than by Welding

Subpart J–Test Requirements

Subpart K–Uprating

Subpart L–Operations

Subpart P–Gas Distribution Pipeline Integrity Management (IM)

Authority: 49 U.S.C. 5103, 60102, 60104, 60108, 60109, 60110, 60113, 60116, and 60118, 60137; and 49 CFR 1.971.53.

PART 192 – TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE: MINIMUM FEDERAL SAFETY STANDARDS

Subpart A–General

§192.1 What is the scope of this part?

(a) This part prescribes minimum safety requirements for pipeline facilities and the transportation of gas, including pipeline facilities and the transportation of gas within the limits of the outer continental shelf as that term is defined in the Outer Continental Shelf Lands Act (43 U.S.C. 1331).

(b) This part does not apply to—

(1) Offshore gathering of gas in State waters upstream from the outlet flange of each facility where hydrocarbons are produced or where produced hydrocarbons are first separated, dehydrated, or otherwise processed, whichever facility is farther downstream;

(2) Pipelines on the Outer Continental Shelf (OCS) that are producer-operated and cross into State waters without first connecting to a transporting operator's facility on the OCS, upstream (generally seaward) of the last valve on the last production facility on the OCS. Safety equipment protecting PHMSA-regulated pipeline segments is not excluded. Producing operators for those pipeline segments upstream of the last valve of the last production facility on the OCS may petition the Administrator, or designee, for approval to operate under PHMSA regulations governing pipeline design, construction, operation, and maintenance under 49 CFR 190.9;

(3) Pipelines on the Outer Continental Shelf upstream of the point at which operating responsibility transfers from a producing operator to a transporting operator;

(4) Onshore gathering of gas–

(i) Through a pipeline that operates at less than 0 psig (0 kPa);

(ii) Through a pipeline that is not a regulated onshore gathering line (as determined in §192.8); and

(iii) Within inlets of the Gulf of Mexico, except for the requirements in §192.612; or

(5) Any pipeline system that transports only petroleum gas or petroleum gas/air mixtures to—

(i) Fewer than 10 customers, if no portion of the system is located in a public place; or

(ii) A single customer, if the system is located entirely on the customer's premises (no matter if a portion of the system is located in a public place).

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-67, 56 FR 63764, Dec. 5, 1991; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-81, 62 FR 61692, Nov. 19, 1997; Amdt. 192-92, 68 FR 46109, Aug. 5, 2003; 70 FR 11135, Mar. 8, 2005, Amdt. 192-102, 71 FR 13289, Mar. 15, 2006; Amdt. 192-103c, 72 FR 4655, Feb. 1, 2007]

§192.3 Definitions.

As used in this part:

Abandoned means permanently removed from service.

Active corrosion means continuing corrosion that, unless controlled, could result in a condition that is detrimental to public safety.

Administrator means the Administrator, Pipeline and Hazardous Materials Safety Administration or his or her delegate.

Alarm means an audible or visible means of indicating to the controller that equipment or processes are outside operator-defined, safety-related parameters.

Control room means an operations center staffed by personnel charged with the responsibility for remotely monitoring and controlling a pipeline facility.

Controller means a qualified individual who remotely monitors and controls the safety-related operations of a pipeline facility via a SCADA system from a control room, and who has operational authority and accountability for the remote operational functions of the pipeline facility.

Customer meter means the meter that measures the transfer of gas from an operator to a consumer.

Distribution Line means a pipeline other than a gathering or transmission line.

Electrical survey means a series of closely spaced pipe-to-soil readings over pipelines which are subsequently analyzed to identify locations where a corrosive current is leaving the pipeline.

Exposed underwater pipeline means an underwater pipeline where the top of the pipe protrudes above the underwater natural bottom (as determined by recognized and generally accepted practices) in waters less than 15 feet (4.6 meters) deep, as measured from mean low water.

Gas means natural gas, flammable gas, or gas which is toxic or corrosive.

Gathering Line means a pipeline that transports gas from a current production facility to a transmission line or main.

Gulf of Mexico and its inlets means the waters from the mean high water mark of the coast of the Gulf of Mexico and its inlets open to the sea (excluding rivers, tidal marshes, lakes, and canals) seaward to include the territorial sea and Outer Continental Shelf to a depth of 15 feet (4.6 meters), as measured from the mean low water.

Hazard to navigation means, for the purpose of this part, a pipeline where the top of the pipe is less than 12 inches (305 millimeters) below the underwater natural bottom (as determined by recognized and generally accepted practices) in water less than 15 feet (4.6 meters) deep, as measured from the mean low water.

High pressure distribution system means a distribution system in which the gas pressure in the main is higher than the pressure provided to the customer.

Line section means a continuous run of transmission line between adjacent compressor stations, between a compressor station and storage facilities, between a compressor station and a block valve, or between adjacent block valves.

Listed specification means a specification listed in section I of Appendix B of this part.

Low-pressure distribution system means a distribution system in which the gas pressure in the main is substantially the same as the pressure provided to the customer.

Main means a distribution line that serves as a common source of supply for more than one service line.

Maximum actual operating pressure means the maximum pressure that occurs during normal operations over a period of 1 year

Maximum allowable operating pressure (MAOP) means the maximum pressure at which a pipeline or segment of a pipeline may be operated under this part.

Municipality means a city, county, or any other political subdivision of a State.

Offshore means beyond the line of ordinary low water along that portion of the coast of the United States that is in direct contact with the open seas and beyond the line marking the seaward limit of inland waters.

Operator means a person who engages in the transportation of gas.

Outer Continental Shelf means all submerged lands lying seaward and outside the area of lands beneath navigable waters as defined in Section 2 of the Submerged Lands Act (43 U.S.C. 1301) and of which the subsoil and seabed appertain to the United States and are subject to its jurisdiction and control.

Person means any individual, firm, joint venture, partnership, corporation, association, State, municipality, cooperative association, or joint stock association, and including any trustee, receiver, assignee, or personal representative thereof.

Petroleum gas means propane, propylene, butane, (normal butane or isobutanes), and butylene (including isomers), or mixtures composed predominantly of these gases, having a vapor pressure not exceeding 208 psi (1434 kPa) at 100°F (38°C).

Pipe means any pipe or tubing used in the transportation of gas, including pipe-type holders.

Pipeline means all parts of those physical facilities through which gas moves in transportation, including pipe, valves, and other appurtenance attached to pipe, compressor units, metering stations, regulator stations, delivery stations, holders, and fabricated assemblies.

Pipeline environment includes soil resistivity (high or low), soil moisture (wet or dry), soil contaminants that may promote corrosive activity, and other known conditions that could affect the probability of active corrosion.

Pipeline facility means new and existing pipeline, rights-of-way, and any equipment, facility, or building used in the transportation of gas or in the treatment of gas during the course of transportation.

Service Line means a distribution line that transports gas from a common source of supply to an individual customer, to two adjacent or adjoining residential or small commercial customers, or to multiple residential or small commercial customers served through a meter header or manifold. A service line ends at the outlet of the customer meter or at the connection to a customer's piping, whichever is further downstream, or at the connection to customer piping if there is no meter.

Service regulator means the device on a service line that controls the pressure of gas delivered from a higher pressure to the pressure provided to the customer. A service regulator may serve one customer or multiple customers through a meter header or manifold.

SMYS means specified minimum yield strength is:

(a) For steel pipe manufactured in accordance with a listed specification, the yield strength specified as a minimum in that specification; or

(b) For steel pipe manufactured in accordance with an unknown or unlisted specification, the yield strength determined in accordance with §192.107(b).

State means each of the several States, the District of Columbia, and the Commonwealth of Puerto Rico.

Supervisory Control and Data Acquisition (SCADA) system means a computer-based system or systems used by a controller in a control room that collects and displays information about a pipeline facility and may have the ability to send commands back to the pipeline facility.

Transmission line means a pipeline, other than a gathering line, that: (1) transports gas from a gathering line or storage facility to a gas distribution center, storage facility, or large volume customer that is not down-stream from a gas distribution center; (2) operates at a hoop stress of 20 percent or more of SMYS; or (3) transports gas within a storage field.

Note: A large volume customer may receive similar volumes of gas as a distribution center, and includes factories, power plants, and institutional users of gas.

Transportation of gas means the gathering, transmission, or distribution of gas by pipeline or the storage of gas, in or affecting interstate or foreign commerce.

Welder means a person who performs manual or semi-automatic welding.

Welding operator means a person who operates machine or automatic welding equipment.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-13, 38 FR 9084, Apr. 10, 1973; Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-58, 53 FR 1633, Jan. 21, 1988; Amdt. 192-67, 56 FR 63764, Dec. 5, 1991; Amdt. 192-72, 59 FR 17281, May 12, 1994; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-81, 62 FR 61692, Nov. 19, 1997; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-89, 65 FR 54440, Sept. 8, 2000; Amdt. 192-91, 68 FR 11748, Mar. 12, 2003; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-98, 69 FR 48400, Aug. 10, 2004; Amdt. 192-94A, 69 FR 54591, Sept. 9, 2004; Amdt. 192-94B, 70 FR 3147, Amdt. 192-98, 69 FR 48400, Aug. 10, 2004, Jan. 21, 2005; 70 FR 11135, Mar. 8, 2005: Amdt. 192-112, 74 FR 63310, Dec. 3, 2009; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.5 Class locations.

(a) This section classifies pipeline locations for purposes of this part. The following criteria apply to classifications under this section.

(1) A "class location unit" is an onshore area that extends 220 yards (200 meters) on either side of the centerline of any continuous 1-mile (1.6 kilometers) length of pipeline.

(2) Each separate dwelling unit in a multiple dwelling unit building is counted as a separate building intended for human occupancy.

(b) Except as provided in paragraph (c) of this section, pipeline locations are classified as follows:

(1) A Class 1 location is:

(i) An offshore area; or

(ii) Any class location unit that has 10 or fewer buildings intended for human occupancy.

(2) A Class 2 location is any class location unit that has more than 10 but fewer than 46 buildings intended for human occupancy.

(3) A Class 3 location is:

(i) Any class location unit that has 46 or more buildings intended for human occupancy; or

(ii) An area where the pipeline lies within 100 yards (91 meters) of either a building or a small, well-defined outside area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12-month period. (The days and weeks need not be consecutive.)

(4) A Class 4 location is any class location unit where buildings with four or more stories above ground are prevalent.

(c) The length of Class locations 2, 3, and 4 may be adjusted as follows:

(1) A Class 4 location ends 220 yards (200 meters) from the nearest building with four or more stories above ground.

(2) When a cluster of buildings intended for human occupancy requires a Class 2 or 3 location, the class location ends 220 yards (200 meters) from the nearest building in the cluster.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-56, 52 FR 32924, Sept. 1, 1987; Amdt. 192-78, 61 FR 28770, June 6, 1996;

Amdt. 192-78B, 61 FR 35139, July 5, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.7 What documents are incorporated by reference partly or wholly in this part?

(a) This part prescribes standards, or portions thereof, incorporated by reference into this part with the approval of the Director of the Federal Register in 5 **U.S.C. 552**(a) and **1 CFR part 51**. The materials listed in this section have the full force of law. To enforce any edition other than that specified in this section, PHMSA must publish a notice of change in the **Federal Register**.

(1) *Availability of standards incorporated by reference*. All of the materials incorporated by reference are available for inspection from several sources, including the following:

(i) The Office of Pipeline Safety, Pipeline and Hazardous Materials Safety Administration, 1200 New Jersey Avenue SE., Washington, DC 20590. For more information contact 202-366-4046 or go to the PHMSA Web site at: *http://www.phmsa.dot.gov/pipeline/regs.*

(ii) The National Archives and Records Administration (NARA). For more information on the availability of this material at NARA, call 202-741-6030 or go to the NARA Web site at *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.*

(iii) Copies of standards incorporated by reference in this part can also be purchased or are otherwise made available from the respective standards-developing organization at the addresses provided in the centralized IBR section below.

(2) [Reserved]

(b) American Petroleum Institute (API), 1220 L Street, NW., Washington, DC 20005, phone: 202-682-8000, http://api.org/.

(1) API Recommended Practice 5L1, "Recommended Practice for Railroad Transportation of Line Pipe," 7th edition, September 2009, (API RP 5L1), IBR approved for § 192.65(a).

(2) API Recommended Practice 5LT, "Recommended Practice for Truck Transportation of Line Pipe," First edition, March 2012, (API RP 5LT), IBR approved for § 192.65(c).

(3) API Recommended Practice 5LW, "Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels," 3rd edition, September 2009, (API RP 5LW), IBR approved for § 192.65(b).

(4) API Recommended Practice 80, "Guidelines for the Definition of Onshore Gas Gathering Lines," 1st edition, April 2000, (API RP 80), IBR approved for § 192.8(a).

(5) API Recommended Practice 1162, "Public Awareness Programs for Pipeline Operators," 1st edition, December 2003, (API RP 1162), IBR approved for §192.616(a), (b), and (c).

(6) API Recommended Practice 1165, "Recommended Practice for Pipeline SCADA Displays," First edition, January 2007, (API RP 1165), IBR approved for § 192.631(c).

(7) API Specification 5L, "Specification for Line Pipe," 45th edition, effective July 1, 2013, (API Spec 5L), IBR approved for §§ 192.55(e); 192.112(a), (b), (d), (e); 192.113; and Item I, Appendix B to Part 192.

(8) ANSI/API Specification 6D, "Specification for Pipeline Valves," 23rd edition, effective October 1, 2008, including Errata 1 (June 2008), Errata 2 (November 2008), Errata 3 (February 2009), Errata 4 (April 2010), Errata 5 (November 2010), Errata 6 (August 2011), Addendum 1 (October 2009, Addendum 2 (August 2011), and Addendum 3 (October 2012), (ANSI/API Spec 6D), IBR approved for § 192.145(a).

(9) API Standard 1104, "Welding of Pipelines and Related Facilities," 20th edition, October 2005, including errata/addendum (July 2007) and errata 2 (2008), (API Std 1104), IBR approved for §§ 192.225(a); 192.227(a); 192.229(c); 192.241(c); and Item II, Appendix B.

(c) ASME International (ASME), Three Park Avenue, New York, NY 10016, 800-843-2763 (U.S./Canada), http://www.asme.org/.

(1) ASME/ANSI B16.1-2005, "Gray Iron Pipe Flanges and Flanged Fittings: (Classes 25, 125, and 250)," August 31, 2006, (ASME/ANSI B16.1), IBR approved for § 192.147(c).

(2) ASME/ANSI B16.5-2003, "Pipe Flanges and Flanged Fittings, "October 2004, (ASME/ANSI B16.5), IBR approved for §§ 192.147(a) and 192.279.

(3) ASME/ANSI B31G-1991 (Reaffirmed 2004), "Manual for Determining the Remaining Strength of Corroded Pipelines," 2004, (ASME/ANSI B31G), IBR approved for §§ 192.485(c) and 192.933(a).

(4) ASME/ANSI B31.8-2007, "Gas Transmission and Distribution Piping Systems," November 30, 2007, (ASME/ANSI B31.8), IBR approved for §§ 192.112(b) and 192.619(a).

(5) ASME/ANSI B31.8S-2004, "Supplement to B31.8 on Managing System Integrity of Gas Pipelines," 2004, (ASME/ANSI B31.8S-2004), IBR approved for §§ 192.903 note to *Potential impact radius*; 192.907 introductory text, (b); 192.911 introductory text, (i), (k), (l), (m); 192.913(a), (b), (c); 192.917(a), (b), (c), (d), (e); 192.921(a); 192.923(b); 192.925(b); 192.927(b), (c); 192.929(b); 192.933(c), (d); 192.935(a), (b); 192.937(c); 192.939(a); and 192.945(a).

(6) ASME Boiler & Pressure Vessel Code, Section I, "Rules for Construction of Power Boilers 2007," 2007 edition, July 1, 2007, (ASME BPVC, Section I), IBR approved for § 192.153(b).

(7) ASME Boiler & Pressure Vessel Code, Section VIII, Division 1 "Rules for Construction of Pressure Vessels," 2007 Edition, July 1, 2007, (ASME BPVC, Section VIII, Division 1), IBR approved for §§ 192.153(a), (b), (d); and 192.165(b).

(8) ASME Boiler & Pressure Vessel Code, Sectin VIII, Division 2 "Alternate Rules, Rules for Construction of Pressure Vessels," 2007 edition, July 1, 2007, (ASME PBVC, Section VIII, Division 2), IBR approved for §§ 192.153(b), (d); and 192.165(b).

(9) ASME Boiler & Pressure Vessel Code, Section IX: "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators," 2007 edition, July 1, 2007, ASME PBVC, Section IX, IBR approved for §§ 192.225(a); 192.227(a); and Item II, Appendix B to Part 192.

(d) American Society for Testing and Materials (ASTM), 100 Bar Harbor Drive, PO Box C700, West Conshohocken, PA 19428, phone: (610) 832-9585, Web site: http:www.astm.org/.

(1) ASTM A53/A53M-10, "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless," approved October 1, 2010, (ASTM A53/A53M), IBR approved for § 192.113; and Item II, Appendix B to Part 192.

(2) ASTM A106/A106M-10, "Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service," approved October 1, 2010, (ASTM A106/A106M), IBR approved for § 192.113; and Item I, Appendix B to Part 192.

(3) ASTM A333/A333M-11, "Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service," approved April 1, 2011, (ASTM A333/A333M), IBR approved for § 192.113; and Item I, Appendix B to Part 192.

(4) ASTM A372/A372M-10, "Standard Specification for Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels," approved October 1, 2010, (ASTM A372/A372M), IBR approved for § 192.177(b).

(5) ASTM A381-96 (reapproved 2005), "Standard Specification for Metal-Arc Welded Steel Pipe for Use with High-Pressure Transmission Systems," approved October 1, 2005, (ASTM A381), IBR approved for § 192.113; and Item I, Appendix B to Part 192.

(6) ASTM A578/A578M-96 (reapproved 2001), "Standard Specification for Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications,"

(ASTM A578/A578M), IBR approved for § 192.112(c).

(7) ASTM A671/A671M-10, "Standard Specification for Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures," approved April 1, 2010, (ASTM A671/A671M), IBR approved for §192.113; and Item I, Appendix B to Part 192.

(8) ASTM A672/A672M-09, "Standard Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures," approved October 1, 2009, (ASTM A672/A672M), IBR approved for § 192.113 and Item I, Appendix B to Part 192.

(9) ASTM A691/A691M-09, "Standard Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures," approved October 1, 2009, (ASTM A691/A691M), IBR approved for § 192.113 and Item I, Appendix B to Part 192.

(10) ASTM D638-03, "Standard Test Method for Tensile Properties of Plastics," 2003, (ASTM D638), IBR approved for § 192.283(a) and (b).

(11) ASTM D2513-87, "Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings," (ASTM D2513-87), IBR approved for § 192.63(a).

(12) ASTM D2513-99, "Standard Specificatin for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings," (ASTM D2513-99), IBR approved for §§ 192.191(b); 192.281(b); 192.283(a) and Item 1, Appendix B to Part 192.

(13) ASTM D2513-09a, "Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings," approved December 1, 2009, (ASTM D2513-09a), IBR approved for §§ 192.123€; 192.191(b); 192.283(a); and Item 1, Appendix B to Part 192.

(14) ASTM D2517-00, "Standard Specification for Reinforced Epoxy Resin Gas Pressure Pipe and Fittings," (ASTM D2517), IBR approved for §§ 192.191(a); 192.281(d); 192.283(a); and Item I, Appendix B to Part 192.

(15) ASTM F1055-1998, "Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controller Polyethylene Pipe and Tubing," (ASTM F1055), IBR approved for § 192.283(a).

(e) Gas Technology Institute (GTI), *formerly the Gas Research Institute (GRI),* 1700 S. Mount Prospect Road, Des Plaines, IL 60018, phone: 847-768-0500, Web site: www.gastechnology.org.

(1) GRI 02/0057 (2002) "Internal Corrosion Direct Assessment of Gas Transmission Pipelines Methodology," (GRI 02/0057), IBR approved for § 192.927(c).

(2) [Reserved]

(f) Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), 127 Park St NE, Vienna, VA 22180, phone: 703-281-6613, Web site: http://www.mss-hq.org/.

(1) MSS SP-44-2010, Standard Practice, "Steel Pipeline Flanges," 2010 edition, (including Errata (May 20, 2011)), (MSS SP-44), IBR approved for § 192.147(a).

(2) [Reserved]

(g) NACE International (NACE), 1440 South Creek Drive, Houston, TX 77084; phone: 281-228-6223 or 800-797-6223, Web site: http://www.nace.org/Publications/.

(1) ANSI/NACE SP0502-2010, Standard Practice, "Pipeline External Corrosion Direct Assessment Methodology," revised June 24, 2010, (NACE SP0502), IBR approved for §§ 192.923(b); 192.925(b); 192.931(d); 192.935(b) and 192.939(a).

(2) [Reserved]

(h) National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, Massachusetts 02169, phone: 1-617-984-7275, Web site: http://www.nfpa.org.

(1) NFPA-30 (2012), "Flammable and Combustible Liquids Code," 2012 edition, June 20, 2011, including Errata 30-12-1 (September 27, 2011) and Errata 30-12-2 (November 14, 2011), (NFPA-30), IBR approved for § 192.735(b).

(2) NFPA-58 (2004), "Liquefied Petroleum Gas Code (LP-Gas Code)," (NFPA-58), IBR approved for § 192.11(a), (b), and (c).

(3) NFPA-59 (2004), "Utility LP-Gas Plant Code," (NFPA-59), IBR approved for § 192.11(a), (b), and (c).

(4) NFPA-70 (2011), "National Electric Code," 2011 edition, issued August 5, 2010, (NFPA-70), IBR approved for §§ 192.163(e); and 192.189(c).

(i) Pipeline Research Council International, Inc. (PRCI), c/o Technical Toolboxes, 3801 Kirby Drive, Suite 520, P.O. Box 980550, Houston, TX 77098, phone: 713-630-0505, toll free: 866-866-6766, Web site: *http://www.ttoolboxes.com/*. (Contract number PR-3-805)

(1) AGA, Pipeline Research Committee Project, PR-3-805, "A Modified Criterion for Evaluating the Remaining Strength of Corroded Pipe," (December 22, 1989), (PRCI PR-3-805 (R-STRENG)), IBR approved for §§ 192.485(c); 192.933(a) and (d).

(2) [Reserved]

(j) Plastics Pipe Institute, Inc. (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, phone: 469-499-1044, Web site: http://www.plasticpipe.org/.

(1) PPI TR-3/2008 HDB/HDS/PDB/SDB/MRS Policies (2008), "Policies and Procedures for Developing Hydrostatic Design Gasis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe," May 2008, IBR approved for § 192.121.

(2) [Reserved]

[Part 192 – Org., Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-51, 51 FR 15333, Apr. 23, 1986; Amdt. 192-68, 58 FR 14519, Mar 18, 1993; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-94, 69 FR 32886, June 15, 2004; Amdt. 192-94A, 69 FR 54591, Sept. 9, 2004; 70 FR 11135, Mar. 8, 2005; Amdt. 192-99, 70 FR 28833, May 19, 2005; Amdt. 192-102, 71 FR 13289, Mar. 15, 2006; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-103c, 72 FR 4655, Feb. 1, 2007; Amdt. 192-[106], 73 FR 16562, Mar. 28, 2008; Amdt. 192-[107], 73 FR 62147, October 17, 2008; Amdt. 192-[109], 74 FR 2889, January 16, 2009; Amdt. 192-[110], 74 FR 17099, April 14, 2009; Amdt. 192-112, 74 FR 63310, Dec. 3, 2009; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.8 How are onshore gathering lines and regulated onshore gathering lines determined?

(a) An operator must use API RP 80 (incorporated by reference, see §192.7), to determine if an onshore pipeline (or part of a connected series of pipelines) is an onshore gathering line. The determination is subject to the limitations listed below. After making this determination, an operator must determine if the onshore gathering line is a regulated onshore gathering line under paragraph (b) of this section.

(1) The beginning of gathering, under section 2.2(a)(1) of API RP 80, may not extend beyond the furthermost downstream point in a production operation as defined in section 2.3 of API RP 80. This furthermost downstream point does not include equipment that can be used in either production or transportation, such as separators or dehydrators, unless that equipment is involved in the processes of "production and preparation for transportation or delivery of hydrocarbon gas" within the meaning of "production operation."

(2) The endpoint of gathering, under section 2.2(a)(1)(A) of API RP 80, may not extend beyond the first downstream natural gas processing plant, unless the operator can demonstrate, using sound engineering principles, that gathering extends to a further downstream plant.

(3) If the endpoint of gathering, under section 2.2(a)(1)(C) of API RP 80, is determined by the commingling of gas from separate pro-

duction fields, the fields may not be more than 50 miles from each other, unless the Administrator finds a longer separation distance is justified in a particular case (see 49 CFR §190.9).

(4) The endpoint of gathering, under section 2.2(a)(1)(D) of API RP 80, may not extend beyond the furthermost downstream compressor used to increase gathering line pressure for delivery to another pipeline.

(b) For purposes of §192.9, "regulated onshore gathering line" means:

(1) Each onshore gathering line (or segment of onshore gathering line) with a feature described in the second column that lies in an area described in the third column; and

(2) As applicable, additional lengths of line described in the fourth column to provide a safety buffer:

Type	Feature	Area	Safety buffer
A	—Metallic and the MAOP produces a hoop stress of 20 percent or more of SMYS. If the stress level is unknown, an operator must determine the stress level according to the applicable provisions in subpart C of this part. —Non-metallic and the MAOP is more than 125 psig (862 kPa).	Class 2, 3, or 4 location (see § 192.5).	None.
B	—Metallic and the MAOP produces a hoop stress of less than 20 percent of SMYS. If the stress level is unknown, an operator must determine the stress level according to the applicable provisions in subpart C of this part. —Non-metallic and the MAOP is 125 psig (862 kPa) or less.	*Area 1*. Class 3 or 4 location. *Area 2*. An area within a Class 2 location the operator determines by using any of the following three methods: (a) A Class 2 location. (b) An area extending 150 feet (45.7 m) on each side of the centerline of any continuous 1 mile (1.6 km) of pipeline and including more than 10 but fewer than 46 dwellings. (c) An area extending 150 feet (45.7 m) on each side of the centerline of any continous 1000 feet (305 m) of pipeline and including 5 or more dwellings.	If the gathering line is in Area 2(b) or 2(c), the additional lengths of line extend upstream and downstream from the area to a point where the line is at least 150 feet (45.7 m) from the nearest dwelling in the area. However, if a cluster of dwellings in Area 2 (b) or 2(c) qualifies a line as Type B, the Type B classification ends 150 feet (45.7 m) from the nearest dwelling in the cluster.

[Amdt. 192-102, 71 FR 13289, Mar. 15, 2006]

§192.9 What requirements apply to gathering lines?

(a) *Requirements.* An operator of a gathering line must follow the safety requirements of this part as prescribed by this section.

(b) *Offshore lines.* An operator of an offshore gathering line must comply with requirements of this part applicable to transmission lines, except the requirements in §192.150 and in subpart O of this part.

(c) *Type A lines.* An operator of a Type A regulated onshore gathering line must comply with the requirements of this part applicable to transmission lines, except the requirements in §192.150 and in subpart O of this part. However, an operator of a Type A regulated onshore gathering line in a Class 2 location may demonstrate compliance with subpart N by describing the processes it uses to determine the qualification of persons performing operations and maintenance tasks.

(d) *Type B lines.* An operator of a Type B regulated onshore gathering line must comply with the following requirements:

(1) If a line is new, replaced, relocated, or otherwise changed, the design, installation, construction, initial inspection, and initial testing must be in accordance with requirements of this part applicable to transmission lines;

(2) If the pipeline is metallic, control corrosion according to requirements of subpart I of this part applicable to transmission lines;

(3) Carry out a damage prevention program under §192.614;

(4) Establish a public education program under §192.616;

(5) Establish the MAOP of the line under §192.619; and

(6) Install and maintain line markers according to the requirements for transmission lines in §192.707.

(7) Conduct leakage surveys in accordance with § 192.706 using leak detection equipment and promptly repair hazardous leaks that are discovered in accordance with § 192.703(c).

(e) *Compliance deadlines.* An operator of a regulated onshore gathering line must comply with the following deadlines, as applicable.

(1) An operator of a new, replaced, relocated, or otherwise changed line must be in compliance with the applicable requirements of this section by the date the line goes into service, unless an exception in §192.13 applies.

(2) If a regulated onshore gathering line existing on April 14, 2006 was not previously subject to this part, an operator has until the date stated in the second column to comply with the applicable requirement for the line listed in the first column, unless the Administrator finds a later deadline is justified in a particular case:

Requirement	Compliance deadline
Control corrosion according to Subpart I requirements for transmission lines.	April 15, 2009.
Carry out a damage prevention program under §192.614.	October 15, 2007.
Establish MAOP under §192.619	October 15, 2007.
Install and maintain line markers under §192.707.	April 15, 2008.
Establish a public education program under §192.616.	April 15, 2008.
Other provisions of this part as required by paragraph (c) of this section for Type A lines.	April 15, 2009.

(3) If, after April 14, 2006, a change in class location or increase in dwelling density causes an onshore gathering line to be a regulated onshore gathering line, the operator has 1 year for Type B lines and 2 years for Type A lines after the line becomes a regulated onshore gathering line to comply with this section.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-72, 59 FR 17281, April 12, 1994; Amdt. 192-95B, 69 FR 18227, April 6, 2004, Amdt. 192-102, 71 FR 13289, Mar. 15, 2006; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.10 Outer continental shelf pipelines.

Operators of transportation pipelines on the Outer Continental Shelf (as defined in the Outer Continental Shelf Lands Act (43 U.S.C. 1331) must identify on all their respective pipelines the specific points at which operating responsibility transfers to a producing operator. For those instances in which the transfer points are not identifiable by a durable marking, each operator will have until September 15, 1998 to identify the transfer points. If it is not practicable to durably mark a transfer point and the transfer point is located above water, the operator must depict the transfer point on a schematic located near the transfer point. If a transfer point is located subsea, then the operator must identify the transfer point on a schematic which must be maintained at the nearest upstream facility and provided to PHMSA upon request. For those cases in which adjoining operators have not agreed on a transfer point by September 15, 1998 the Regional Director and the MMS Regional Supervisor will make a joint determination of the transfer point.

[Amdt. 192-81, 62 FR 61692, Nov. 19, 1997; 70 FR 11135, Mar. 8, 2005]

§192.11 Petroleum gas systems.

(a) Each plant that supplies petroleum gas by pipeline to a natural gas distribution system must meet the requirements of this part and ANSI/NFPA NFPA 58 and 59 (incorporated by reference, *see* § 192.7), NFPA 58 and 59.

(b) Each pipeline system subject to this part that transports only petroleum gas or petroleum gas/air mixtures must meet the requirements of this part and of ANSI/NFPA NFPA 58 and 59 (incorporated by reference, *see* § 192.7) NFPA 58 and 59.

(c) In the event of a conflict between this part and ANSI/NFPA NFPA 58 and 59 (incorporated by reference, *see* § 192.7), ANSI/NFPA NFPA 58 and 59 prevail.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-75, 61 FR 18512, Apr. 26, 1996; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-119, 80 FR 168, January 5, 2015]

192.12 [Removed]

[Amdt. 192-10, 37 FR 21638, Oct. 13, 1972 as amended by Amdt. 192-36, 45 FR 10769, Oct. 23, 1980]

§192.13 What general requirements apply to pipelines regulated under this part?

(a) No person may operate a segment of pipeline listed in the first column that is readied for service after the date in the second column, unless:

(1) The pipeline has been designed, installed, constructed; initially inspected, and initially tested in accordance with this part; or

(2) The pipeline qualifies for use under this part according to the requirements in §192.14.

Pipeline	Date
Offshore gathering line.	July 31, 1977.
Regulated onshore gathering line to which this part did not apply until April 14, 2006.	March 15 2007.
All other pipelines.	March 12, 1971.

(b) No person may operate a segment of pipeline listed in the first column that is replaced, relocated, or otherwise changed after the date in the second column, unless the replacement, relocation, or change has been made according to the requirements in this part.

Pipeline	Date
Offshore gathering line.	July 31, 1977.
Regulated onshore gathering line to which this part did not apply until April 14, 2006.	March 15 2007.
All other pipelines.	November 12, 1970.

(c) Each operator shall maintain, modify as appropriate, and follow the plans, procedures, and programs that it is required to establish under this part.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-30, 42 FR 60146, Nov. 25, 1977, Amdt. 192-102, 71 FR 13289, Mar. 15, 2006]

§192.14 Conversion to service subject to this part.

(a) A steel pipeline previously used in service not subject to this part qualifies for use under this part if the operator prepares and follows a written procedure to carry out the following requirements:

(1) The design, construction, operation, and maintenance history of the pipeline must be reviewed and, where sufficient historical records are not available, appropriate tests must be performed to determine if the pipeline is in a satisfactory condition for safe operation.

(2) The pipeline right-of-way, all aboveground segments of the pipeline, and appropriately selected underground segments must be

visually inspected for physical defects and operating conditions which reasonably could be expected to impair the strength or tightness of the pipeline.

(3) All known unsafe defects and conditions must be corrected in accordance with this part.

(4) The pipeline must be tested in accordance with Subpart J of this part to substantiate the maximum allowable operating pressure permitted by Subpart L of this part.

(b) Each operator must keep for the life of the pipeline a record of investigations, tests, repairs, replacements, and alterations made under the requirements of paragraph (a) of this section.

[Amdt. 192-30, 42 FR 60146, Nov. 25, 1977]

§192.15 Rules of regulatory construction.

(a) As used in this part:

"Includes" means "including but not limited to."

"May" means "is permitted to" or "is authorized to."

"May not" means "is not permitted to" or "is not authorized to."

"Shall" is used in the mandatory and imperative sense.

(b) In this part:

(1) Words importing the singular include the plural;

(2) Words importing the plural include the singular; and,

(3) Words importing the masculine gender include the feminine.

[Part 192 - Org., Aug. 19, 1970]

§192.16 Customer notification.

(a) This section applies to each operator of a service line who does not maintain the customer's buried piping up to entry of the first building downstream, or, if the customer's buried piping does not enter a building, up to the principal gas utilization equipment or the first fence (or wall) that surrounds that equipment. For the purpose of this section, "customer buried piping" does not include branch lines that serve yard lanterns, pool heaters, or other types of secondary equipment. Also, "maintain" means monitor for corrosion according to §192.465 if the customer's buried piping is metallic, survey for leaks according to §192.723, and if an unsafe condition is found, shut off the flow of gas, advise the customer of the need to repair the unsafe condition, or repair the unsafe condition.

(b) Each operator shall notify each customer once in writing of the following information:

(1) The operator does not maintain the customer's buried piping.

(2) If the customer's buried piping is not maintained, it may be subject to the potential hazards of corrosion and leakage.

(3) Buried gas piping should be–

(i) Periodically inspected for leaks;

(ii) Periodically inspected for corrosion if the piping is metallic; and

(iii) Repaired if any unsafe condition is discovered.

(4) When excavating near buried gas piping, the piping should be located in advance, and the excavation done by hand.

(5) The operator (if applicable), plumbing contractors, and heating contractors can assist in locating, inspecting, and repairing the customer's buried piping.

(c) Each operator shall notify each customer not later than August 14, 1996, or 90 days after the customer first receives gas at a particular location, whichever is later. However, operators of master meter systems may continuously post a general notice in a prominent location frequented by customers.

(d) Each operator must make the following records available for inspection by the Administrator or a State agency participating under 40 U.S.C. 60105 or 60106;

(1) A copy of the notice currently in use; and

(2) Evidence that notices have been sent to customers within the previous 3 years.

[Amdt. 192-74, 60 FR 41821, Aug. 14, 1995 as amended by Amdt. 192-74A, 60 FR 63450, Dec. 11, 1995; Amdt. 192-84, 63 FR 7721, Feb. 17, 1998]

§192.17 [Reserved]

[Amdt. 192-1, 35 FR 16405, Oct. 21, 1970 as amended by Amdt. 192-38, 48 FR 37250, July 20, 1981]

Subpart B–Materials

§192.51 Scope.

This subpart prescribes minimum requirements for the selection and qualification of pipe and components for use in pipelines.

[Part 192 - Org., Aug. 19, 1970]

§192.53 General.

Materials for pipe and components must be:

(a) Able to maintain the structural integrity of the pipeline under temperature and other environmental conditions that may be anticipated;

(b) Chemically compatible with any gas that they transport and with any other material in the pipeline with which they are in contact; and,

(c) Qualified in accordance with the applicable requirements of this subpart.

[Part 192 - Org., Aug. 19, 1970]

§192.55 Steel pipe.

(a) New steel pipe is qualified for use under this part if:

(1) It was manufactured in accordance with a listed specification;

(2) It meets the requirements of–

(i) Section II of Appendix B to this part; or

(ii) If it was manufactured before November 12, 1970, either section II or III of Appendix B to this part; or

(3) It is used in accordance with paragraph (c) or (d) of this section.

(b) Used steel pipe is qualified for use under this part if:

(1) It was manufactured in accordance with a listed specification and it meets the requirements of paragraph II-C of Appendix B to this part;

(2) It meets the requirements of:

(i) Section II of Appendix B to this part; or

(ii) If it was manufactured before November 12, 1970, either section II or III of Appendix B to this part;

(3) It has been used in an existing line of the same or higher pressure and meets the requirements of paragraph II-C of Appendix B to this part; or

(4) It is used in accordance with paragraph (c) of this section.

(c) New or used steel pipe may be used at a pressure resulting in a hoop stress of less than 6,000 psi (41 Mpa) where no close coiling or close bending is to be done, if visual examination indicates that the pipe is in good condition and that it is free of split seams and other defects that would cause leakage. If it is to be welded, steel pipe that has not been manufactured to a listed specification must also pass the weldability tests prescribed in paragraph II-B of Appendix B to this part.

(d) Steel pipe that has not been previously used may be used as replacement pipe in a segment of pipeline if it has been manufactured prior to November 12, 1970, in accordance with the same specification as the pipe used in constructing that segment of pipeline.

(e) New steel pipe that has been cold expanded must comply with the mandatory provisions of API Specification 5L API Spec 5L (incorporated by reference, *see* § 192.7).

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 17, 1970; Amdt. 192-12, 38 FR 4760, Feb. 22, 1973; Amdt. 192-51, 51 FR 15333, Apr. 23, 1986; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.57 [Removed and Reserved]

[5 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-62, 54 FR 5625, Feb. 6, 1989]

§192.59 Plastic pipe.

(a) New plastic pipe is qualified for use under this part if:

(1) It is manufactured in accordance with a listed specification; and

(2) It is resistant to chemicals with which contact may be anticipated.

(b) Used plastic pipe is qualified for use under this part if:

(1) It was manufactured in accordance with a listed specification;

(2) It is resistant to chemicals with which contact may be anticipated;

(3) It has been used only in natural gas service.

(4) Its dimensions are still within the tolerances of the specification to which it was manufactured; and,

(5) It is free of visible defects.

(c) For the purpose of paragraphs (a)(1) and (b)(1) of this section, where pipe of a diameter included in a listed specification is impractical to use, pipe of a diameter between the sizes included in a listed specification may be used if it:

(1) Meets the strength and design criteria required of pipe included in that listed specification; and

(2) Is manufactured from plastic compounds which meet the criteria for material required of pipe included in that listed specification.

(d) Rework and/or regrind material is not allowed in plastic pipe produced after March 6, 2015 used under this part.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-19, 40 FR 10472, Mar. 6, 1975; Amdt. 192-58, 53 FR 1633, Jan. 21, 1988; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.61 [Removed and Reserved]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-62, 54 FR 5625, Feb. 6, 1989]

§192.63 Marking of materials.

(a) Except as provided in paragraph (d) of this section, each valve, fitting, length of pipe, and other component must be marked–

(1) As prescribed in the specification or standard to which it was manufactured, except that thermoplastic pipe and fittings made of plastic materials other than polyethylene must be marked in accordance with ASTM D2513-87 (incorporated by reference, see §192.7); or

(2) To indicate size, material, manufacturer, pressure rating, and temperature rating, and as appropriate, type, grade, and model.

(b) Surfaces of pipe and components that are subject to stress from internal pressure may not be field die stamped.

(c) If any item is marked by die stamping, the die must have blunt or rounded edges that will minimize stress concentrations.

(d) Paragraph (a) of this section does not apply to items manufactured before November 12, 1970, that meet all of the following:

(1) The item is identifiable as to type, manufacturer, and model.

(2) Specifications or standards giving pressure, temperature, and other appropriate criteria for the use of items are readily available.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 17, 1970; Amdt. 192-31, 43 FR 13883, Apr. 3, 1978; Amdt. 192-61, 53 FR 36793, Sept. 22, 1988; Amdt. 192-61A, 54 FR 32642, Aug. 9, 1989; Amdt. 192-62, 54 FR 5627, Feb. 6, 1989; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-76, 61 FR 26121, May 25, 1996; Amdt. 192-76A, 61 FR 36825, July 15, 1996; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

192.65 Transportation of pipe.

(a) *Railroad.* In a pipeline to be operated at a hoop stress of 20 percent or more of SMYS, an operator may not use install pipe having an outer diameter to wall thickness ratio of 70 to 1, or more, that is transported by railroad unless the transportation is performed by API RP 5L1 (incorporated by reference, *see* § 192.7).:

(1) The transportation is performed in accordance with API Recommended Practice 5LW (incorporated by reference, see §192.7).

(2) In the case of pipe transported before November 12, 1970, the pipe is tested in accordance with Subpart J of this Part to at least 1.25 times the maximum allowable operating pressure if it is to be installed in a class 1 location and to at least 1.5 times the maximum allowable operating pressure if it is to be installed in a class 2, 3, or 4 location. Notwithstanding any shorter time period permitted under Subpart J of this Part, the test pressure must be maintained for at least 8 hours.

(b) *Ship or barge*. In a pipeline to be operated at a hoop stress of 20 percent or more of SMYS, an operator may not use pipe having an outer diameter to wall thickness ratio of 70 to 1, or more, that is transported by ship or barge on both inland and marine waterways unless the transportation is performed in accordance with API Recommended Practice 5LW API RP 5LW (incorporated by reference, see §192.7).

(c) *Truck*. In a pipeline to be operated at a hoop stress of 20 percent or more of SMYS, an operator may not use pipe having an outer diameter to wall thickness ratio of 70 to 1, or more, that is transported by truck unless the transportation is performed in accordance with API RP 5LT (incorporated by reference, *see* §192.7).

[Amdt. 192-12, 38 FR 4760, Feb. 22, 1973, as amended by Amdt. 192-17, 40 FR 6346, Feb. 11, 1975; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015; Amdt. 192-120, 80 FR 12763, March 11, 2015]

Subpart C–Pipe Design

§192.101 Scope.

This subpart prescribes the minimum requirements for the design of pipe.

[Part 192 - Org., Aug. 19, 1970]

§192.103 General.

Pipe must be designed with sufficient wall thickness, or must be installed with adequate protection, to withstand anticipated external pressures and loads that will be imposed on the pipe after installation.

[Part 192 - Org., Aug. 19, 1970]

§192.105 Design formula for steel pipe.

(a) The design pressure for steel pipe is determined in accordance with the following formula:

$$P = (2\,St/D) \times F \times E \times T$$

P =Design pressure in pounds per square inch (kPa) gage.
S =Yield strength in pounds per square inch (kPa) determined in accordance with §192.107.
D =Nominal outside diameter of the pipe in inches (millimeters).
t = Nominal wall thickness of the pipe in inches. If this is unknown, it is determined in accordance with §192.109. Additional wall thickness required for concurrent external loads in accordance with §192.103 may not be included in computing design pressure.
F =Design factor determined in accordance with §192.111.
E =Longitudinal joint factor determined in accordance with §192.113.
T =Temperature derating factor determined in accordance with §192.115.

(b) If steel pipe that has been subjected to cold expansion to meet the SMYS is subsequently heated, other than by welding or stress relieving as a part of welding, the design pressure is limited to 75 percent of the pressure determined under paragraph (a) of this section if the temperature of the pipe exceeds 900°F (482°C) at any time or is held above 600°F (316°C) for more than one hour.

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-47, 49 FR 7569, May. 1, 1984; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.107 Yield strength (*S*) for steel pipe.

(a) For pipe that is manufactured in accordance with a specification listed in section I of Appendix B of this part, the yield strength to be used in the design formula in §192.105 is the SMYS stated in the listed specification, if that value is known.

(b) For pipe that is manufactured in accordance with a specification not listed in section I of Appendix B to this part or whose specification or tensile properties are unknown, the yield strength to be used in the design formula in §192.105 is one of the following:

(1) If the pipe is tensile tested in accordance with section II-D of Appendix B to this part, the lower of the following:

(i) 80 percent of the average yield strength determined by the tensile tests.

(ii) The lowest yield strength determined by the tensile tests.

(2) If the pipe is not tensile tested as provided in paragraph (b)(1) of this section, 24,000 psi (165 Mpa).

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-84, 63 FR 7721, Feb. 17, 1998; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.109 Nominal wall thickness (*t*) for steel pipe.

(a) If the nominal wall thickness for steel pipe is not known, it is determined by measuring the thickness of each piece of pipe at quarter points on one end.

(b) However, if the pipe is of uniform grade, size, and thickness and there are more than 10 lengths, only 10 percent of the individual lengths, but not less than 10 lengths, need be measured. The thickness of the lengths that are not measured must be verified by applying a gauge set to the minimum thickness found by the measurement. The nominal wall thickness to be used in the design formula in §192.105 is the next wall thickness found in commercial specifications that is below the average of all the measurements taken. However, the nominal wall thickness used may not be more than 1.14 times the smallest measurement taken on pipe less than 20 inches (508 millimeters) in outside diameter, nor more than 1.11 times the smallest measurement taken on pipe 20 inches (508 millimeters) or more in outside diameter.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.111 Design factor (F) for steel pipe.

(a) Except as otherwise provided in paragraphs (b), (c), and (d) of this section, the design factor to be used in the design formula in §192.105 is determined in accordance with the following table:

Class location	Design factor (F)
1	0.72
2	0.60
3	0.50
4	0.40

(b) A design factor of 0.60 or less must be used in the design formula in §192.105 for steel pipe in Class 1 locations that:

(1) Crosses the right-of-way of an unimproved public road, without a casing;

(2) Crosses without a casing, or makes a parallel encroachment on, the right-of-way of either a hard surfaced road, a highway, a public street, or a railroad;

(3) Is supported by a vehicular, pedestrian, railroad, or pipeline bridge; or

(4) Is used in a fabricated assembly, (including separators, mainline valve assemblies, cross-connections, and river crossing headers) or is used within five pipe diameters in any direction from the last fitting of a fabricated assembly, other than a transition piece or an elbow used in place of a pipe bend which is not associated with a fabricated assembly.

(c) For Class 2 locations, a design factor of 0.50, or less, must be used in the design formula in §192.105 for uncased steel pipe that crosses the right-of-way of a hard surfaced road, a highway, a public street, or a railroad.

(d) For Class 1 and Class 2 locations, a design factor of 0.50, or less, must be used in the design formula in §192.105 for–

(1) Steel pipe in a compressor station, regulating station, or measuring station, and

(2) Steel pipe, including a pipe riser, on a platform located offshore or in inland navigable waters.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976]

§192.112 Additional design requirements for steel pipe using alternative maximum allowable operating pressure.

For a new or existing pipeline segment to be eligible for operation at the alternative maximum allowable operating pressure (MAOP) calculated under §192.620, a segment must meet the following additional design requirements. Records for alternative MAOP must be maintained, for the useful life of the pipeline, demonstrating compliance with these requirements:

To address this design issue:	The pipeline segment must meet these additional requirements:
(a) General standards for the steel pipe.	(1) The plate, skelp, or coil used for the pipe must be micro-alloyed, fine grain, fully killed, continuously cast steel with calcium treatment.
	(2) The carbon equivalents of the steel used for pipe must not exceed 0.25 percent by weight, as calculated by the Ito-Bessyo formula (Pcm formula) or 0.43 percent by weight, as calculated by the International Institute of Welding (IIW) formula.
	(3) The ratio of the specified outside diameter of the pipe to the specified wall thickness must be less than 100. The wall thickness or other mitigative measures must prevent denting and ovality anomalies during construction, strength testing and anticipated operational stresses.
	(4) The pipe must be manufactured using API Specification 5L API Spec 5L, product specification level 2 (incorporated by reference, see § 192.7) for maximum operating pressures and minimum and maximum operating temperatures and other requirements under this section.
(b) Fracture control.	(1) The toughness properties for pipe must address the potential for initiation, propagation and arrest of fractures in accordance with: (i) API Specification 5L API Spec 5L (incorporated by reference, see §192.7); or (ii) American Society of Mechanical Engineers (ASME) B31.8 (incorporated by reference, see §192.7); and (iii) Any correction factors needed to address pipe grades, pressures, temperatures, or gas compositions not expressly addressed in API Specification 5L API Spec 5L, product specification level 2 or ASME B31.8 (incorporated by reference, see §192.7).
	(2) Fracture control must: (i) Ensure resistance to fracture initiation while addressing the full range of operating temperatures, pressures, gas compositions, pipe grade and operating stress levels, including maximum pressures and minimum temperatures for shut-in conditions, that the pipeline is expected to experience. If these parameters change during operation of the pipeline such that they are outside the bounds of what was considered in the design evaluation, the evaluation must be reviewed and updated to assure continued resistance to fracture initiation over the operating life of the pipeline; (ii) Address adjustments to toughness of pipe for each grade used and the decompression behavior of the gas at operating parameters; (iii) Ensure at least 99 percent probability of fracture arrest within eight pipe lengths with a probability of not less than 90 percent within five pipe lengths; and(iv) Include fracture toughness testing that is equivalent to that described in supplementary requirements SR5A, SR5B, and SR6 of API Specification 5L (incorporated by reference, see § 192.7) and ensures ductile fracture and arrest with the following exceptions: (A) The results of the Charpy impact test prescribed in SR5A must indicate at least 80 percent minimum shear area for any single test on each heat of steel; and (B) The results of the drop weight test prescribed in SR6 must indicate 80 percent average shear area with a minimum single test result of 60 percent shear area for any steel test samples. The test results must ensure a ductile fracture and arrest.
	(3) If it is not physically possible to achieve the pipeline toughness properties of paragraphs (b)(1) and (2) of this section, additional design features, such as mechanical or composite crack arrestors and/or heavier walled pipe of proper design and spacing, must be used to ensure fracture arrest as described in paragraph (b)(2)(iii) of this section.
(c) Plate/coil quality control.	(1) There must be an internal quality management program at all mills involved in producing steel, plate, coil, skelp, and/or rolling pipe to be operated at alternative MAOP. These programs must be structured to eliminate or detect defects and inclusions affecting pipe quality.
	(2) A mill inspection program or internal quality management program must include (i) and either (ii) or (iii):
	(i) An ultrasonic test of the ends and at least 35 percent of the surface of the plate/coil or pipe to identify imperfections that impair serviceability such as laminations, cracks, and inclusions. At least 95 percent of the lengths of pipe manufactured must be tested. For all pipelines designed after December 22, 2008, the test must be done in accordance with ASTM A578/A578M Level B,

	or API 5L API Spec 5L Paragraph 7.8.10 (incorporated by reference, see § 192.7) or equivalent method, and either
	(ii) A macro etch test or other equivalent method to identify inclusions that may form centerline segregation during the continuous casting process. Use of sulfur prints is not an equivalent method. The test must be carried out on the first or second slab of each sequence graded with an acceptance criteria of one or two on the Mannesmann scale or equivalent; or
	(iii) A quality assurance monitoring program implemented by the operator that includes audits of: (a) all steelmaking and casting facilities, (b) quality control plans and manufacturing procedure specifications, (c) equipment maintenance and records of conformance, (d) applicable casting superheat and speeds, and (e) centerline segregation monitoring records to ensure mitigation of centerline segregation during the continuous casting process.
(d) Seam quality control.	(1) There must be a quality assurance program for pipe seam welds to assure tensile strength provided in API Specification 5L API Spec 5L (incorporated by reference, see §192.7) for appropriate grades.
	(2) There must be a hardness test, using Vickers (Hv10) hardness test method or equivalent test method, to assure a maximum hardness of 280 Vickers of the following: (i) A cross section of the weld seam of one pipe from each heat plus one pipe from each welding line per day; and (ii) For each sample cross section, a minimum of 13 readings (three for each heat affected zone, three in the weld metal, and two in each section of pipe base metal).
	(3) All of the seams must be ultrasonically tested after cold expansion and mill hydrostatic testing.
(e) Mill hydrostatic test.	(1) All pipe to be used in a new pipeline segment installed after October 1, 2015, must be hydrostatically tested at the mill at a test pressure corresponding to a hoop stress of 95 percent SMYS for 10 seconds. The test pressure may include a combination of internal test pressure and the allowance for end loading stresses imposed by the pipe mill hydrostatic testing equipment as allowed by ~~API Specification 5L~~ API Spec 5L, Appendix K (incorporated by reference, see §192.7).
	(2) Pipe in operation prior to December 22, 2008, must have been hydrostatically tested at the mill at a test pressure corresponding to a hoop stress of 90 percent SMYS for 10 seconds.
	(3) Pipe in operation on or after December 22, 2008, but before October 1, 2015, must have been hydrostatically tested at the mill at a test pressure corresponding to a hoop stress of 95 percent SMYS for 10 seconds. The test pressure may include a combination of internal test pressure and the allowance for end loading stresses imposed by the pipe mill hydrostatic testing equipment as allowed by "ANSI/API Spec 5L" (incorporated by reference, *see* § 192.7).
(f) Coating.	(1) The pipe must be protected against external corrosion by a non- shielding coating.
	(2) Coating on pipe used for trenchless installation must be non- shielding and resist abrasions and other damage possible during installation.
	(3) A quality assurance inspection and testing program for the coating must cover the surface quality of the bare pipe, surface cleanliness and chlorides, blast cleaning, application temperature control, adhesion, cathodic disbondment, moisture permeation, bending, coating thickness, holiday detection, and repair.
(g) Fittings and flanges.	(1) There must be certification records of flanges, factory induction bends and factory weld ells. Certification must address material properties such as chemistry, minimum yield strength and minimum wall thickness to meet design conditions.
	(2) If the carbon equivalents of flanges, bends and ells are greater than 0.42 percent by weight, the qualified welding procedures must include a pre-heat procedure.
	(3) Valves, flanges and fittings must be rated based upon the required specification rating class for the alternative MAOP.
(h) Compressor stations.	(1) A compressor station must be designed to limit the temperature of the nearest downstream segment operating at alternative MAOP to a maximum of 120 degrees Fahrenheit (49 degrees Celsius) or the higher temperature allowed in paragraph (h)(2) of this section unless a long-term coating integrity monitoring program is implemented in accordance with paragraph (h)(3) of this section.
	(2) If research, testing and field monitoring tests demonstrate that the coating type being used will withstand a higher temperature in long-term operations, the compressor station may be designed to limit downstream piping to that higher temperature. Test results and acceptance criteria ad-

	dressing coating adhesion, cathodic disbondment, and coating condition must be provided to each PHMSA pipeline safety regional office where the pipeline is in service at least 60 days prior to operating above 120 degrees Fahrenheit (49 degrees Celsius). An operator must also notify a State pipeline safety authority when the pipeline is located in a State where PHMSA has an interstate agent agreement, or an intrastate pipeline is regulated by that State.
	(3) Pipeline segments operating at alternative MAOP may operate at temperatures above 120 degrees Fahrenheit (49 degrees Celsius) if the operator implements a long-term coating integrity monitoring program. The monitoring program must include examinations using direct current voltage gradient (DCVG), alternating current voltage gradient (ACVG), or an equivalent method of monitoring coating integrity. An operator must specify the periodicity at which these examinations occur and criteria for repairing identified indications. An operator must submit its long- term coating integrity monitoring program to each PHMSA pipeline safety regional office in which the pipeline is located for review before the pipeline segments may be operated at temperatures in excess of 120 degrees Fahrenheit (49 degrees Celsius). An operator must also notify a State pipeline safety authority when the pipeline is located in a State where PHMSA has an interstate agent agreement, or an intrastate pipeline is regulated by that State.

[Amdt. 192-[107], 73 FR 62147, October 17, 2008 as amended by Amdt.192-111, 74 FR 62503, Nov. 30, 2009; Amdt. 192-119, 80 FR 168, January 5, 2015; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.113 Longitudinal joint factor (E) for steel pipe.

The longitudinal joint factor to be used in the design formula in §192.105 is determined in accordance with the following table:

Specification	Pipe Class	Longitudinal Joint Factor (E)
ASTM A53/ A53M	Seamless	1.00
	Electric resistance welded	1.00
	Furnace butt welded	0.60
ASTM A106	Seamless	1.00
ASTM A333/ A333M	Seamless	1.00
	Electric resistance welded	1.00
ASTM A381	Double submerged arc welded	1.00
ASTM A671	Electric-fusion welded	1.00
ASTM A672	Electric-fusion welded	1.00
ASTM A691	Electric-fusion welded	1.00
API 5L API Spec 5L	Seamless	1.00
	Electric resistance welded	1.00
	Electric flash welded	1.00
	Submerged arc welded	1.00
	Furnace butt welded	0.60
Other	Pipe over 4 inches (102 millimeters)	0.80
Other	Pipe 4 inches (102 millimeters) or less	0.60

If the type of longitudinal joint cannot be determined, the joint factor to be used must not exceed that designated for "Other."

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-51, 51 FR 15333, Apr. 23, 1986; Amdt. 192-62 54 FR 5625, Feb. 6, 1989; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.115 Temperature derating factor (T) for steel pipe.

The temperature derating factor to be used in the design formula in §192.105 is determined as follows:

Gas Temperature in degrees Fahrenheit (Celsius)	Temperature derating factor (T)
250 (121)or less	1.000
300 (149)	0.967

350 (177)	0.933
400 (204)	0.900
450 (232)	0.867

For intermediate gas temperatures, the derating factor is determined by interpolation.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.117 [Reserved]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10157, Feb. 2, 1981 and 46 FR 10706, Feb. 4, 1981, effective Mar. 31, 1981; Amdt. 192-62, 54 FR 5625, Feb. 6, 1989]

§192.119 [Reserved]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-62, 54 FR 5625, Feb. 6, 1989]

§192.121 Design of plastic pipe.

Subject to the limitations of §192.123, the design pressure for plastic pipe is determined in accordance with either of the following formulas:

$$P = 2S \frac{t}{(D-t)}(DF)$$

$$P = \frac{2S}{(SDR-1)}(DF)$$

P = Design pressure, gage, psig (kPa).

S = For thermoplastic pipe, the HDB determined in accordance with the listed specification at a temperature equal to 73 °F (23°C), 100°F (38°C), 120°F (49°C), or 140°F (60°C). In the absence an HDB established at the specified temperature, the HDB of a higher temperature may be used in determining a design pressure rating at the specified temperature by arithmetic interpolation using the procedure in Part D.2 of PPI TR-3/2008, *HDB/PDB/SDB/MRS Policies*", (incorporated by reference, *see* §192.7). For reinforced thermosetting plastic pipe, 11,000 psig (75,842 kPa). [Note: Arithmetic interpolation is not allowed for PA-11 pipe.]

t = Specified wall thickness, inches (mm).

D = Specified outside diameter, inches (mm).

SDR = Standard dimension ratio, the ratio of the average specified outside diameter to the minimum specified wall thickness, corresponding to a value from a common numbering system that was derived from the American National Standards Institute preferred number series 10.

DF = 0.32 or =0.40 for PA-11 pipe produced after January 23, 2009 with a nominal pipe size (IPS or CTS) 4-inch or less, and a SDR of 11 or greater (i.e. thicker pipe wall).

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-31, 43 FR 13883, Apr. 3, 1978; 43 FR 43308, Sept. 25, 1978; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-[108], 73 FR 79002, Dec. 24, 2008; Amdt. 192-111, 74 FR 62503, Nov. 30, 2009; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.123 Design limitations for plastic pipe.

(a) Except as provided in paragraph (e) and paragraph (f) of this section, the design pressure may not exceed a gauge pressure of 100 psig (689 kPa)for plastic pipe used in:

(1) Distribution systems; or

(2) Classes 3 and 4 locations.

(b) Plastic pipe may not be used where operating temperatures of the pipe will be:

(1) Below -20°F (-29°C), or -40°F (-40°C) if all pipe and pipeline components whose operating temperature will be below -20°F (-29°C) have a temperature rating by the manufacturer consistent with that operating temperature; or

(2) Above the following applicable temperatures:

(i) For thermoplastic pipe, the temperature at which the HDB used in the design formula under §192.121 is determined.

(ii) For reinforced thermosetting plastic pipe, 150°F (66°C).

(c) The wall thickness for thermoplastic pipe may not be less than 0.062 inch (1.57 millimeters).

(d) The wall thickness for reinforced thermosetting plastic pipe may not be less than that listed in the following table:

Normal size in inches (millimeters)	Minimum wall thickness in inches (millimeters)
2 (51)	0.060 (1.52)
3 (76)	0.060 (1.52)
4 (102)	0.070 (1.78)
6 (152)	0.100 (2.54)

(e) The design pressure for thermoplastic pipe produced after July 14, 2004 may exceed a gauge pressure of 100 psig (689 kPa) provided that:

(1) The design pressure does not exceed 125 psig (862 kPa);

(2) The material is a PE2406 or a PE3408 polyethylene (PE) pipe with the designation code as specified within ASTM D2513-9909a (incorporated by reference, *see* §192.7);

(3) The pipe size is nominal pipe size (IPS) 12 or less; and

(4) The design pressure is determined in accordance with the design equation defined in §192.121.

(f) The design pressure for polyamide-11 (PA-11) pipe produced after January 23, 2009 may exceed a gauge pressure of 100 psig (689 kPa) provided that:

(1) The design pressure does not exceed 200 psig (1379 kPa);

(2) The pipe size is nominal pipe size (IPS or CTS) 4-inch or less; and

(3) The pipe has a standard dimension ratio of SDR-11 or greater (i.e., thicker pipe wall).

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-31, 43 FR 13883, Apr. 3, 1978; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-94A, 69 FR 54591, Sept. 9, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006: Amdt. 192-[108], 73 FR 79002, Dec. 24, 2008; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.125 Design of copper pipe.

(a) Copper pipe used in mains must have a minimum wall thickness of 0.065 inches (1.65 millimeters) and must be hard drawn.

(b) Copper pipe used in service lines must have wall thickness not less than that indicated in following table:

Standard size (inch) (millimeter)	Nominal O.D. (inch) (millimeter)	Wall thickness (inch) (millimeter)	
		Nominal	Tolerance
½ (13)	0.625 (16)	.040 (1.06)	.0035 (.0889)
5/8 (16)	0.750 (19)	.042 (1.07)	.0035 (.0889)
¾ (19)	0.875 (22)	.045 (1.14)	.0040 (.102)
1 (25)	1.125 (29)	.050 (1.27)	.0040 (.102)
1¼ (32)	1.375 (35)	.055 (1.40)	.0045 (.1143)
1½ (38)	1.625 (41)	.060 (1.52)	.0045 (.1143)

(c) Copper pipe used in mains and service lines may not be used at pressures in excess of 100 psi (689 kPa) gage.

(d) Copper pipe that does not have an internal corrosion resistant lining may not be used to carry gas that has an average hydrogen sulfide content of more than 0.3 grains/100 ft^3 ($6.9/m^3$) under standard conditions. Standard conditions refers to 60°F and 14.7 psia (15.6°C and one atmosphere).

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-62, 54 FR 5625, Feb. 6, 1989; Amdt. 192-85, 63 FR 37500, July 13, 1998]

Subpart D–Design of Pipeline Components

§192.141 Scope.

This subpart prescribes minimum requirements for the design and installation of pipeline components and facilities. In addition, it prescribes requirements relating to protection against accidental overpressuring.

[Part 192 - Org., Aug. 19, 1970]

§192.143 General requirements.

(a) Each component of a pipeline must be able to withstand operating pressures and other anticipated loadings without impairment of its serviceability with unit stresses equivalent to those allowed for comparable material in pipe in the same location and kind of service. However, if design based upon unit stresses is impractical for a particular component, design may be based upon a pressure rating established by the manufacturer by pressure testing that component or a prototype of the component.

(b) The design and installation of pipeline components and facilities must meet applicable requirements for corrosion control found in subpart I of this part.

[Amdt. 192-48, 49 CFR 19823, May 10, 1984 as amended by 72 FR 20055, April 23, 2007]

§192.144 Qualifying metallic components.

Notwithstanding any requirement of this subpart which incorporates by reference an edition of a document listed in §192.7 or Appendix B of this part, a metallic component manufactured in accordance with any other edition of that document is qualified for use under this part if—

(a) It can be shown through visual inspection of the cleaned component that no defect exists which might impair the strength or tightness of the component; and

(b) The edition of the document under which the component was manufactured has equal or more stringent requirements for the following as an edition of that document currently or previously listed in §192.7 or Appendix B of this part:

(1) Pressure testing;

(2) Materials; and,

(3) Pressure and temperature ratings.

[Amdt. 192-45, 48 FR 30637, July 5, 1983; Amdt. 192-94, 69 FR 32886, June 14, 2004]

§192.145 Valves.

(a) Except for cast iron and plastic valves, each valve must meet the minimum requirements of API 6D ANSI/API Spec 6D (incorporated by reference, *see* §192.7), or to a national or international standard that provides an equivalent performance level. A valve may not be used under operating conditions that exceed the applicable pressure-temperature ratings contained in those requirements.

(b) Each cast iron and plastic valve must comply with the following:

(1) The valve must have a maximum service pressure rating for temperatures that equal or exceed the maximum service temperature.

(2) The valve must be tested as part of the manufacturing, as follows:

(i) With the valve in the fully open position, the shell must be tested with no leakage to a pressure at least 1.5 times the maximum service rating.

(ii) After the shell test, the seat must be tested to a pressure no less than 1.5 times the maximum service pressure rating. Except for swing check valves, test pressure during the seat test must be applied successively on each side of the closed valve with the opposite side open. No visible leakage is permitted.

(iii) After the last pressure test is completed, the valve must be operated through its full travel to demonstrate freedom from interference.

(c) Each valve must be able to meet the anticipated operating conditions.

(d) No valve having shell (body, bonnet, cover, and/or end flange) components made of ductile iron may be used at pressures exceeding 80 percent of the pressure ratings for comparable steel valves at their listed temperature. However, a valve having shell components made of ductile iron may be used at pressures up to 80 percent of the pressure ratings for comparable steel valves at their listed temperature, if:

(1) The temperature-adjusted service pressure does not exceed 1,000 psi (7 MPa) gage; and

(2) Welding is not used on any ductile iron component in the fabrication of the valve shells or their assembly.

(e) No valve having shell (body, bonnet, cover, and/or end flange) components made of cast iron, malleable iron, or ductile iron may be used in the gas pipe components of compressor stations.

[Part 192 - Org., Aug. 19,1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 17, 1970; Amdt. 192-22, 41 FR 13590, Mar. 31, 1976; Amdt. 192-37, 46 FR 10159, Feb. 2, 1981; Amdt. 192-62, 54 FR 5625, Feb. 6, 1989; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.147 Flanges and flange accessories.

(a) Each flange or flange accessory (other than cast iron) must meet the minimum requirements of ASME/ANSI B 16.5, MSS SP-44 ASME/ANSI B 16.5 and MSS SP-44 (incorporated by reference, *see* § 192.7), or the equivalent.

(b) Each flange assembly must be able to withstand the maximum pressure at which the pipeline is to be operated and to maintain its physical and chemical properties at any temperature to which it is anticipated that it might be subjected in service.

(c) Each flange on a flanged joint in cast iron pipe must conform in dimensions, drilling, face and gasket design to ASME/ANSI B16.1 (incorporated by reference, *see* §192.7) and be cast integrally with the pipe, valve, or fitting.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-62, 54 FR 5625, Feb. 6, 1989; Amdt. 192-68, 54 FR 14519, Mar. 18, 1993; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.149 Standard fittings.

(a) The minimum metal thickness of threaded fittings may not be less than specified for the pressures and temperatures in the applicable standards referenced in this part, or their equivalent.

(b) Each steel butt-welding fitting must have pressure and temperature ratings based on stresses for pipe of the same or equivalent material. The actual bursting strength of the fitting must at least equal the computed bursting strength of pipe of the designated material and wall thickness, as determined by a prototype that was tested to at least the pressure required for the pipeline to which it is being added.

[Part 192 - Org., Aug. 19, 1970]

§192.150 Passage of internal inspection devices.

(a) Except as provided in paragraphs (b) and (c) of this section, each new transmission line and each replacement of line pipe, valve, fitting, or other line component in a transmission line must be designed and constructed to accommodate the passage of instrumented internal inspection devices.

(b) This section does not apply to:

(1) Manifolds;

(2) Station piping such as at compressor stations, meter stations, or regulator stations;

(3) Piping associated with storage facilities, other than a continuous run of transmission line between a compressor station and storage facilities;

(4) Cross-overs;

(5) Sizes of pipe for which an instrumented internal inspection device is not commercially available;

(6) Transmission lines, operated in conjunction with a distribution system which are installed in Class 4 locations;

(7) Offshore transmission lines, except transmission lines 10¾ inches (273 millimeters) or more in outside diameter on which construction begins after December 28, 2005, that run from platform to platform or platform to shore unless—

(i) Platform space or configuration is incompatible with launching or retrieving instrumented internal inspection devices; or

(ii) If the design includes taps for lateral connections, the operator can demonstrate, based on investigation or experience, that there is no reasonably practical alternative under the design circumstances to the use of a tap that will obstruct the passage of instrumented internal inspection devices; and

(8) Other piping that, under §190.9 of this chapter, the Administrator finds in a particular case would be impracticable to design and construct to accommodate the passage of instrumented internal inspection devices.

(c) An operator encountering emergencies, construction time constraints or other unforeseen construction problems need not construct a new or replacement segment of a transmission line to meet paragraph (a) of this section, if the operator determines and documents why an impracticability prohibits compliance with paragraph (a) of this section. Within 30 days after discovering the emergency or construction problem the operator must petition, under §190.9 of this chapter, for approval that design and construction to accommodate passage of instrumented internal inspection devices would be impracticable. If the petition is denied, within 1 year after the date of the notice of the denial, the operator must modify that segment to allow passage of instrumented internal inspection devices.

[Amdt. 192-72, 59 FR 17275, Apr. 12, 1994as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-97, 69 FR 36024, June 28, 2004]

§192.151 Tapping.

(a) Each mechanical fitting used to make a hot tap must be designed for at least the operating pressure of the pipeline.

(b) Where a ductile iron pipe is tapped, the extent of full-thread engagement and the need for the use of outside-sealing service connections, tapping saddles, or other fixtures must be determined by service conditions.

(c) Where a threaded tap is made in cast iron or ductile iron pipe, the diameter of the tapped hole may not be more than 25 percent of the nominal diameter of the pipe unless the pipe is reinforced, except that

(1) Existing taps may be used for replacement service, if they are free of cracks and have good threads; and

(2) A 1¼-inch (32 millimeters) tap may be made in a 4-inch (102 millimeters) cast iron or ductile iron pipe, without reinforcement.

However, in areas where climate, soil, and service conditions may create unusual external stresses on cast iron pipe, unreinforced taps may be used only on 6-inch (152 millimeters) or larger pipe.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.153 Components fabricated by welding.

(a) Except for branch connections and assemblies of standard pipe and fittings joined by circumferential welds, the design pressure of each component fabricated by welding, whose strength cannot be determined, must be established in accordance with paragraph UG-101 of section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code (BPVC) (Section VIII, Division 1) (incorporated by reference, *see* §192.7).

(b) Each prefabricated unit that uses plate and longitudinal seams must be designed, constructed, and tested in accordance with section VIII, Division 1, or section VIII, Division 2 of the ASME BPVC (Section VIII, Division 1 or Section VIII, Division 2)(incorporated by reference, *see* § 192.7)Boiler and Pressure Vessel Code, except for the following:

(1) Regularly manufactured butt-welding fittings.

(2) Pipe that has been produced and tested under a specification listed in Appendix B to this part.

(3) Partial assemblies such as split rings or collars.

(4) Prefabricated units that the manufacturer certifies have been tested to at least twice the maximum pressure to which they will be subjected under the anticipated operating conditions.

(c) Orange-peel bull plugs and orange-peel swages may not be used on pipelines that are to operate at a hoop stress of 20 percent or more of the SMYS of the pipe.

(d) Except for flat closures designed in accordance with section VIII of the ASME BPVC (Section VIII, Division 1 or 2) Boiler and Pressure Code, flat closures and fish tails may not be used on pipe that either operates at 100 p.s.i. (689 kPa) gage, or more, or is more than 3 inches (76 millimeters) nominal diameter.

(e) A component having a design pressure established in accordance with paragraph (a) or paragraph (b) of this section and subject to the strength testing requirements of § 192.505(b) must be tested to at least 1.5 times the MAOP.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 17, 1970; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-119, 80 FR 168, January 5, 2015; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.155 Welded branch connections.

Each welded branch connection made to pipe in the form of a single connection, or in a header or manifold as a series of connections, must be designed to ensure that the strength of the pipeline system is not reduced, taking into account the stresses in the remaining pipe wall due to the opening in the pipe or header, the shear stresses produced by the pressure acting on the area of the branch opening, and any external loadings due to thermal movement, weight, and vibration.

[Part 192 - Org., Aug. 19, 1970]

§192.157 Extruded outlets.

Each extruded outlet must be suitable for anticipated service conditions and must be at least equal to the design strength of the pipe and other fittings in the pipeline to which it is attached.

[Part 192 - Org., Aug. 19, 1970]

§192.159 Flexibility.

Each pipeline must be designed with enough flexibility to prevent thermal expansion or contraction from causing excessive stresses in the pipe or components, excessive bending or unusual loads at joints, or undesirable forces or moments at points of connection to equipment, or at anchorage or guide points.

[Part 192 - Org., Aug. 19, 1970]

§192.161 Supports and anchors.

(a) Each pipeline and its associated equipment must have enough anchors or supports to:

(1) Prevent undue strain on connected equipment;

(2) Resist longitudinal forces caused by a bend or offset in the pipe; and,

(3) Prevent or damp out excessive vibration.

(b) Each exposed pipeline must have enough supports or anchors to protect the exposed pipe joints from the maximum end force caused by internal pressure and any additional forces caused by temperature expansion or contraction or by the weight of the pipe and its contents.

(c) Each support or anchor on an exposed pipeline must be made of durable, noncombustible material and must be designed and installed as follows:

(1) Free expansion and contraction of the pipeline between supports or anchors may not be restricted.

(2) Provision must be made for the service conditions involved.

(3) Movement of the pipeline may not cause disengagement of the support equipment.

(d) Each support on an exposed pipeline operated at a stress level of 50 percent or more of SMYS must comply with the following:

(1) A structural support may not be welded directly to the pipe.

(2) The support must be provided by a member that completely encircles the pipe.

(3) If an encircling member is welded to a pipe, the weld must be continuous and cover the entire circumference.

(e) Each underground pipeline that is connected to a relatively unyielding line or other fixed object must have enough flexibility to provide for possible movement, or it must have an anchor that will limit the movement of the pipeline.

(f) Except for offshore pipelines, each underground pipeline that is being connected to new branches must have a firm foundation for both the header and the branch to prevent detrimental lateral and vertical movement.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-58, 53 FR 1633, Jan. 21, 1988]

§192.163 Compressor stations: Design and construction.

(a) *Location of compressor building.* Except for a compressor building on a platform located offshore or in inland navigable waters, each main compressor building of a compressor station must be located on property under the control of the operator. It must be far enough away from adjacent property, not under control of the operator, to minimize the possibility of fire being communicated to the compressor building from structures on adjacent property. There must be enough open space around the main compressor building to allow the free movement of fire-fighting equipment.

(b) *Building construction.* Each building on a compressor station site must be made of noncombustible materials if it contains either–

(1) Pipe more than 2 inches (51 millimeters) in diameter that is carrying gas under pressure; or

(2) Gas handling equipment other than gas utilization equipment used for domestic purposes.

(c) *Exits.* Each operating floor of a main compressor building must have at least two separated and unobstructed exits located so as to provide a convenient possibility of escape and an unobstructed passage to a place of safety. Each door latch on an exit must be of a type which can be readily opened from the inside without a key. Each swinging door located in an exterior wall must be mounted to swing outward.

(d) *Fenced areas.* Each fence around a compressor station must have at least two gates located so as to provide a convenient opportunity for escape to a place of safety, or have other facilities affording a similarly convenient exit from the area. Each gate located within 200 feet (61 meters) of any compressor plant building must open outward and, when occupied, must be openable from the inside without a key.

(e) *Electrical facilities.* Electrical equipment and wiring installed in compressor stations must conform to the National Electrical

Code, ANSI/NFPA 70 NFPA-70, so far as that code is applicable.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.165 Compressor stations: Liquid removal.

(a) Where entrained vapors in gas may liquefy under the anticipated pressure and temperature conditions, the compressor must be protected against the introduction of those liquids in quantities that could cause damage.

(b) Each liquid separator used to remove entrained liquids at a compressor station must:

(1) Have a manually operable means of removing these liquids.

(2) Where slugs of liquid could be carried into the compressors, have either automatic liquid removal facilities, an automatic compressor shutdown device, or a high liquid level alarm; and,

(3) Be manufactured in accordance with section VIII of the ASME Boiler and Pressure Vessel Code (BPVC) (incorporated by reference, *see* § 192.7) and the additional requirements of § 192.153(e), except that liquid separators constructed of pipe and fittings without internal welding must be fabricated with a design factor of 0.4, or less.

[Part 192 - Org., Aug. 19, 1970; Amdt. 192-119, 80 FR 168, January 5, 2015; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.167 Compressor stations: Emergency shutdown.

(a) Except for unattended field compressor stations of 1,000 horsepower (746 kilowatts) or less, each compressor station must have an emergency shutdown system that meets the following:

(1) It must be able to block gas out of the station and blow down the station piping.

(2) It must discharge gas from the blowdown piping at a location where the gas will not create a hazard.

(3) It must provide means for the shutdown of gas compressing equipment, gas fires, and electrical facilities in the vicinity of gas headers and in the compressor building, except, that:

(i) Electrical circuits that supply emergency lighting required to assist station personnel in evacuating the compressor building and the area in the vicinity of the gas headers must remain energized; and

(ii) Electrical circuits needed to protect equipment from damage may remain energized.

(4) It must be operable from at least two locations, each of which is:

(i) Outside the gas area of the station;

(ii) Near the exit gates, if the station is fenced, or near emergency exits, if not fenced; and,

(iii) Not more than 500 feet (153 meters) from the limits of the station.

(b) If a compressor station supplies gas directly to a distribution system with no other adequate source of gas available, the emergency shutdown system must be designed so that it will not function at the wrong time and cause an unintended outage on the distribution system.

(c) On a platform located offshore or in inland navigable waters, the emergency shutdown system must be designed and installed to actuate automatically by each of the following events:

(1) In the case of an unattended compressor station:

(i) When the gas pressure equals the maximum allowable operating pressure plus 15 percent or

(ii) When an uncontrolled fire occurs on the platform; and

(2) In the case of a compressor station in a building:

(i) When an uncontrolled fire occurs in the building; or

(ii) When the concentration of gas in air reaches 50 percent or more of the lower explosive limit in a building which has a source of ignition.

For the purpose of paragraph (c)(2)(ii) of this section, an electrical facility which conforms to Class 1, Group D of the National Electrical Code is not a source of ignition.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.169 Compressor stations: Pressure limiting devices.

(a) Each compressor station must have pressure relief or other suitable protective devices of sufficient capacity and sensitivity to ensure that the maximum allowable operating pressure of the station piping and equipment is not exceeded by more than 10 percent.

(b) Each vent line that exhausts gas from the pressure relief valves of a compressor station must extend to a location where the gas may be discharged without hazard.

[Part 192 - Org., Aug. 19, 1970]

192.171 Compressor stations: Additional safety equipment.

(a) Each compressor station must have adequate fire protection facilities. If fire pumps are a part of these facilities, their operation may not be affected by the emergency shutdown system.

(b) Each compressor station prime mover, other than an electrical induction or synchronous motor, must have an automatic device to shut down the unit before the speed of either the prime mover or the driven unit exceeds a maximum safe speed.

(c) Each compressor unit in a compressor station must have a shutdown or alarm device that operates in the event of inadequate cooling or lubrication of the unit.

(d) Each compressor station gas engine that operates with pressure gas injection must be equipped so that stoppage of the engine automatically shuts off the fuel and vents the engine distribution manifold.

(e) Each muffler for a gas engine in a compressor station must have vent slots or holes in the baffles of each compartment to prevent gas from being trapped in the muffler.

[Part 192 - Org., Aug. 19, 1970]

§192.173 Compressor stations: Ventilation.

Each compressor station building must be ventilated to ensure that employees are not endangered by the accumulation of gas in rooms, sumps, attics, pits, or other enclosed places.

[Part 192 - Org., Aug. 19, 1970]

§192.175 Pipe-type and bottle-type holders.

(a) Each pipe-type and bottle-type holder must be designed so as to prevent the accumulation of liquids in the holder, in connecting pipe, or in auxiliary equipment, that might cause corrosion or interfere with the safe operation of the holder.

(b) Each pipe-type or bottle-type holder must have minimum clearance from other holders in accordance with the following formula:

$$C = (D \times P \times F)/48.33)$$

$$(C = (3D \times P \times F)/1{,}000)$$

in which:

C =	Minimum clearance between pipe containers or bottles in inches (millimeters).
D =	Outside diameter of pipe containers or bottles in inches (millimeters).
P =	Maximum allowable operating pressure, psi (kPa) gage.
F =	Design factor as set forth in §192.111 of this part.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.177 Additional provisions for bottle-type holders.

(a) Each bottle-type holder must be–

(1) Located on a site entirely surrounded by fencing that prevents access by unauthorized persons and with minimum clearance from the fence as follows:

Maximum allowable operating pressure	Minimum clearance (feet) (meters)
Less than 1,000 p.s.i. (7 Mpa) gage	25 (7.6)
1,000 p.s.i. (7 Mpa) gage or more	100 (31)

(2) Designed using the design factors set forth in §192.111; and,

(3) Buried with a minimum cover in accordance with §192.327.

(b) Each bottle-type holder manufactured from steel that is not weldable under field conditions must comply with the following:

(1) A bottle-type holder made from alloy steel must meet the chemical and tensile requirements for the various grades of steel in ASTM A372/372M (incorporated by reference, *see* §192.7).

(2) The actual yield-tensile ratio of the steel may not exceed 0.85.

(3) Welding may not be performed on the holder after it has been heat treated or stress relieved, except that copper wires may be attached to the small diameter portion of the bottle end closure for cathodic protection if a localized thermit welding process is used.

(4) The holder must be given a mill hydrostatic test at a pressure that produces a hoop stress at least equal to 85 percent of the SMYS.

(5) The holder, connection pipe, and components must be leak tested after installation as required by Subpart J of this part.

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt 192-58, 53 FR 1635, Jan 21, 1988; Amdt 192-62, 54 FR 5625, Feb. 6, 1989; Amdt 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.179 Transmission line valves.

(a) Each transmission line, other than offshore segments, must have sectionalizing block valves spaced as follows, unless in a particular case the Administrator finds that alternative spacing would provide an equivalent level of safety:

(1) Each point on the pipeline in a Class 4 location must be within 2½ miles (4 kilometers) of a valve.

(2) Each point on the pipeline in a Class 3 location must be within 4 miles (6.4 kilometers) of a valve.

(3) Each point on the pipeline in a Class 2 location must be within 7½ miles (12 kilometers) of a valve.

(4) Each point on the pipeline in a Class 1 location must be within 10 miles (16 kilometers) of a valve.

(b) Each sectionalizing block valve on a transmission line, other than offshore segments, must comply with the following:

(1) The valve and the operating device to open or close the valve must be readily accessible and protected from tampering and damage.

(2) The valve must be supported to prevent settling of the valve or movement of the pipe to which it is attached.

(c) Each section of a transmission line, other than offshore segments, between main line valves must have a blowdown valve with enough capacity to allow the transmission line to be blown down as rapidly as practicable. Each blowdown discharge must be located so the gas can be blown to the atmosphere without hazard and, if the transmission line is adjacent to an overhead electric line, so that the gas is directed away from the electrical conductors.

(d) Offshore segments of transmission lines must be equipped with valves or other components to shut off the flow of gas to an offshore platform in an emergency.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.181 Distribution line valves.

(a) Each high-pressure distribution system must have valves spaced so as to reduce the time to shut down a section of main in an emergency. The valve spacing is determined by the operating pressure, the size of the mains, and the local physical conditions.

(b) Each regulator station controlling the flow or pressure of gas in a distribution system must have a valve installed on the inlet piping at a distance from the regulator station sufficient to permit the operation of the valve during an emergency that might preclude access to the station.

(c) Each valve on a main installed for operating or emergency purposes must comply with the following:

(1) The valve must be placed in a readily accessible location so as to facilitate its operation in an emergency.

(2) The operating stem or mechanism must be readily accessible.

(3) If the valve is installed in a buried box or enclosure, the box or enclosure must be installed so as to avoid transmitting external loads to the main.

[Part 192 - Org., Aug. 19, 1970]

§192.183 Vaults: Structural design requirements.

(a) Each underground vault or pit for valves, pressure relieving, pressure limiting, or pressure regulating stations, must be able to meet the loads which may be imposed upon it, and to protect installed equipment.

(b) There must be enough working space so that all of the equipment required in the vault or pit can be properly installed, operated, and maintained.

(c) Each pipe entering, or within, a regulator vault or pit must be steel for sizes 10 inches (254 millimeters), and less, except that control and gage piping may be copper. Where pipe extends through the vault or pit structure, provision must be made to prevent the passage of gases or liquids through the opening and to avert strains in the pipe.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.185 Vaults: Accessibility.

Each vault must be located in an accessible location and, so far as practical, away from:

(a) Street intersections or points where traffic is heavy or dense;

(b) Points of minimum elevation, catch basins, or places where the access cover will be in the course of surface waters; and,

(c) Water, electric, steam, or other facilities.

[Part 192 - Org., Aug. 19, 1970]

§192.187 Vaults: Sealing, venting, and ventilation.

Each underground vault or closed top pit containing either a pressure regulating or reducing station, or a pressure limiting or relieving station, must be sealed, vented or ventilated, as follows:

(a) When the internal volume exceeds 200 cubic feet (5.7 cubic meters):

(1) The vault or pit must be ventilated with two ducts, each having at least the ventilating effect of a pipe 4 inches (102 millimeters) in diameter;

(2) The ventilation must be enough to minimize the formation of combustible atmosphere in the vault or pit; and,

(3) The ducts must be high enough above grade to disperse any gas-air mixtures that might be discharged.

(b) When the internal volume is more than 75 cubic feet (2.1 cubic meters) but less than 200 cubic feet (5.7 cubic meters):

(1) If the vault or pit is sealed, each opening must have a tight fitting cover without open holes through which an explosive mixture might be ignited, and there must be a means for testing the internal atmosphere before removing the cover;

(2) If the vault or pit is vented, there must be a means of preventing external sources of ignition from reaching the vault atmosphere; or

(3) If the vault or pit is ventilated, paragraph (a) or (c) of this section applies.

(c) If a vault or pit covered by paragraph (b) of this section is ventilated by openings in the covers or gratings and the ratio of the internal volume, in cubic feet, to the effective ventilating area of the cover or grating, in square feet, is less than 20 to 1, no additional ventilation is required.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.189 Vaults: Drainage and waterproofing.

(a) Each vault must be designed so as to minimize the entrance of water.

(b) A vault containing gas piping may not be connected by means of a drain connection to any other underground structure.

(c) Electrical equipment in vaults must conform to the applicable requirements of Class 1, Group D, of the National Electrical Code, ANSI/NFPA 70 NFPA-70 (incorporated by reference, *see* § 192.7).

[Part 192 - Org., Aug. 19, 1970as amended by Amdt. 192-76, 61 FR 26121, May 24, 1996; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.191 Design pressure of plastic fittings.

(a) Thermosetting fittings for plastic pipe must conform to ASTM D 2517, (incorporated by reference, see §192.7).

(b) Thermoplastic fittings for plastic pipe must conform to ASTM D2513-99 for plastic materials other than polyethylene or ASTM D2513–09a for polyethylene plastic materials.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 17, 1970; Amdt. 192-58, 53 FR 1633, Jan. 21, 1988; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.193 Valve installation in plastic pipe.

Each valve installed in plastic pipe must be designed so as to protect the plastic material against excessive torsional or shearing loads when the valve or shutoff is operated, and from any other secondary stresses that might be exerted through the valve or its enclosure.

[Part 192 - Org., Aug. 19, 1970]

§192.195 Protection against accidental overpressuring.

(a) General requirements. Except as provided in §192.197, each pipeline that is connected to a gas source so that the maximum allowable operating pressure could be exceeded as the result of pressure control failure or of some other type of failure, must have pressure relieving or pressure limiting devices that meet the requirements of §192.199 and §192.201.

(b) Additional requirements for distribution systems. Each distribution system that is supplied from a source of gas that is at a higher pressure than the maximum allowable operating pressure for the system must

(1) Have pressure regulation devices capable of meeting the pressure, load, and other service conditions that will be experienced in normal operation of the system, and that could be activated in the event of failure of some portion of the system; and

(2) Be designed so as to prevent accidental overpressuring.

[Part 192 - Org., Aug. 19, 1970]

§192.197 Control of the pressure of gas delivered from high-pressure distribution systems.

(a) If the maximum actual operating pressure of the distribution system is 60 psi (414 kPa) gage, or less, and a service regulator having the following characteristics is used, no other pressure limiting device is required:

(1) A regulator capable of reducing distribution line pressure to pressures recommended for household appliances.

(2) A single port valve with proper orifice for the maximum gas pressure at the regulator inlet.

(3) A valve seat made of resilient material designed to withstand abrasion of the gas, impurities in gas, cutting by the valve, and to resist permanent deformation when it is pressed against the valve port.

(4) Pipe connections to the regulator not exceeding 2 inches (51 millimeters) in diameter.

(5) A regulator that, under normal operating conditions, is able to regulate the downstream pressure within the necessary limits of accuracy and to limit the build-up of pressure under no-flow conditions to prevent a pressure that would cause the unsafe operation of any connected and properly adjusted gas utilization equipment.

(6) A self-contained service regulator with no external static or control lines.

(b) If the maximum actual operating pressure of the distribution system is 60 p.s.i. (414 kPa) gage or less, and a service regulator that does not have all of the characteristics listed in paragraph (a) of this section is used, or if the gas contains materials that seriously interfere with the operation of service regulators, there must be suitable protective devices to prevent unsafe overpressuring of the customer's appliances if the service regulator fails.

(c) If the maximum actual operating pressure of the distribution system exceeds 60 p.s.i. (414 kPa) gage, one of the following methods must be used to regulate and limit, to the maximum safe value, the pressure of gas delivered to the customer:

(1) A service regulator having the characteristics listed in paragraph (a) of this section, and another regulator located upstream from the service regulator. The upstream regulator may not be set to maintain a pressure higher than 60 p.s.i. (414 kPa) gage. A device must be installed between the upstream regulator and the service regulator to limit the pressure on the inlet of the service regulator to 60 p.s.i. (414 kPa) gage or less in case the upstream regulator fails to function properly. This device may be either a relief valve or an automatic shutoff that shuts, if the pressure on the inlet of the service regulator exceeds the set pressure 60p.s.i. (414 kPa) gage or less), and remains closed until manually reset.

(2) A service regulator and a monitoring regulator set to limit, to a maximum safe value, the pressure of the gas delivered to the customer.

(3) A service regulator with a relief valve vented to the outside atmosphere, with the relief valve set to open so that the pressure of gas going to the customer does not exceed a maximum safe value. The relief valve may either be built into the service regulator or it may be a separate unit installed downstream from the service regulator. This combination may be used alone only in those cases where the inlet pressure on the service regulator does not exceed the manufacturer's safe working pressure

rating of the service regulator, and may not be used where the inlet pressure on the service regulator exceeds 125 p.s.i. (862 kPa) gage. For higher inlet pressure, the methods in paragraph (c)(1) or (2) of this section must be used.

(4) A service regulator and an automatic shutoff device that closes upon a rise in pressure downstream from the regulator and remains closed until manually reset.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 7, 1970; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.199 Requirements for design of pressure relief and limiting devices.

Except for rupture discs, each pressure relief or pressure limiting device must:

(a) Be constructed of materials such that the operation of a device will not be impaired by corrosion;

(b) Have valves and valve seats that are designed not to stick in a position that will make the device inoperative;

(c) Be designed and installed so that it can be readily operated to determine if the valve is free, can be tested to determine the pressure at which it will operate, and can be tested for leakage when in the closed position;

(d) Have support made of noncombustible material;

(e) Have discharge stacks, vents, or outlet ports designed to prevent accumulation of water, ice, or snow, located where gas can be discharged into the atmosphere without undue hazard;

(f) Be designed and installed so that the size of the openings, pipe, and fittings located between the system to be protected and the pressure relieving device, and the size of the vent line, are adequate to prevent hammering of the valve and to prevent impairment of relief capacity;

(g) Where installed at a district regulator station to protect a pipeline system from overpressuring, be designed and installed to prevent any single incident such as an explosion in a vault or damage by a vehicle from affecting the operation of both the overpressure protective device and the district regulator; and,

(h) Except for a valve that will isolate the system under protection from its source of pressure, be designed to prevent unauthorized operation of any stop valve that will make the pressure relief valve or pressure limiting device inoperative.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 17, 1970]

§192.201 Required capacity of pressure relieving and limiting stations.

(a) Each pressure relief station or pressure limiting station or group of those stations installed to protect a pipeline must have enough capacity, and must be set to operate, to insure the following:

(1) In a low pressure distribution system, the pressure may not cause the unsafe operation of any connected and properly adjusted gas utilization equipment.

(2) In pipelines other than a low pressure distribution system:

(i) If the maximum allowable operating pressure is 60 p.s.i. (414 kPa) gage or more, the pressure may not exceed the maximum allowable operating pressure plus 10 percent or the pressure that produces a hoop stress of 75 percent of SMYS, whichever is lower;

(ii) If the maximum allowable operating pressure is 12 p.s.i. (83 kPa) gage or more, but less than 60 p.s.i. (414 kPa) gage, the pressure may not exceed the maximum allowable operating pressure plus 6 p.s.i. (41 kPa) gage; or

(iii) If the maximum allowable operating pressure is less than 12 p.s.i. (83 kPa) gage, the pressure may not exceed the maximum allowable operating pressure plus 50 percent.

(b) When more than one pressure regulating or compressor station feeds into a pipeline, relief valves or other protective devices must be installed at each station to ensure that the complete failure of the largest capacity regulator or compressor, or any single run of lesser capacity regulators or compressors in that station, will not impose pressures on any part of the pipeline or distribution system in excess of those for which it was designed, or against which it was protected, whichever is lower.

(c) Relief valves or other pressure limiting devices must be installed at or near each regulator station in a low-pressure distribution system, with a capacity to limit the maximum pressure in the main to a pressure that will not exceed the safe operating pressure for any connected and properly adjusted gas utilization equipment.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-9, 37 FR 20826, Oct. 4, 1972; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.203 Instrument, control, and sampling pipe and components.

(a) Applicability. This section applies to the design of instrument, control, and sampling pipe and components. It does not apply to permanently closed systems, such as fluid-filled temperature-responsive devices.

(b) Materials and design. All materials employed for pipe and components must be designed to meet the particular conditions of service and the following:

(1) Each takeoff connection and attaching boss, fitting, or adapter must be made of suitable material, be able to withstand the maximum service pressure and temperature of the pipe or equipment to which it is attached, and be designed to satisfactorily withstand all stresses without failure by fatigue.

(2) Except for takeoff lines that can be isolated from sources of pressure by other valving, a shutoff valve must be installed in each takeoff line as near as practicable to the point of takeoff. Blowdown valves must be installed where necessary.

(3) Brass or copper material may not be used for metal temperatures greater than 400°F (204°C).

(4) Pipe or components that may contain liquids must be protected by heating or other means from damage due to freezing.

(5) Pipe or components in which liquids may accumulate must have drains or drips.

(6) Pipe or components subject to clogging from solids or deposits must have suitable connections for cleaning.

(7) The arrangement of pipe, components, and supports must provide safety under anticipated operating stresses.

(8) Each joint between sections of pipe, and between pipe and valves or fittings, must be made in a manner suitable for the anticipated pressure and temperature condition. Slip type expansion joints may not be used. Expansion must be allowed for by providing flexibility within the system itself.

(9) Each control line must be protected from anticipated causes of damage and must be designed and installed to prevent damage to any one control line from making both the regulator and the over-pressure protective device inoperative.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998]

Subpart E–Welding of Steel in Pipelines

§192.221 Scope.

(a) This subpart prescribes minimum requirements for welding steel materials in pipelines.

(b) This subpart does not apply to welding that occurs during the manufacture of steel pipe or steel pipeline components.

[Part 192 - Org., Aug. 19, 1970]

§192.223 [Removed]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-52, 51 FR 20294, June 4, 1986]

§192.225 Welding procedures.

(a) Welding must be performed by a qualified welder or welding operator in accordance with welding procedures qualified under section 5, section 12, or Appendix A of API Std 1104 (incorporated by reference, *see* § 192.7) or section IX of the ASME Boiler and Pressure Vessel Code (BPVC) "Welding and Brazing Qualifications" (incorporated by reference, *see* §192.7) to produce welds which meeting the requirements of this subpart. The quality of the test welds used to qualify welding procedures shall must be determined by destructive testing in accordance with the applicable referenced welding standard(s).

(b) Each welding procedure must be recorded in detail, including the results of the qualifying tests. This record must be retained and followed whenever the procedure is used.

[Part 192 - Org., Aug. 19, 1970, as amended by
Amdt. 192-18, 40 FR 10181, Mar. 5, 1975;
Amdt. 192-22, 41 FR 13590, Mar. 31, 1976;
Amdt. 192-37, 46 FR 10157, Feb. 2, 1981;
Amdt. 192-52, 51 FR 20297, June 4, 1986;
Amdt. 192-94, 69 FR 32886, June 14, 2004;
Amdt. 192-103, 71 FR 33402, June 8, 2006;
Amdt. 192-119, 80 FR 168, January 5, 2015;
Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.227 Qualification of welders.

(a) Except as provided in paragraph (b) of this section, each welder or welding operator must be qualified in accordance with section 6, section 12, or Appendix A of API Std 1104 (incorporated by reference, *see* §192.7) or section IX of the ASME Boiler and Pressure Vessel Code (BPVC) (incorporated by reference, *see* §192.7). However, a welder or welding operator qualified under an earlier edition than the edition listed in §192.7 of this part may weld but may not re-qualify under that earlier edition.

(b) A welder may qualify to perform welding on pipe to be operated at a pressure that produces a hoop stress of less than 20 percent of SMYS by performing an acceptable test weld, for the process to be used, under the test set forth in section I of Appendix C of this part. A Each welder who is to make a welded service line connection to a main must also first perform an acceptable test weld under section II of Appendix C of this part as a requirement of the qualifying test.

[Part 192 - Org., Aug. 19, 1970, as amended by
Amdt. 192-18, 40 FR 10181, Mar. 5, 1975;
Amdt. 192-18A, 40 FR 27222, June 27, 1975;
Amdt. 192-22, 41 FR 13590, Mar. 31, 1976;
Amdt. 192-37, 46 FR 10157, Feb. 2, 1981;
Amdt. 192-43, 47 FR 46850, Oct. 21, 1982;
Amdt. 192-52, 51 FR 20294, June 4, 1986;
Amdt. 192-75, 61 FR 18512, Apr. 26, 1996;
Amdt. 192-78, 61 FR 28770, June 6, 1996;
Amdt. 192-94, 69 FR 32886, June 14, 2004;
Amdt. 192-103, 71 FR 33402, June 8, 2006;
Amdt. 192-103c, 72 FR 4655, Feb. 1, 2007;
Amdt. 192-119, 80 FR 168, January 5, 2015;
Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.229 Limitations on welders and welding operators.

(a) No welder or welding operator whose qualification is based on nondestructive testing may weld compressor station pipe and components.

(b) No A welder or welding operator may not weld with a particular welding process unless, within the preceding 6 calendar months, he the welder or welding operator hwas engaged in welding with that process.

(c) A welder or welding operator qualified under §192.227(a)–

(1) May not weld on pipe to be operated at a pressure that produces a hoop stress of 20 percent or more of SMYS unless within the preceding 6 calendar months the welder or welding operator has had one weld tested and found acceptable under the either sections 6, or section 9, section 12 or Appendix A of API Standard Std 1104 (incorporated by reference, *see* §192.7). Alternatively, welders or welding operators may maintain an ongoing qualification status by performing welds tested and found acceptable under the above acceptance criteria at least twice each calendar year, but at intervals not exceeding 7½ months. A welder or welding operator qualified under an earlier edition of a standard listed in §192.7 of this part may weld, but may not re-qualify under that earlier edition; and

(2) May not weld on pipe to be operated at a pressure that produces a hoop stress of less than 20 percent of SMYS unless the welder or welding operator is tested in accordance with paragraph (c)(1) of this section or re-qualifies under paragraph (d)(1) or (d)(2) of this section.

(d) A welder or welding operator qualified under §192.227(b) may not weld unless–

(1) Within the preceding 15 calendar months, but at least once each calendar year, the welder or welding operator has re-qualified under §192.227(b); or

(2) Within the preceding 7½ calendar months, but at least twice each calendar year, the welder or welding operator has had–

(i) A production weld cut out, tested, and found acceptable in accordance with the qualifying test; or

(ii) For a welders who works only on service lines 2 inches (51 millimeters) or smaller in diameter, the welder has had two sample welds tested and found acceptable in accordance with the test in section III of Appendix C of this part.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-18, 40 FR 10181, Mar. 5, 1975; Amdt. 192-18A, 40 FR 27222, June 27, 1975; Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-119, 80 FR 168, January 5, 2015; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.231 Protection from weather.

The welding operation must be protected from weather conditions that would impair the quality of the completed weld.

[Part 192 - Org., Aug. 19, 1970]

§192.233 Miter joints.

(a) A miter joint on steel pipe to be operated at a pressure that produces a hoop stress of 30 percent or more of SMYS may not deflect the pipe more than 3°.

(b) A miter joint on steel pipe to be operated at a pressure that produces a hoop stress of less than 30 percent, but more than 10 percent of SMYS may not deflect the pipe more than 12½° and must be a distance equal to one pipe diameter or more away from any other miter joint, as measured from the crotch of each joint.

(c) A miter joint on steel pipe to be operated at a pressure that produces a hoop stress of 10 percent or less of SMYS may not deflect the pipe more than 90°.

[Part 192 - Org., Aug. 19, 1970]

§192.235 Preparation for welding.

Before beginning any welding, the welding surfaces must be clean and free of any material that may be detrimental to the weld, and the pipe or component must be aligned to provide the most favorable condition for depositing the root bead. This alignment must be preserved while the root bead is being deposited.

[Part 192 - Org., Aug. 19, 1970]

§192.237 [Removed]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-52, 51 FR 20294, June 4, 1986]

§192.239 [Removed]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-52, 51 FR 20294, June 4, 1986]

§192.241 Inspection and test of welds.

(a) Visual inspection of welding must be conducted by an individual qualified by appropriate training and experience to ensure that:

(1) The welding is performed in accordance with the welding procedure; and

(2) The weld is acceptable under paragraph (c) of this section.

(b) The welds on a pipeline to be operated at a pressure that produces a hoop stress of 20 percent or more of SMYS must be nondestructively tested in accordance with §192.243, except that welds that are visually inspected and approved by a qualified welding inspector need not be nondestructively tested if:

(1) The pipe has a nominal diameter of less than 6 inches (152 millimeters); or

(2) The pipeline is to be operated at a pressure that produces a hoop stress of less than 40 percent of SMYS and the welds are so limited in number that nondestructive testing is impractical.

(c) The acceptability of a weld that is nondestructively tested or visually inspected is determined according to the standards in Ssection 9 or Appendix A of API Standard Std 1104 (incorporated by reference, *see* §192.7). Appendix A of API Std 1104 may not be used to accept cracks.However, if a girth weld is unacceptable under those standards for a reason other than a crack, and if Appendix A to API Std 1104 applies to the weld, the acceptability of the weld may be further determined under that appendix.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-18, 40 FR 10181, Mar. 5, 1975; Amdt. 192-18A, 40 FR 27222, June 27, 1975; Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-119, 80 FR 168, January 5, 2015; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.243 Nondestructive testing.

(a) Nondestructive testing of welds must be performed by any process, other than trepanning, that will clearly indicate defects that may affect the integrity of the weld.

(b) Nondestructive testing of welds must be performed:

(1) In accordance with written procedures; and

(2) By persons who have been trained and qualified in the established procedures and with the equipment employed in testing.

(c) Procedures must be established for the proper interpretation of each nondestructive test of a weld to ensure the acceptability of the weld under §192.241(c).

(d) When nondestructive testing is required under §192.241(b), the following percentages of each day's field butt welds, selected at random by the operator, must be nondestructively tested over their entire circumference;

(1) In Class 1 locations, except offshore, at least 10 percent.

(2) In Class 2 locations, at least 15 percent.

(3) In Class 3 and Class 4 locations, at crossings of major or navigable rivers, offshore, and within railroad or public highway rights-of-way, including tunnels, bridges, and overhead road crossings, 100 percent unless impracticable, in which case at least 90 percent. Nondestructive testing must be impracticable for each girth weld not tested.

(4) At pipeline tie-ins, including tie-ins of replacement sections, 100 percent.

(e) Except for a welder or welding operator whose work is isolated from the principal welding activity, a sample of each welder's or welding operator's work for each day must be nondestructively tested, when nondestructive testing is required under §192.241(b).

(f) When nondestructive testing is required under §192.241(b), each operator must retain, for the life of the pipeline, a record showing by milepost, engineering station, or by geographic feature, the number of girth welds made, the number nondestructively tested, the number rejected, and the disposition of the rejects.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-50, 50 FR 37191, Sept. 12, 1985; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-120, 80 FR 12763, March 11, 2015]

192.245 Repair or removal of defects.

(a) Each weld that is unacceptable under §192.241(c) must be removed or repaired. Except for welds on an offshore pipeline being installed from a pipeline vessel, a weld must be removed if it has a crack that is more than 8 percent of the weld length.

(b) Each weld that is repaired must have the defect removed down to sound metal and the segment to be repaired must be preheated if conditions exist which would adversely affect the quality of the weld repair. After repair, the segment of the weld that was repaired must be inspected to ensure its acceptability.

(c) Repair of a crack, or of any defect in a previously repaired area must be in accordance with written weld repair procedures that have been qualified under §192.225. Repair procedures must provide that the minimum mechanical properties specified for the welding procedure used to make the original weld are met upon completion of the final weld repair.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-46, 48 FR 48669, Oct. 20, 1983]

Subpart F–Joining of Materials Other Than by Welding

§192.271 Scope.

(a) This subpart prescribes minimum requirements for joining materials in pipelines, other than by welding.

(b) This subpart does not apply to joining during the manufacture of pipe or pipeline components.

[Part 192 - Org., Aug. 19, 1970]

§192.273 General.

(a) The pipeline must be designed and installed so that each joint will sustain the longitudinal pullout or thrust forces caused by contraction or expansion of the piping or by anticipated external or internal loading.

(b) Each joint must be made in accordance with written procedures that have been proved by test or experience to produce strong gas tight joints.

(c) Each joint must be inspected to insure compliance with this subpart.

[Part 192 - Org., Aug. 19, 1970]

§192.275 Cast iron pipe.

(a) Each caulked bell and spigot joint in cast iron pipe must be sealed with mechanical leak clamps.

(b) Each mechanical joint in cast iron pipe must have a gasket made of a resilient material as the sealing medium. Each gasket must be suitably confined and retained under compression by a separate gland or follower ring.

(c) Cast iron pipe may not be joined by threaded joints.

(d) Cast iron pipe may not be joined by brazing.

(e) [Removed]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-62, 54 FR 5628, Feb. 6, 1989]

§192.277 Ductile iron pipe.

(a) Ductile iron pipe may not be joined by threaded joints.

(b) Ductile iron pipe may not be joined by brazing.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-62, 54 FR 5628, Feb. 6, 1989, effective Mar. 8, 1989]

§192.279 Copper pipe.

Copper pipe may not be threaded except that copper pipe used for joining screw fittings or valves may be threaded if the wall thickness is equivalent to the comparable size of Schedule 40 or heavier wall pipe listed in Table C1 of ASME/ANSI B16.5.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-62 , 54 FR 5628, Feb. 6, 1989; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993]

§192.281 Plastic pipe.

(a) *General.* A plastic pipe joint that is joined by solvent cement, adhesive, or heat fusion may not be disturbed until it has properly set. Plastic pipe may not be joined by a threaded joint or miter joint.

(b) *Solvent cement joints.* Each solvent cement joint on plastic pipe must comply with the following:

(1) The mating surfaces of the joint must be clean, dry, and free of material which might be detrimental to the joint.

(2) The solvent cement must conform to ASTM D 2513-99, (incorporated by reference, see §192.7).

(3) The joint may not be heated to accelerate the setting of the cement.

(c) Heat-fusion joints. Each heat-fusion joint on plastic pipe must comply with the following:

(1) A butt heat-fusion joint must be joined by a device that holds the heater element square to the ends of the piping, compresses the heated ends together, and holds the pipe in proper alignment while the plastic hardens.

(2) A socket heat-fusion joint must be joined by a device that heats the mating surfaces of the joint uniformly and simultaneously to essentially the same temperature.

(3) An electrofusion joint must be joined utilizing the equipment and techniques of the fittings manufacturer or equipment and techniques shown, by testing joints to the requirements of §192.283(a)(1)(iii), to be at least equivalent to those of the fittings manufacturer.

(4) Heat may not be applied with a torch or other open flame.

(d) Adhesive joints. Each adhesive joint on plastic pipe must comply with the following:

(1) The adhesive must conform to ASTM Designation: D 2517 (incorporated by reference, *see* §192.7).

(2) The materials and adhesive must be compatible with each other.

(e) Mechanical joints. Each compression type mechanical joint on plastic pipe must comply with the following:

(1) The gasket material in the coupling must be compatible with the plastic.

(2) A rigid internal tubular stiffener, other than a split tubular stiffener, must be used in conjunction with the coupling.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-34, 44 FR 42968, July 23, 1979; Amdt. 192-58, 53 FR 1635, Jan. 21, 1988; Amdt. 192-61, 53 FR 36793, Sept. 22, 1988; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.283 Plastic pipe; Qualifying joining procedures.

(a) Heat fusion, solvent cement, and adhesive joints. Before any written procedure established under §192.273(b) is used for making plastic pipe joints by a heat fusion, solvent cement, or adhesive method, the procedure must be qualified by subjecting specimen joints made according to theprocedure to the following tests:

(1) The burst test requirements of–

(i) In the case of thermoplastic pipe, paragraph 6.6 (Sustained Pressure Test) or paragraph 6.7 (Minimum Hydrostatic Burst Test) of ASTM D2513–99 for plastic materials other than polyethylene or ASTM D2513–09a (incorporated by reference, *see* §192.7) for polyethylene plastic materials;

(ii) In the case of thermosetting plastic pipe, paragraph 8.5 (Minimum Hydrostatic Burst Pressure) or paragraph 8.9 (Sustained Static Pressure Test) of ASTM D2517 (incorporated by reference, *see* §192.7); or

(iii) In the case of electrofusion fittings for polyethylene (PE) pipe and tubing, paragraph 9.1 (Minimum Hydraulic Burst Pressure Test), paragraph 9.2 (Sustained Pressure Test), paragraph 9.3 (Tensile Strength Test), or paragraph 9.4 (Joint Integrity Tests) of ASTM F1055 (incorporated by reference, *see* §192.7).

(2) For procedures intended for lateral pipe connections, subject a specimen joint made from pipe sections joined at right angles according to the procedure to a force on the lateral pipe until failure occurs in the specimen. If failure initiates outside the joint area, the procedure qualifies for use; and,

(3) For procedures intended for non-lateral pipe connections, follow the tensile test requirements of ASTM D638 (incorporated by reference, *see* §192.7), except that the test may be conducted at ambient temperature and humidity. If the specimen elongates no less than 25 percent or failure initiates outside the joint area, the procedure qualifies for use.

(b) Mechanical joints. Before any written procedure established under §192.273(b) is used for making mechanical plastic pipe joints that are designed to withstand tensile forces, the procedure must be qualified by subjecting five specimen joints made according to the procedure to the following tensile test:

(1) Use an apparatus for the test as specified in ASTM D 638 (except for conditioning), (incorporated by reference, *see* §192.7).

(2) The specimen must be of such length that the distance between the grips of the apparatus and the end of the stiffener does not affect the joint strength.

(3) The speed of testing is 0.20 in. (5.0 mm) per minute, plus or minus 25 percent.

(4) Pipe specimens less than 4 in. (102 mm) in diameter are qualified if the pipe yields to an elongation of no less than 25 percent or failure initiates outside the joint area.

(5) Pipe specimens 4 in. (102 mm) and larger in diameter shall be pulled until the pipe is subjected to a tensile stress equal to or greater than the maximum thermal stress that would be produced by a temperature change of 100°F (38°C) or until the pipe is pulled from the fitting. If the pipe pulls from the fitting, the lowest value of the five test results or the manufacturer's rating, whichever is lower must be used in the design calculations for stress.

(6) Each specimen that fails at the grips must be retested using new pipe.

(7) Results obtained pertain only to the specific outside diameter, and material of the pipe tested, except that testing of a heavier wall pipe may be used to qualify pipe of the same material but with a lesser wall thickness.

(c) A copy of each written procedure being used for joining plastic pipe must be available to the persons making and inspecting joints.

(d) Pipe or fittings manufactured before July 1, 1980, may be used in accordance with procedures that the manufacturer certifies will produce a joint as strong as the pipe.

[Amdt. 192-34, 44 FR 42968, July 23, 1979 as amended by Amdt. 192-34A, 45 FR 9931, Feb. 14, 1980; Amdt. 192-34B, 46 FR 39, Jan. 2, 1981; Amdt. 192-34(1), 47 FR 32720, July 29, 1982; Amdt. 192-34(2), 47 FR 49973, Nov. 4, 1982; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-94A, 69 FR 54591, Sept. 9, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.285 Plastic pipe: Qualifying persons to make joints.

(a) No person may make a plastic pipe joint unless that person has been qualified under the applicable joining procedure by:

(1) Appropriate training or experience in the use of the procedure; and

(2) Making a specimen joint from pipe sections joined according to the procedure that passes the inspection and test set forth in paragraph (b) of this section.

(b) The specimen joint must be:

(1) Visually examined during and after assembly or joining and found to have the same appearance as a joint or photographs of a joint that is acceptable under the procedure; and

(2) In the case of a heat fusion, solvent cement, or adhesive joint;

(i) Tested under any one of the test methods listed under §192.283(a) applicable to the type of joint and material being tested;

(ii) Examined by ultrasonic inspection and found not to contain flaws that would cause failure; or

(iii) Cut into at least three longitudinal straps, each of which is:

(A) Visually examined and found not to contain voids or discontinuities on the cut surfaces of the joint area; and

(B) Deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area.

(c) A person must be re-qualified under an applicable procedure, once each calendar year at intervals not exceeding 15 months, or after any production joint is found unacceptable by testing under § 192.513., if during any 12-month period that person:

(1) Does not make any joints under that procedure; or

(2) Has 3 joints or 3 percent of the joints made, whichever is greater, under that procedure that are found unacceptable by testing under §192.513.

(d) Each operator shall establish a method to determine that each person making joints in plastic pipelines in the operator's system is qualified in accordance with this section.

[Amdt. 192-34, 44 FR 42968, July 23, 1979 as amended by Amdt. 192-34A, 45 FR 9931, Feb. 14, 1980, Amdt. 192-34B, 46 FR 39, Jan. 2, 1981; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.287 Plastic pipe: Inspection of joints.

No person may carry out the inspection of joints in plastic pipes required by §§ 192.273 (c) and 192.285(b) unless that person has been qualified by appropriate training or experience in evaluating the acceptability of plastic pipe joints made under the applicable joining procedure.

[Amdt. 192-34, 44 FR 42968, July 23, 1979; Amdt. 192-94, 69 FR 32886, June 14, 2004]

Subpart G–General Construction Requirements for Transmission Lines and Mains.

§192.301 Scope.

This subpart prescribes minimum requirements for constructing transmission lines and mains.

[Part 192 - Org., Aug. 19, 1970]

§192.303 Compliance with specifications or standards.

Each transmission line or main must be constructed in accordance with comprehensive written specifications or standards that are consistent with this part.

[Part 192 - Org., Aug. 19, 1970]

§192.305 Inspection: General.

Each transmission line or and main must be inspected to ensure that it is constructed in accordance with this subpart. An operator must not use operator personnel to perform a required inspection if the operator personnel performed the construction task requiring inspection. Nothing in this section prohibits the operator from inspecting construction tasks with operator personnel who are involved in other construction tasks.

[Part 192 - Org., Aug. 19, 1970; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.307 Inspection of materials.

Each length of pipe and each other component must be visually inspected at the site of installation to ensure that it has not sustained any visually determinable damage that could impair its serviceability.

[Part 192 - Org., Aug. 19, 1970]

§192.309 Repair of steel pipe.

(a) Each imperfection or damage that impairs the serviceability of a length of steel pipe must be repaired or removed. If a repair is made by grinding, the remaining wall thickness must a least be equal to either:

(1) The minimum thickness required by the tolerances in the specification to which the pipe was manufactured; or

(2) The nominal wall thickness required for the design pressure of the pipeline.

(b) Each of the following dents must be removed from steel pipe to be operated at a pressure that produces a hoop stress of 20 percent, or more, of SMYS, unless the dent is repaired by a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe:

(1) A dent that contains a stress concentrator such as a scratch, gouge, groove, or arc burn.

(2) A dent that affects the longitudinal weld or a circumferential weld.

(3) In pipe to be operated at a pressure that produces a hoop stress of 40 percent or more of SMYS, a dent that has a depth of:

(i) More than ¼ inch (6.4 millimeters) in pipe 12¾ inches (324 millimeters) or less in outer diameter; or

(ii) More than 2 percent of the nominal pipe diameter in pipe over 12¾ inches (324 millimeters) in outer diameter.

For the purposes of this section, a "dent" is a depression that produces a gross disturbance in the curvature of the pipe wall without reducing the pipe-wall thickness. The depth of a dent is measured as the gap between the lowest point of the dent and a prolongation of the original contour of the pipe.

(c) Each arc burn on steel pipe to be operated at a pressure that produces a hoop stress of 40 percent or more, of SMYS must be repaired or removed. If a repair is made by grinding, the arc burn must be completely removed and the remaining wall thickness must be at least equal to either:

(1) The minimum wall thickness required by the tolerances in the specification to which the pipe was manufactured; or

(2) The nominal wall thickness required for the design pressure of the pipeline.

(d) A gouge, groove, arc burn, or dent may not be repaired by insert patching or by pounding out.

(e) Each gouge, groove, arc burn, or dent that is removed from a length of pipe must be removed by cutting out the damaged portion as a cylinder.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 17, 1970; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-88, 64 FR 69660, Dec. 14, 1999]

§192.311 Repair of plastic pipe.

Each imperfection or damage that would impair the serviceability of plastic pipe must be repaired or removed.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.313 Bends and elbows.

(a) Each field bend in steel pipe, other than a wrinkle bend made in accordance with §192.315, must comply with the following:

(1) A bend must not impair the serviceability of the pipe.

(2) Each bend must have a smooth contour and be free from buckling, cracks, or any other mechanical damage.

(3) On pipe containing a longitudinal weld, the longitudinal weld must be as near as practicable to the neutral axis of the bend unless:

(i) The bend is made with an internal bending mandrel; or

(ii) The pipe is 12 inches (305 millimeters) or less in outside diameter or has a diameter to wall thickness ratio less than 70.

(b) Each circumferential weld of steel pipe which is located where the stress during bending causes a permanent deformation in the pipe must be nondestructively tested either before or after the bending process.

(c) Wrought-steel welding elbows and transverse segments of these elbows may not be used for changes in direction on steel pipe that is 2 inches (51 millimeters) or more in diameter unless the arc length, as measured along the crotch, is at least 1 inch (25 millimeters).

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-26, 41 FR 26106, June 24, 1976; Amdt. 192-29, 42 FR 42865, Aug. 25, 1977; Amdt. 192-29C, 42 FR 60148, Nov. 25, 1977; Amdt. 192-49, 50 FR 13225, Apr. 3, 1985; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.315 Wrinkle bends in steel pipe.

(a) A wrinkle bend may not be made on steel pipe to be operated at a pressure that produces a hoop stress of 30 percent or more, of SMYS.

(b) Each wrinkle bend on steel pipe must comply with the following:

(1) The bend must not have any sharp kinks.

(2) When measured along the crotch of the bend, the wrinkles must be a distance of at least one pipe diameter.

(3) On pipe 16 inches (406 millimeters) or larger in diameter, the bend may not have a deflection of more than 1½° for each wrinkle.

(4) On pipe containing a longitudinal weld the longitudinal seam must be as near as practicable to the neutral axis of the bend.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.317 Protection from hazards.

(a) The operator must take all practicable steps to protect each transmission line or main from washouts, floods, unstable soil, landslides, or other hazards that may cause the pipeline to move or to sustain abnormal loads. In addition, the operator must take all practicable steps to protect offshore pipelines from damage by mud slides, water currents, hurricanes, ship anchors, and fishing operations.

(b) Each above ground transmission line or main, not located offshore or in inland navigable water areas, must be protected from accidental damage by vehicular traffic or other similar causes, either by being placed at a safe distance from the traffic or by installing barricades.

(c) Pipelines, including pipe risers, on each platform located offshore or in inland navigable waters must be protected from accidental damage by vessels.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-78, 61 FR 28770, June 6, 1996]

§192.319 Installation of pipe in a ditch

(a) When installed in a ditch, each transmission line that is to be operated at a pressure producing a hoop stress of 20 percent or more of SMYS must be installed so that the pipe fits the ditch so as to minimize stresses and protect the pipe coating from damage.

(b) When a ditch for a transmission line or main is backfilled, it must be backfilled in a manner that:

(1) Provides firm support under the pipe; and

(2) Prevents damage to the pipe and pipe coating from equipment or from the backfill material.

(c) All offshore pipe in water at least 12 feet (3.7 meters) deep, but not more than 200 feet (61 meters) deep, as measured from the mean low tide, except pipe in the Gulf of Mexico and its inlets under 15 feet (4.6 meters)of water, must be installed so that the top of the pipe is below the natural bottom unless the pipe is supported by stanchions, held in place by anchors or heavy concrete coating, or protected by an equivalent means. Pipe in the Gulf of Mexico and its inlets under 15 feet (4.6 meters) of water must be installed so that the top of the pipe is 36 inches (914 millimeters) below the seabed for normal excavation or 18 inches (457 millimeters) for rock excavation.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.321 Installation of plastic pipe.

(a) Plastic pipe must be installed below ground level except as provided by paragraphs (g) and (h) of this section.

(b) Plastic pipe that is installed in a vault or any other below grade enclosure must be completely encased in gas-tight metal pipe and fittings that are adequately protected from corrosion.

(c) Plastic pipe must be installed so as to minimize shear or tensile stresses.

(d) Thermoplastic pipe that is not encased must have a minimum wall thickness of 0.090 inch (2.29 millimeters), except that pipe with an outside diameter of 0.875 inch (22.3 millimeters) or less may have a minimum wall thickness of 0.062 inch (1.58 millimeters).

(e) Plastic pipe that is not encased must have an electrically conducting wire or other means of locating the pipe while it is underground. Tracer wire may not be wrapped around the pipe and contact with the pipe must be minimized but is not prohibited. Tracer wire or other metallic elements installed for pipe locating purposes must be resistant to corrosion damage, either by use of coated copper wire or by other means.

(f) Plastic pipe that is being encased must be inserted into the casing pipe in a manner that will protect the plastic. The leading end of the plastic must be closed before insertion.

(g) Uncased plastic pipe may be temporarily installed above ground level under the following conditions:

(1) The operator must be able to demonstrate that the cumulative aboveground exposure of the pipe does not exceed the manufacturer's recommended maximum period of exposure or 2 years, whichever is less.

(2) The pipe either is located where damage by external forces is unlikely or is otherwise protected against such damage.

(3) The pipe adequately resists exposure to ultraviolet light and high and low temperatures.

(h) Plastic pipe may be installed on bridges provided that it is:

(1) Installed with protection from mechanical damage, such as installation in a metallic casing;

(2) Protected from ultraviolet radiation; and

(3) Not allowed to exceed the pipe temperature limits specified in §192.123.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003; Amdt. 192-94, 69 FR 32886, June 14, 2004]

§192.323 Casing.

Each casing used on a transmission line or main under a railroad or highway must comply with the following:

(a) The casing must be designed to withstand the superimposed loads.

(b) If there is a possibility of water entering the casing, the ends must be sealed.

(c) If the ends of an unvented casing are sealed and the sealing is strong enough to retain the maximum allowable operating pressure of the pipe, the casing must be designed to hold this pressure at a stress level of not more than 72 percent of SMYS.

(d) If vents are installed on a casing, the vents must be protected from the weather to prevent water from entering the casing.

[Part 192 - Org., Aug. 19, 1970]

§192.325 Underground clearance.

(a) Each transmission line must be installed with at least 12 inches (305 millimeters) of clearance from any other underground structure not associated with the transmission line. If this clearance cannot be attained, the transmission line must be protected from damage that might result from the proximity of the other structure.

(b) Each main must be installed with enough clearance from any other underground structure to allow proper maintenance and to protect against damage that might result from proximity to other structures.

(c) In addition to meeting the requirements of paragraphs (a) or (b) of this section, each plastic transmission line or main must be installed with sufficient clearance, or must be insulated, from any source of heat so as to prevent the heat from impairing the serviceability of the pipe.

(d) Each pipe-type or bottle-type holder must be installed with a minimum clearance from any other holder as prescribed in §192.175(b).

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.327 Cover.

(a) Except as provided in paragraphs (c), (e), (f), and (g) of this section, each buried transmission line must be installed with a minimum cover as follows:

Location	Normal soil	Consolidated rock
	Inches (Millimeters)	Inches (Millimeters)
Class 1 locations	30 (762)	18 (457)
Class 2, 3, and 4 locations	36 (914)	24 (610)
Drainage ditches of public roads and railroad crossings	36 (914)	24 (610)

(b) Except as provided in paragraphs (c) and (d) of this section, each buried main must be installed with at least 24 inches (610 millimeters) of cover.

(c) Where an underground structure prevents the installation of a transmission line or main with the minimum cover, the transmission line or main may be installed with less cover if it is provided with additional protection to withstand anticipated external loads.

(d) A main may be installed with less than 24 inches (610 millimeters) of cover if the law of the State or municipality:

(1) Establishes a minimum cover of less than 24 inches (610 millimeters);

(2) Requires that mains be installed in a common trench with other utility lines; and,

(3) Provides adequately for prevention of damage to the pipe by external forces.

(e) Except as provided in paragraph (c) of this section, all pipe installed in a navigable river, stream, or harbor must be installed with a minimum cover of 48 inches (1219 millimeters) in soil or 24 inches (610 millimeters) in consolidated rock between the top of the pipe and the underwater natural bottom (as determined by recognized and generally accepted practices).

(f) All pipe installed offshore, except in the Gulf of Mexico and its inlets, under water not more than 200 feet (60 meters) deep, as measured from the mean low tide, must be installed as follows:

(1) Except as provided in paragraph (c) of this section, pipe under water less than 12 feet (3.66 meters) deep, must be installed with a minimum cover of 36 inches (914 millimeters) in soil or 18 inches (457 millimeters) in consolidated rock between the top of the pipe and the natural bottom.

(2) Pipe under water at least 12 feet (3.66 meters) deep must be installed so that the top of the pipe is below the natural bottom, unless the pipe is supported by stanchions, held in place by anchors or heavy concrete coating, or protected by an equivalent means.

(g) All pipelines installed under water in the Gulf of Mexico and its inlets, as defined in §192.3, must be installed in accordance with §192.612(b)(3).

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-98, 69 FR 48400, Aug. 10, 2004]

§192.328 Additional construction requirements for steel pipe using alternative maximum allowable operating pressure.

For a new or existing pipeline segment to be eligible for operation at the alternative maximum allowable operating pressure calculated under §192.620, a segment must meet the following additional construction requirements. Records must be maintained, for the useful life of the pipeline, demonstrating compliance with these requirements:

To address this construction issue:	The pipeline segment must meet this additional construction requirement:
(a) Quality assurance.	(1) The construction of the pipeline segment must be done under a quality assurance plan addressing pipe inspection, hauling and stringing, field bending, welding, non-destructive examination of girth welds, applying and testing field applied coating, lowering of the pipeline into the ditch, padding and backfilling, and hydrostatic testing.
	(2) The quality assurance plan for applying and testing field applied coating to girth welds must be: (i) Equivalent to that required under §192.112(f)(3) for pipe; and (ii) Performed by an individual with the knowledge, skills, and ability to assure effective coating application.
(b) Girth welds.	(1) All girth welds on a new pipeline segment must be non- destructive-

	ly examined in accordance with §192.243(b) and (c).
(c) Depth of cover.	(1) Notwithstanding any lesser depth of cover otherwise allowed in §192.327, there must be at least 36 inches (914 millimeters) of cover or equivalent means to protect the pipeline from outside force damage.
	(2) In areas where deep tilling or other activities could threaten the pipeline, the top of the pipeline must be installed at least one foot below the deepest expected penetration of the soil.
(d) Initial strength testing.	(1) The pipeline segment must not have experienced failures indicative of systemic material defects during strength testing, including initial hydrostatic testing. A root cause analysis, including metallurgical examination of the failed pipe, must be performed for any failure experienced to verify that it is not indicative of a systemic concern. The results of this root cause analysis must be reported to each PHMSA pipeline safety regional office where the pipe is in service at least 60 days prior to operating at the alternative MAOP. An operator must also notify a State pipeline safety authority when the pipeline is located in a State where PHMSA has an interstate agent agreement, or an intrastate pipeline is regulated by that State.
(e) Interference currents.	(1) For a new pipeline segment, the construction must address the impacts of induced alternating current from parallel electric transmission lines and other known sources of potential interference with corrosion control.

[Amdt. 192-[107], 73 FR 62147, October 17, 2008]

Subpart H–Customer Meters, Service Regulators, and Service Lines

§192.351 Scope.

This subpart prescribes minimum requirements for installing customer meters, service regulators, service lines, service line valves, and service line connections to mains.

[Part 192 - Org., Aug. 19, 1970]

§192.353 Customer meters and regulators: Location.

(a) Each meter and service regulator, whether inside or outside a building, must be installed in a readily accessible location and be protected from corrosion and other damage, including, if installed outside a building, vehicular damage that may be anticipated. However, the upstream regulator in a series may be buried.

(b) Each service regulator installed within a building must be located as near as practical to the point of service line entrance.

(c) Each meter installed within a building must be located in a ventilated place and not less than 3 feet (914 millimeters) from any source of ignition or any source of heat which might damage the meter.

(d) Where feasible, the upstream regulator in a series must be located outside the building, unless it is located in a separate metering or regulating building.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.355 Customer meters and regulators: Protection from damage.

(a) Protection from vacuum or back pressure. If the customer's equipment might create either a vacuum or a back pressure, a device must be installed to protect the system.

(b) Service regulator vents and relief vents. Service regulator vents and relief vents must terminate outdoors, and the outdoor terminal must:

(1) Be rain and insect resistant;

(2) Be located at a place where gas from the vent can escape freely into the atmosphere and away from any opening into the building; and,

(3) Be protected from damage caused by submergence in areas where flooding may occur.

(c) Pits and vaults. Each pit or vault that houses a customer meter or regulator at a place where vehicular traffic is anticipated, must be able to support that traffic.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-58, 53 FR 1633, Jan. 21, 1988]

§192.357 Customer meters and regulators: Installation.

(a) Each meter and each regulator must be installed so as to minimize anticipated stresses upon the connecting piping and the meter.

(b) When close all-thread nipples are used, the wall thickness remaining after the threads are cut must meet the minimum wall thickness requirements of this part.

(c) Connections made of lead or other easily damaged material may not be used in the installation of meters or regulators.

(d) Each regulator that might release gas in its operation must be vented to the outside atmosphere.

[Part 192 - Org., Aug. 19, 1970]

§192.359 Customer meter installations: Operating pressure.

(a) A meter may not be used at a pressure that is more than 67 percent of the manufacturer's shell test pressure.

(b) Each newly installed meter manufactured after November 12, 1970, must have been tested to a minimum of 10 p.s.i. (69 kPa) gage.

(c) A rebuilt or repaired tinned steel case meter may not be used at a pressure that is more than 50 percent of the pressure used to test the meter after rebuilding or repairing.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 17, 1970; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.361 Service lines: Installation.

(a) Depth. Each buried service line must be installed with at least 12 inches (305 millimeters) of cover in private property and at least 18 inches (457 millimeters) of cover in streets and roads. However, where an underground structure prevents installation at those depths, the service line must be able to withstand any anticipated external load.

(b) Support and backfill. Each service line must be properly supported on undisturbed or well-compacted soil, and material used for backfill must be free of materials that could damage the pipe or its coating.

(c) Grading for drainage. Where condensate in the gas might cause interruption in the gas supply to the customer, the service line must be graded so as to drain into the main or into drips at the low points in the service line.

(d) Protection against piping strain and external loading. Each service line must be installed so as to minimize anticipated piping strain and external loading.

(e) Installation of service lines into buildings. Each underground service line installed below grade through the outer foundation wall of a building must:

(1) In the case of a metal service line, be protected against corrosion;

(2) In the case of a plastic service line, be protected from shearing action and backfill settlement; and

(3) Be sealed at the foundation wall to prevent leakage into the building.

(f) Installation of service lines under buildings. Where an underground service line is installed under a building:

(1) It must be encased in a gas tight conduit;

(2) The conduit and the service line must, if the service line supplies the building it underlies, extend into a normally usable and accessible part of the building; and,

(3) The space between the conduit and the service line must be sealed to prevent gas leakage into the building and, if the conduit is sealed at both ends, a vent line from the annular space must extend to a point where gas would not be a hazard, and extend above grade, terminating in a rain and insect resistant fitting.

(g) Locating underground service lines. Each underground nonmetallic service line that is not encased must have a means of locating the pipe that complies with §192.321(e).

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-75, 61 FR 18512, Apr. 26, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.363 Service lines: Valve requirements.

(a) Each service line must have a service line valve that meets the applicable requirements of Subparts B and D of this part. A valve incorporated in a meter bar, that allows the meter to be bypassed, may not be used as a service line valve.

(b) A soft seat service line valve may not be used if its ability to control the flow of gas could be adversely affected by exposure to anticipated heat.

(c) Each service line valve on a high-pressure service line, installed above ground or in an area where the blowing of gas would be hazardous, must be designed and constructed to minimize the possibility of the removal of the core of the valve with other than specialized tools.

[Part 192 - Org., Aug. 19, 1970]

§192.365 Service lines: Location of valves.

(a) Relation to regulator or meter. Each service line valve must be installed upstream of the regulator or, if there is no regulator, upstream of the meter.

(b) Outside valves. Each service line must have a shutoff valve in a readily accessible location that, if feasible, is outside of the building.

(c) Underground valves. Each underground service line valve must be located in a covered durable curb box or standpipe that allows ready operation of the valve and is supported independently of the service lines.

[Part 192 - Org., Aug. 19, 1970]

§192.367 Service lines: General requirements for connections to main piping.

(a) Location. Each service line connection to a main must be located at the top of the main or, if that is not practical, at the side of the main, unless a suitable protective device is installed to minimize the possibility of dust and moisture being carried from the main into the service line.

(b) Compression-type connection to main. Each compression-type service line to main connection must:

(1) Be designed and installed to effectively sustain the longitudinal pullout or thrust forces caused by contraction or expansion of the piping, or by anticipated external or internal loading; and

(2) If gaskets are used in connecting the service line to the main connection fitting, have gaskets that are compatible with the kind of gas in the system.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-75, 61 FR 18512, Apr. 26, 1996]

§192.369 Service lines: Connections to cast iron or ductile iron mains.

(a) Each service line connected to a cast iron or ductile iron main must be connected by a mechanical clamp, by drilling and tapping the main, or by another method meeting the requirements of §192.273.

(b) If a threaded tap is being inserted, the requirements of §192.151(b) and (c) must also be met.

[Part 192 - Org., Aug. 19, 1970]

§192.371 Service lines: Steel.

Each steel service line to be operated at less than 100 p.s.i. (689 kPa) gage must be constructed of pipe designed for a minimum of 100 p.s.i. (689 kPa) gage.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17660, Nov. 17, 1970; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.373 Service lines: Cast iron and ductile iron.

(a) Cast or ductile iron pipe less than 6 inches (152 millimeters) in diameter may not be installed for service lines.

(b) If cast iron pipe or ductile iron pipe is installed for use as a service line, the part of the service line which extends through the building wall must be of steel pipe.

(c) A cast iron or ductile iron service line may not be installed in unstable soil or under a building.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.375 Service lines: Plastic.

(a) Each plastic service line outside a building must be installed below ground level, except that–

(1) It may be installed in accordance with §192.321(g); and

(2) It may terminate above ground level and outside the building, if–

(i) The above ground level part of the plastic service line is protected against deterioration and external damage; and

(ii) The plastic service line is not used to support external loads.

(b) Each plastic service line inside a building must be protected against external damage.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-78, 61 FR 28770, June 6, 1996]

§192.377 Service lines: Copper

Each copper service line installed within a building must be protected against external damage.

[Part 192 - Org., Aug. 19, 1970]

§192.379 New service lines not in use.

Each service line that is not placed in service upon completion of installation must comply with one of the following until the customer is supplied with gas:

(a) The valve that is closed to prevent the flow of gas to the customer must be provided with a locking device or other means designed to prevent the opening of the valve by persons other than those authorized by the operator.

(b) A mechanical device or fitting that will prevent the flow of gas must be installed in the service line or in the meter assembly.

(c) The customer's piping must be physically disconnected from the gas supply and the open pipe ends sealed.

[Amdt. 192-8, 37 FR 20694, Oct. 1972]

§192.381 Service lines: Excess flow valve performance standards.

(a) Excess flow valves to be used on single residence service lines that operate continuously throughout the year at a pressure not less than 10 p.s.i. (69 kPa) gage must be manufactured and tested by the manufacturer according to an industry specification, or the manufacturer's written specification, to ensure that each valve will:

(1) Function properly up to the maximum operating pressure at which the valve is rated;

(2) Function properly at all temperatures reasonably expected in the operating environment of the service line;

(3) At 10 p.s.i. (69 kPa) gage:

(i) Close at, or not more than 50 percent above, the rated closure flow rate specified by the manufacturer; and

(ii) Upon closure, reduce gas flow–

(A) For an excess flow valve designed to allow pressure to equalize across the valve, to no more than 5 percent of the manufacturer's specified closure flow rate, up to a maximum of 20 cubic feet per hour (0.57 cubic meters per hour); or

(B) For an excess flow valve designed to prevent equalization of pressure across the valve, to no more than 0.4 cubic feet per hour (.01 cubic meters per hour); and

(4) Not close when the pressure is less than the manufacturer's minimum specified operating pressure and the flow rate is below the manufacturer's minimum specified closure flow rate.

(b) An excess flow valve must meet the applicable requirements of Subparts B and D of this part.

(c) An operator must mark or otherwise identify the presence of an excess flow valve on the service line.

(d) An operator shall locate an excess flow valve as near as practical to the fitting connecting the service line to its source of gas supply.

(e) An operator should not install an excess flow valve on a service line where the operator has prior experience with contaminants in the gas stream, where these contaminants could be expected to cause the excess flow valve to malfunction or where the excess flow valve would interfere with necessary operation and maintenance activities on the service, such as blowing liquids from the line.

[Amdt. 192-79, 61 FR 31449, June 20, 1996 as amended by Amdt. 192-80, 62 FR 2618, Jan. 17, 1997; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.383 Excess flow valve installation.

(a) Definitions. As used in this section:

Replaced service line means a gas service line where the fitting that connects the service line to the main is replaced or the piping connected to this fitting is replaced.

Service line serving single-family residence means a gas service line that begins at the fitting that connects the service line to the main and serves only one single-family residence.

(b) *Installation required.* An excess flow valve (EFV) installation must comply with the performance standards in §192.381. The operator must install an EFV on any new or replaced service line serving a single-family residence after February 12, 2010, unless one or more of the following conditions is present:

(1) The service line does not operate at a pressure of 10 psig or greater throughout the year;

(2) The operator has prior experience with contaminants in the gas stream that could interfere with the EFV's operation or cause loss of service to a residence;

(3) An EFV could interfere with necessary operation or maintenance activities, such as blowing liquids from the line; or

(4) An EFV meeting performance standards in §192.381 is not commercially available to the operator.

(c) *Reporting*. Each operator must report the EFV measures detailed in the annual report required by § 191.11.

[Amdt. 192-83, 63 FR 5464, Feb. 3, 1998 as amended by Amdt. 192-113, 74 FR 63905, Dec. 4, 2009; Amdt. 192-113c, 75 FR5244, Feb. 2, 2010, Amdt. 192-116, 76 FR 5494, February 1, 2011]

Subpart I–Requirements for Corrosion Control

§192.451 Scope.

(a) This subpart prescribes minimum requirements for the protection of metallic pipelines from external, internal, and atmospheric corrosion.

(b) [Reserved]

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-33, 43 FR 39389, Sept. 5, 1978]

§192.452 How does this subpart apply to converted pipelines and regulated onshore gathering lines?

(a) *Converted pipelines.* Notwithstanding the date the pipeline was installed or any earlier deadlines for compliance, each pipeline which qualifies for use under this part in accordance with §192.14 must meet the requirements of this subpart specifically applicable to pipelines installed before August 1, 1971, and all other applicable requirements within 1 year after the pipeline is readied for service. However, the requirements of this subpart specifically applicable to pipelines installed after July 31, 1971, apply if the pipeline substantially meets those requirements before it is readied for service or it is a segment which is replaced, relocated, or substantially altered.

(b) *Regulated onshore gathering lines.* For any regulated onshore gathering line under §192.9 existing on April 14, 2006, that was not previously subject to this part, and for any onshore gathering line that becomes a regulated onshore gathering line under §192.9 after April 14, 2006, because of a change in class location or increase in dwelling density:

(1) The requirements of this subpart specifically applicable to pipelines installed before August 1, 1971, apply to the gathering line regardless of the date the pipeline was actually installed; and

(2) The requirements of this subpart specifically applicable to pipelines installed after July 31, 1971, apply only if the pipeline substantially meets those requirements.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-30, 42 FR 60146, Nov. 25, 1977, Amdt. 192-102, 71 FR 13289, Mar. 15, 2006]

§192.453 General.

The corrosion control procedures required by §192.605(b)(2), including those for the design, installation, operation, and maintenance of cathodic protection systems, must be carried out by, or under the direction of, a person qualified in pipeline corrosion control methods.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-71, 59 FR 6575, Feb. 11, 1994]

§192.455 External corrosion control: Buried or submerged pipelines installed after July 31, 1971.

(a) Except as provided in paragraphs (b), (c), and (f) of this section, each buried or submerged pipeline installed after July 31, 1971, must be protected against external corrosion, including the following:

(1) It must have an external protective coating meeting the requirements of §192.461.

(2) It must have a cathodic protection system designed to protect the pipeline in accordance with this subpart, installed and placed in operation within 1 year after completion of construction.

(b) An operator need not comply with paragraph (a) of this section, if the operator can demonstrate by tests, investigation, or experience in the area of application, including, as a minimum, soil resistivity measurements and tests for corrosion accelerating bacteria, that a corrosive environment does not exist. However, within 6 months after an installation made pursuant to the preceding sentence, the operator shall conduct tests, including pipe-to-soil potential measurements with respect to either a continuous reference electrode or an electrode using close spacing, not to exceed 20 feet (6 meters), and soil resistivity measurements at potential profile peak locations, to adequately evaluate the potential profile along the entire pipeline. If the tests made indicate that a corrosive condition exists, the pipeline must be cathodically protected in accordance with paragraph (a)(2) of this section.

(c) An operator need not comply with paragraph (a) of this section, if the operator can demonstrate by tests, investigation, or experience that-

(1) For a copper pipeline, a corrosive environment does not exist; or

(2) For a temporary pipeline with an operating period of service not to exceed 5 years beyond installation, corrosion during the 5-year period of service of the pipeline will not be detrimental to public safety.

(d) Notwithstanding the provisions of paragraph (b) or (c) of this section, if a pipeline is externally coated, it must be cathodically protected in accordance with paragraph (a)(2) of this section.

(e) Aluminum may not be installed in a buried or submerged pipeline if that aluminum is exposed to an environment with a natural pH in excess of 8, unless tests or experience indicate its suitability in the particular environment involved.

(f) This section does not apply to electrically isolated, metal alloy fittings in plastic pipelines, if:

(1) For the size fitting to be used, an operator can show by test, investigation, or experience in the area of application that adequate corrosion control is provided by the alloy composition; and

(2) The fitting is designed to prevent leakage caused by localized corrosion pitting.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-28, 42 FR 35654, July 11, 1977; Amdt. 192-39, 47 FR 9842, Mar. 8, 1982; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.457 External corrosion control: Buried or submerged pipelines installed before August 1, 1971.

(a) Except for buried piping at compressor, regulator, and measuring stations, each buried or submerged transmission line installed before August 1, 1971, that has an effective external coating must be cathodically protected along the entire area that is effectively coated, in accordance with this subpart. For the purposes of this subpart, a pipeline does not have an effective external coating if its cathodic protection current requirements are substantially the same as if it were bare. The operator shall make tests to determine the cathodic protection current requirements.

(b) Except for cast iron or ductile iron, each of the following buried or submerged pipelines installed before August 1, 1971, must be cathodically protected in accordance with this subpart in areas in which active corrosion is found:

(1) Bare or ineffectively coated transmission lines.

(2) Bare or coated pipes at compressor, regulator, and measuring stations.

(3) Bare or coated distribution lines.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39389, Sept. 5, 1978; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.459 External corrosion control: Examination of buried pipeline when exposed.

Whenever an operator has knowledge that any portion of a buried pipeline is exposed, the exposed portion must be examined for evidence of external corrosion if the pipe is bare, or if the coating is deteriorated. If external corrosion requiring remedial action under §§ 192.483 through 192.489 is found, the operator shall investigate circumferentially and longitudinally beyond the exposed portion (by visual examination, indirect method, or both) to determine whether additional corrosion requiring remedial action exists in the vicinity of the exposed portion.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-87, 64 FR 56978, Oct. 22, 1999]

§192.461 External corrosion control: Protective coating.

(a) Each external protective coating, whether conductive or insulating, applied for the purpose of external corrosion control must–

(1) Be applied on a properly prepared surface;

(2) Have sufficient adhesion to the metal surface to effectively resist underfilm migration of moisture;

(3) Be sufficiently ductile to resist cracking;

(4) Have sufficient strength to resist damage due to handling and soil stress; and,

(5) Have properties compatible with any supplemental cathodic protection.

(b) Each external protective coating which is an electrically insulating type must also have low moisture absorption and high electrical resistance.

(c) Each external protective coating must be inspected just prior to lowering the pipe into the ditch and backfilling, and any damage detrimental to effective corrosion control must be repaired.

(d) Each external protective coating must be protected from damage resulting from adverse ditch conditions or damage from supporting blocks.

(e) If coated pipe is installed by boring, driving, or other similar method, precautions must be taken to minimize damage to the coating during installation.

[Amdt. 192-4, 36 FR 12297, June 30, 1971]

§192.463 External corrosion control: Cathodic protection.

(a) Each cathodic protection system required by this subpart must provide a level of cathodic protection that complies with one or more of the applicable criteria contained in Appendix D of this part. If none of these criteria is applicable, the cathodic protection system must provide a level of cathodic protection at least equal to that provided by compliance with one or more of these criteria.

(b) If amphoteric metals are included in a buried or submerged pipeline containing a metal or different anodic potential–

(1) The amphoteric metals must be electrically isolated from the remainder of the pipeline and cathodically protected; or

(2) The entire buried or submerged pipeline must be cathodically protected at a cathodic potential that meets the requirements of Appendix D of this part for amphoteric metals.

(c) The amount of cathodic protection must be controlled so as not to damage the protective coating or the pipe.

[Amdt. 192-4, 36 FR 12297, June 30, 1971]

§192.465 External corrosion control: Monitoring.

(a) Each pipeline that is under cathodic protection must be tested at least once each calendar year, but with intervals not exceeding 15 months, to determine whether the cathodic protection meets the requirements of §192.463. However, if tests at those intervals are impractical for separately protected short sections of mains or transmission lines, not in excess of 100 feet (30 meters), or separately protected service lines, these pipelines may be surveyed on a sampling basis. At least 10 percent of these protected structures, distributed over the entire system must be surveyed each calendar year, with a different 10 percent checked each subsequent year, so that the entire system is tested in each 10-year period.

(b) Each cathodic protection rectifier or other impressed current power source must be inspected six times each calendar year, but with intervals not exceeding 2½ months, to ensure that it is operating.

(c) Each reverse current switch, each diode, and each interference bond whose failure would jeopardize structure protection must be electrically checked for proper performance six times each calendar year, but with intervals not exceeding 2½ months. Each other interference bond must be checked at least once each calendar year, but with intervals not exceeding 15 months.

(d) Each operator shall take prompt remedial action to correct any deficiencies indicated by the monitoring.

(e) After the initial evaluation required by §§ 192.455(b) and (c) and 192.457(b), each operator must, not less than every 3 years at intervals not exceeding 39 months, reevaluate its unprotected pipelines and cathodically protect them in accordance with this subpart in areas in which active corrosion is found. The operator must determine the areas of active corrosion by electrical survey. However, on distribution lines and where an electrical survey is impractical on transmission lines, areas of active corrosion may be determined by other means that include review and analysis of leak repair and inspection records, corrosion monitoring records, exposed pipe inspection records, and the pipeline environment.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-33, 43 FR 39389, Sept. 5, 1978; Amdt. 192-35, 44 FR 75381, Dec. 20, 1979; Amdt. 192-35A, 45 FR 23441, Apr. 7, 1980; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.467 External corrosion control: Electrical isolation.

(a) Each buried or submerged pipeline must be electrically isolated from other underground metallic structures, unless the pipeline and the other structures are electrically interconnected and cathodically protected as a single unit.

(b) One or more insulating devices must be installed where electrical isolation of a portion of a pipeline is necessary to facilitate the application of corrosion control.

(c) Except for unprotected copper inserted in a ferrous pipe, each pipeline must be electrically isolated from metallic casings that are a part of the underground system. However, if isolation is not achieved because it is impractical, other measures must be taken to minimize corrosion of the pipeline inside the casing.

(d) Inspection and electrical tests must be made to assure that electrical isolation is adequate.

(e) An insulating device may not be installed in an area where a combustible atmosphere is anticipated unless precautions are taken to prevent arcing.

(f) Where a pipeline is located in close proximity to electrical transmission tower footings, ground cables or counterpoise, or in other areas where fault currents or unusual risk of lightning may be anticipated, it must be provided with protection against damage due to fault currents or lightning, and protective measures must also be taken at insulating devices.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39389, Sept. 5, 1978]

§192.469 External corrosion control: Test stations.

Each pipeline under cathodic protection required by this subpart must have sufficient test stations or other contact points for electrical measurement to determine the adequacy of cathodic protection.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-27, 41 FR 34606, Aug. 16, 1976]

192.471 External corrosion control: Test leads.

(a) Each test lead wire must be connected to the pipeline so as to remain mechanically secure and electrically conductive.

(b) Each test lead wire must be attached to the pipeline so as to minimize stress concentration on the pipe.

(c) Each bared test lead wire and bared metallic area at point of connection to the pipeline must be coated with an electrical insulating material compatible with the pipe coating and the insulation on the wire.

[Amdt. 192-4, 36 FR 12297, June 30, 1971]

§192.473 External corrosion control: Interference currents.

(a) Each operator whose pipeline system is subjected to stray currents shall have in effect a continuing program to minimize the detrimental effects of such currents.

(b) Each impressed current type cathodic protection system or galvanic anode system must be designed and installed so as to minimize any adverse effects on existing adjacent underground metallic structures.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39389, Sept. 5, 1978]

§192.475 Internal corrosion control: General.

(a) Corrosive gas may not be transported by pipeline, unless the corrosive effect of the gas on the pipeline has been investigated and steps have been taken to minimize internal corrosion.

(b) Whenever any pipe is removed from a pipeline for any reason, the internal surface must be inspected for evidence of corrosion. If internal corrosion is found–

(1) The adjacent pipe must be investigated to determine the extent of internal corrosion:

(2) Replacement must be made to the extent required by the applicable paragraphs of §§ 192.485, 192.487, or 192,489; and,

(3) Steps must be taken to minimize the internal corrosion.

(c) Gas containing more than 0.25 grain of hydrogen sulfide per 100 cubic feet (5.8 milligrams/m^3) at standard conditions (4 parts per million) may not be stored in pipe-type or bottle-type holders.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39389, Sept. 5, 1978; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.476 Internal corrosion control: Design and construction of transmission line.

(a) Design and construction. Except as provided in paragraph (b) of this section, each new transmission line and each replacement of line pipe, valve, fitting, or other line component in a transmission line must have features incorporated into its design and construction to reduce the risk of internal corrosion. At a minimum, unless it is impracticable or unnecessary to do so, each new transmission line or replacement of line pipe, valve, fitting, or other line component in a transmission line must:

(1) Be configured to reduce the risk that liquids will collect in the line;

(2) Have effective liquid removal features whenever the configuration would allow liquids to collect; and

(3) Allow use of devices for monitoring internal corrosion at locations with significant potential for internal corrosion.

(b) Exceptions to applicability. The design and construction requirements of paragraph (a) of this section do not apply to the following:

(1) Offshore pipeline; and

(2) Pipeline installed or line pipe, valve, fitting or other line component replaced before May 23, 2007.

(c) Change to existing transmission line. When an operator changes the configuration of a transmission line, the operator must evaluate the impact of the change on internal corrosion risk to the downstream portion of an existing onshore transmission line and provide for removal of liquids and monitoring of internal corrosion as appropriate.

(d) Records. An operator must maintain records demonstrating compliance with this section. Provided the records show why incorporating design features addressing paragraph (a)(1), (a)(2), or (a)(3) of this section is impracticable or unnecessary, an operator may fulfill this requirement through written procedures supported by as-built drawings or other construction records.

[72 FR 20055, April 23, 2007]

§192.477 Internal corrosion control: Monitoring.

If corrosive gas is being transported, coupons or other suitable means must be used to determine the effectiveness of the steps taken to minimize internal corrosion. Each coupon or other means of monitoring internal corrosion must be checked two times each calendar year, but with interval not exceeding 7½ months.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39389, Sept. 5, 1978]

§192.479 Atmospheric corrosion control: General.

(a) Each operator must clean and coat each pipeline or portion of pipeline that is exposed to the atmosphere, except pipelines under paragraph (c) of this section.

(b) Coating material must be suitable for the prevention of atmospheric corrosion.

(c) Except portions of pipelines in offshore splash zones or soil-to-air interfaces, the operator need not protect from atmospheric corrosion any pipeline for which the operator demonstrates by test, investigation, or experience appropriate to the environment of the pipeline that corrosion will—

(1) Only be a light surface oxide; or

(2) Not affect the safe operation of the pipeline before the next scheduled inspection.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39389, Sept. 5, 1978; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.481 Atmospheric corrosion control: Monitoring.

(a) Each operator must inspect each pipeline or portion of pipeline that is exposed to the atmosphere for evidence of atmospheric corrosion, as follows:

If the pipline is located:	Then the frequency of inspection is:
Onshore	At least once every 3 calendar years, but with intervals not exceeding 39 months
Offshore	At least once each calendar year, but with intervals not exceeding 15 months

(b) During inspections the operator must give particular attention to pipe at soil-to-air interfaces, under thermal insulation, under disbonded coatings, at pipe supports, in splash zones, at deck penetrations, and in spans over water.

(c) If atmospheric corrosion is found during an inspection, the operator must provide protection against the corrosion as required by §192.479.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-33, 43 FR 39389, Sept. 5, 1978; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.483 Remedial measures: General.

(a) Each segment of metallic pipe that replaces pipe removed from a buried or submerged pipeline because of external corrosion must have a properly prepared surface and must be provided with an external protective coating that meets the requirements of §192.461.

(b) Each segment of metallic pipe that replaces pipe removed from a buried or submerged pipeline because of external corrosion must be cathodically protected in accordance with this subpart.

(c) Except for cast iron or ductile iron pipe, each segment of buried or submerged pipe that is required to be repaired because of external corrosion must be cathodically protected in accordance with this subpart.

[Amdt. 192-4, 36 FR 12297, June 30, 1971]

§192.485 Remedial measures: Transmission lines.

(a) *General corrosion.* Each segment of transmission line with general corrosion and with a remaining wall thickness less than that required for the MAOP of the pipeline must be replaced or the operating pressure reduced commensurate with the strength of the pipe based on actual remaining wall thickness. However, corroded pipe may be repaired by a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe. Corrosion pitting so closely grouped as to affect the overall strength of the pipe is considered general corrosion for the purpose of this paragraph.

(b) *Localized corrosion pitting.* Each segment of transmission line pipe with localized corrosion pitting to a degree where leakage might result must be replaced or repaired, or the operating pressure must be reduced commensurate with the strength of the pipe, based on the actual remaining wall thickness in the pits.

(c) Under paragraphs (a) and (b) of this section, the strength of pipe based on actual remaining wall thickness may be determined by the procedure in ASME/ANSI B31G (incorporated by reference, *see* § 192.7) or the procedure in AGA Pipeline Research Committee Project PR 3-805 (with RSTRENG disk) PRCI PR 3-805 (R-STRENG) (incorporated by reference, *see* § 192.7). Both procedures apply to corroded regions that do not penetrate the pipe wall, subject to the limitations prescribed in the procedures.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39389, Sept. 5, 1978; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-88, 64 FR 69660, Dec. 14, 1999; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.487 Remedial measures: Distribution lines other than cast iron or ductile iron lines.

(a) *General corrosion.* Except for cast iron or ductile iron pipe, each segment of generally corroded distribution line pipe with a remaining wall thickness less than that required for the MAOP of the pipeline, or a remaining wall thickness less than 30 percent of the nominal wall thickness, must be replaced. However, corroded pipe may be repaired by a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe. Corrosion pitting so closely grouped as to affect the overall strength of the pipe is considered general corrosion for the purpose of this paragraph.

(b) Localized corrosion pitting. Except for cast iron or ductile iron pipe, each segment of distribution line pipe with localized corrosion pitting to a degree where leakage might result must be replaced or repaired.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-88, 64 FR 69660, Dec. 14, 1999]

§192.489 Remedial measures: Cast iron and ductile iron pipelines.

(a) General graphitization. Each segment of cast iron or ductile iron pipe on which general graphitization is found to a degree where a fracture or any leakage might result, must be replaced.

(b) Localized graphitization. Each segment of cast iron or ductile iron pipe on which localized graphitization is found to a degree where any leakage might result, must be replaced or repaired, or sealed by internal sealing methods adequate to prevent or arrest any leakage.

[Amdt. 192-4, 36 FR 12297, June 30, 1971]

§192.490 Direct assessment.

Each operator that uses direct assessment as defined in §192.903 on an onshore transmission line made primarily of steel or iron to evaluate the effects of a threat in the first column must carry out the direct assessment according to the standard listed in the second column. These standards do not apply to methods associated with direct assessment, such as close interval surveys, voltage gradient surveys, or examination of exposed pipelines, when used separately from the direct assessment process.

Threat	Standard1
External corrosion	§192.9252
Internal corrosion in pipelines that transport dry gas.	§192.927
Stress corrosion cracking	§192.929

1 For lines not subject to subpart O of this part, the terms "covered segment" and "covered pipeline segment" in §§ 192.925, 192.927, and 192.929 refer to the pipeline segment on which direct assessment is performed.
2 In §192.925(b), the provision regarding detection of coating damage applies only to pipelines subject to subpart O of this part.

[Amdt. 192-102, 70 FR 61571, Oct. 25, 2005]

§192.491 Corrosion control records.

(a) Each operator shall maintain records or maps to show the location of cathodically protected piping, cathodic protection facilities, galvanic anodes, and neighboring structures bonded to the cathodic protection system. Records or maps showing a stated number of anodes, installed in a stated manner or spacing, need not show specific distances to each buried anode.

(b) Each record or map required by paragraph (a) of this section must be retained for as long as the pipeline remains in service.

(c) Each operator shall maintain a record of each test, survey, or inspection required by this subpart in sufficient detail to demonstrate the adequacy of corrosion control measures or that a corrosive condition does not exist. These records must be retained for at least 5 years, except that records related to §§ 192.465(a) and (e) and 192.475(b) must be retained for as long as the pipeline remains in service.

[Amdt. 192-4, 36 FR 12297, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39389, Sept. 5, 1978; Amdt. 192-78, 61 FR 28770, June 6, 1996]

Subpart J–Test Requirements

§192.501 Scope.

This subpart prescribes minimum leak-test and strength-test requirements for pipelines.

[Part 192 - Org., Aug. 19, 1970]

§192.503 General requirements.

(a) No person may operate a new segment of pipeline, or return to service a segment of pipeline that has been relocated or replaced, until–

(1) It has been tested in accordance with this subpart and §192.619 to substantiate the maximum allowable operating pressure; and

(2) Each potentially hazardous leak has been located and eliminated.

(b) The test medium must be liquid, air, natural gas, or inert gas that is–

(1) Compatible with the material of which the pipeline is constructed;

(2) Relatively free of sedimentary materials; and,

(3) Except for natural gas, nonflammable.

(c) Except as provided in §192.505(a), if air, natural gas, or inert gas is used as the test medium, the following maximum hoop stress limitations apply:

Class location	Maximum hoop stress allowed as percentage of SMYS	
	Natural gas	Air or inert gas
1	80	80
2	30	75
3	30	50
4	30	40

(d) Each joint used to tie in a test segment of pipeline is excepted from the specific test requirements of this subpart, but each non-welded joint must be leak tested at not less than its operating pressure.

(e) If a component other than pipe is the only item being replaced or added to a pipeline, a strength test after installation is not required, if the manufacturer of the component certifies that:

(1) The component was tested to at least the pressure required for the pipeline to which it is being added;

(2) The component was manufactured under a quality control system that ensures that each item manufactured is at least equal in strength to a prototype and that the prototype was tested to at least the pressure required for the pipeline to which it is being added; or

(3) The component carries a pressure rating established through applicable ASME/ANSI/Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS) specifications, or by unit strength calculations as described in § 192.143.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-58, 53 FR 1633, Jan. 21, 1988; Amdt. 192-60, 53 FR 36028, Sept. 16, 1988; Amdt. 192-60A, 54 FR 5485, Feb. 3, 1989; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.505 Strength test requirements for steel pipeline to operate at a hoop stress of 30 percent or more of SMYS.

(a) Except for service lines, each segment of a steel pipeline that is to operate at a hoop stress of 30 percent or more of SMYS must be strength tested in accordance with this section to substantiate the proposed maximum allowable operating pressure. In addition, in a Class 1 or Class 2 location, if there is a building intended for human occupancy within 300 feet (91 meters) of a pipeline, a hydrostatic test must be conducted to a test pressure of at least 125 percent of maximum operating pressure on that segment of the pipeline within 300 feet (91 meters) of such a building, but in no event may the test section be less than 600 feet (183 meters) unless the length of the newly installed or relocated pipe is less than 600 feet (183 meters). However, if the buildings are evacuated while the hoop stress exceeds 50 percent of SMYS, air or inert gas may be used as the test medium.

(b) In a Class 1 or Class 2 location, each compressor station, regulator station, and measuring station, must be tested to at least Class 3 location test requirements.

(c) Except as provided in paragraph (e) of this section, the strength test must be conducted by maintaining the pressure at or above the test pressure for at least 8 hours.

(d) If a component other than pipe is the only item being replaced or added to a pipeline, a strength test after installation is not required, if the manufacturer of the component certifies that–

(1) The component was tested to at least the pressure required for the pipeline to which it is being added;

(2) The component was manufactured under a quality control system that ensures that each item manufactured is at least equal in strength to a prototype and that the prototype was tested to at least the pressure required for the pipeline to which it is being added; or

(3) The component carries a pressure rating established through applicable ASME/ANSI, MSS specifications, or by unit strength calculations as described in §192.143.

(e) For fabricated units and short sections of pipe, for which a post installation test is impractical, a preinstallation strength test must be conducted by maintaining the pressure for at least 4 hours.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-94A, 69 FR 54591, Sept. 9, 2004; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.507 Test requirements for pipelines to operate at a hoop stress less than 30 percent of SMYS and at or above 100 p.s.i. (689 kPa) gage.

Except for service lines and plastic pipelines, each segment of a pipeline that is to be operated at a hoop stress less than 30 percent of SMYS and at or above 100 p.s.i. (689 kPa) gage must be tested in accordance with the following:

(a) The pipeline operator must use a test procedure that will ensure discovery of all potentially hazardous leaks in the segment being tested.

(b) If, during the test, the segment is to be stressed to 20 percent or more of SMYS and natural gas, inert gas, or air is the test medium–

(1) A leak test must be made at a pressure between 100 p.s.i. (689 kPa) gage and the pressure required to produce a hoop stress of 20 percent of SMYS; or

(2) The line must be walked to check for leaks while the hoop stress is held at approximately 20 percent of SMYS.

(c) The pressure must be maintained at or above the test pressure for at least 1 hour.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-58, 53 FR 1633, Jan. 21, 1988; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.509 Test requirements for pipelines to operate below 100 p.s.i. (689 kPa) gage.

Except for service lines and plastic pipelines, each segment of a pipeline that is to be operated below 100 p.s.i. (689 kPa) gage must be leak tested in accordance with the following:

(a) The test procedure used must ensure discovery of all potentially hazardous leaks in the segment being tested.

(b) Each main that is to be operated at less than 1 p.s.i. (6.9 kPa) gage must be tested to at least 10 p.s.i. (69 kPa) gage and each main to be operated at or above 1 p.s.i. (6.9 kPa) gage must be tested to at least 90 p.s.i. (621 kPa) gage.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-58, 53 FR 1633, Jan. 21, 1988; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.511 Test requirements for service lines.

(a) Each segment of a service line (other than plastic) must be leak tested in accordance with this section before being placed in service. If feasible, the service line connection to the main must be included in the test; if not feasible, it must be given a leakage test at the operating pressure when placed in service.

(b) Each segment of a service line (other than plastic) intended to be operated at a pressure of at least 1 p.s.i. (6.9 kPa) gage but not more than 40 p.s.i. (276 kPa) gage must be given a leak test at a pressure of not less than 50 p.s.i. (345 kPa) gage.

(c) Each segment of a service line (other than plastic) intended to be operated at pressures of more than 40 p.s.i. (276 kPa) gage must be tested to at least 90 p.s.i. (621 kPa) gage, except that each segment of the steel service line stressed to 20 percent or more of SMYS must be tested in accordance with §192.507 of this subpart.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-75, 61 FR 18512, Apr. 26, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.513 Test requirements for plastic pipelines.

(a) Each segment of a plastic pipeline must be tested in accordance with this section.

(b) The test procedure must insure discovery of all potentially hazardous leaks in the segment being tested.

(c) The test pressure must be at least 150 percent of the maximum operating pressure or 50 p.s.i. (345 kPa) gage, whichever is greater. However, the maximum test pressure may not be more than three times the pressure determined under §192.121, at a temperature not less than the pipe temperature during the test.

(d) During the test, the temperature of thermoplastic material may not be more than 100°F (38°C), or the temperature at which the material's long-term hydrostatic strength has been determined under the listed specification, whichever is greater.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-77, 61 FR 27789, June 3, 1996; Amdt. 192-77A, 61 FR 45905, Aug. 30, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.515 Environmental protection and safety requirements.

(a) In conducting tests under this subpart, each operator shall insure that every reasonable precaution is taken to protect its employees and the general public during the testing. Whenever the hoop stress of the segment of the pipeline being tested will exceed 50 percent of SMYS, the operator shall take all practicable steps to keep persons not working on the testing operation outside of the testing area until the pressure is reduced to or below the proposed maximum allowable operating pressure.

(b) The operator shall insure that the test medium is disposed of in a manner that will minimize damage to the environment.

[Part 192 - Org., Aug. 19, 1970]

§192.517 Records.

(a) Each operator shall make, and retain for the useful life of the pipeline, a record of each test performed under §§ 192.505 and 192.507. The record must contain at least the following information:

(1) The operator's name, the name of the operator's employee responsible for making the test, and the name of any test company used.

(2) Test medium used.

(3) Test pressure.

(4) Test duration.

(5) Pressure recording charts, or other record of pressure readings.

(6) Elevation variations, whenever significant for the particular test.

(7) Leaks and failures noted and their disposition.

(b) Each operator must maintain a record of each test required by §§ 192.509, 192.511, and 192.513 for at least 5 years.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

Subpart K–Uprating

§192.551 Scope.

This subpart prescribes minimum requirements for increasing maximum allowable operating pressures (uprating) for pipelines.

[Part 192 - Org., Aug. 19, 1970]

§192.553 General requirements.

(a) Pressure increases. Whenever the requirements of this subpart require that an increase in operating pressure be made in increments, the pressure must be increased gradually, at a rate that can be controlled, and in accordance with the following:

(1) At the end of each incremental increase, the pressure must be held constant while the entire segment of the pipeline that is affected is checked for leaks.

(2) Each leak detected must be repaired before a further pressure increase is made, except that a leak determined not to be potentially hazardous need not be repaired, if it is monitored during the pressure increase and it does not become potentially hazardous.

(b) Records. Each operator who uprates a segment of pipeline shall retain for the life of the segment a record of each investigation required by this subpart, of all work performed, and of each pressure test conducted, in connection with the uprating.

(c) Written plan. Each operator who uprates a segment of pipeline shall establish a written procedure that will ensure that each applicable requirement of this subpart is complied with.

(d) Limitation on increase in maximum allowable operating pressure. Except as provided in §192.555(c), a new maximum allowable operating pressure established under this subpart may not exceed the maximum that would be allowed under §§ 192.619 and 192.621 for a new segment of pipeline constructed of the same materials in the same location. However, when uprating a steel pipeline, if any variable necessary to determine the design pressure under the design formula (§192.105) is unknown, the MAOP may be increased as provided in §192.619(a)(1).

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.555 Uprating to a pressure that will produce a hoop stress of 30 percent or more of SMYS in steel pipelines.

(a) Unless the requirements of this section have been met, no person may subject any segment of a steel pipeline to an operating pressure that will produce a hoop stress of 30 percent or more of SMYS and that is above the established maximum allowable operating pressure.

(b) Before increasing operating pressure above the previously established maximum allowable operating pressure the operator shall:

(1) Review the design, operating, and maintenance history and previous testing of the segment of pipeline and determine whether the proposed increase is safe and consistent with the requirements of this part; and

(2) Make any repairs, replacements, or alterations in the segment of pipeline that are necessary for safe operation at the increased pressure.

(c) After complying with paragraph (b) of this section, an operator may increase the maximum allowable operating pressure of a segment of pipeline constructed before September 12, 1970, to the highest pressure that is permitted under §192.619, using as test pressure the highest pressure to which the segment of pipeline was previously subjected (either in a strength test or in actual operation).

(d) After complying with paragraph (b) of this section, an operator that does not qualify under paragraph (c) of this section may increase the previously established maximum allowable operating pressure if at least one of the following requirements is met:

(1) The segment of pipeline is successfully tested in accordance with the requirements of this part for a new line of the same material in the same location.

(2) An increased maximum allowable operating pressure may be established for a segment of pipeline in a Class 1 location if the line has not previously been tested, and if:

(i) It is impractical to test it in accordance with the requirements of this part;

(ii) The new maximum operating pressure does not exceed 80 percent of that allowed for a new line of the same design in the same location; and,

(iii) The operator determines that the new maximum allowable operating pressure is consistent with the condition of the segment of pipeline and the design requirements of this part.

(e) Where a segment of pipeline is uprated in accordance with paragraph (c) or (d)(2) of this section, the increase in pressure must be made in increments that are equal to:

(1) 10 percent of the pressure before the uprating; or

(2) 25 percent of the total pressure increase, whichever produces the fewer number of increments.

[Part 192 - Org., Aug. 19, 1970]

§192.557 Uprating: Steel pipelines to a pressure that will produce a hoop stress less than 30 percent of SMYS: plastic, cast iron, and ductile iron pipelines.

(a) Unless the requirements of this section have been met, no person may subject:

(1) A segment of steel pipeline to an operating pressure that will produce a hoop stress less than 30 percent of SMYS and that is above the previously established maximum allowable operating pressure; or

(2) A plastic, cast iron, or ductile iron pipeline segment to an operating pressure that is above the previously established maximum allowable operating pressure.

(b) Before increasing operating pressure above the previously established maximum allowable operating pressure, the operator shall:

(1) Review the design, operating, and maintenance history of the segment of pipeline;

(2) Make a leakage survey (if it has been more than 1 year since the last survey) and repair any leaks that are found, except that a leak determined not to be potentially hazardous need not be repaired, if it is monitored during the pressure increase and it does not become potentially hazardous;

(3) Make any repairs, replacements, or alterations in the segment of pipeline that are necessary for safe operation at the increased pressure;

(4) Reinforce or anchor offsets, bends and dead ends in pipe joined by compression couplings or bell and spigot joints to prevent failure of the pipe joint, if the offset, bend, or dead end is exposed in an excavation;

(5) Isolate the segment of pipeline in which the pressure is to be increased from any adjacent segment that will continue to be operated at a lower pressure; and,

(6) If the pressure in mains or service lines, or both, is to be higher than the pres-

sure delivered to the customer, install a service regulator on each service line and test each regulator to determine that it is functioning. Pressure may be increased as necessary to test each regulator, after a regulator has been installed on each pipeline subject to the increased pressure.

(c) After complying with paragraph (b) of this section, the increase in maximum allowable operating pressure must be made in increments that are equal to 10 p.s.i. (69 kPa) gage or 25 percent of the total pressure increase, whichever produces the fewer number of increments. Whenever the requirements of paragraph (b)(6) of this section apply, there must be at least two approximately equal incremental increases.

(d) If records for cast iron or ductile iron pipeline facilities are not complete enough to determine stresses produced by internal pressure, trench loading, rolling loads, beam stresses, and other bending loads, in evaluating the level of safety of the pipeline when operating at the proposed increased pressure, the following procedures must be followed:

(1) In estimating the stress, if the original laying conditions cannot be ascertained, the operator shall assume that cast iron pipe was supported on blocks with tamped backfill and that ductile iron pipe was laid without blocks with tamped backfill.

(2) Unless the actual maximum cover depth is known, the operator shall measure the actual cover in at least three places where the cover is most likely to be greatest and shall use the greatest cover measured.

(3) Unless the actual nominal wall thickness is known, the operator shall determine the wall thickness by cutting and measuring coupons from at least three separate pipe lengths. The coupons must be cut from pipe lengths in areas where the cover depth is most likely to be the greatest. The average of all measurements taken must be increased by the allowance indicated in the following table:

Allowance (inches) (millimeters)			
Pipe size (inches) (millimeters)	Cast iron pipe		Ductile iron pipe
	Pit cast pipe	Centrifugally cast pipe	
3 to 8 (76 to 203)	0.075 (1.91)	0.065 (1.65)	0.065 (1.65)
10 to 12 (254 to 305)	0.080 (2.03)	0.070 (1.91)	0.070 (1.91)
14 to 24 (356 to 610)	0.080 (2.03)	0.080 (2.03)	0.075 (1.91)
30 to 42 (762 to 1067)	0.090 (2.29)	0.090 (2.29)	0.075 (1.91)
48 (1219)	0.090 (2.29)	0.090 (2.29)	0.080 (2.03)
54 to 60 (1372 to 1524)	0.090 (2.29)		

(4) For cast iron pipe, unless the pipe manufacturing process is known, the operator shall assume that the pipe is pit cast pipe with a bursting tensile strength of 11,000 p.s.i. (76 MPa) gage and a modulus of rupture of 31,000 p.s.i. (214 MPa) gage.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-62, 54 FR 5625, Feb. 6, 1989; Amdt. 192-85, 63 FR 37500, July 13, 1998]

Subpart L–Operations

§192.601 Scope.

This subpart prescribes minimum requirements for the operation of pipeline facilities.

[Part 192 - Org., Aug. 19, 1970]

§192.603 General provisions.

(a) No person may operate a segment of pipeline unless it is operated in accordance with this subpart.

(b) Each operator shall keep records necessary to administer the procedures established under §192.605.

(c) The Administrator or the State Agency that has submitted a current certification under the pipeline safety laws (49 U.S.C. 60101 et seq.) with respect to the pipeline facility governed by an operator's plans and procedures may, after notice and opportunity for hearing as provided in 49 CFR 190.206 or the relevant State procedures, require the operator to amend its plans and procedures as necessary to provide a reasonable level of safety.

[Part 192 - Org., Aug. 9, 1970, as amended by 192-66, 56 FR 31087, July 9, 1991; Amdt. 192-71, 59 FR 6575, Feb. 11, 1994; Amdt. 192-75, 61 FR 18512, Apr. 26, 1996; Amdt. 192-118, 78 FR 58897, Sep. 25, 2013]

§192.605 Procedural manual for operations, maintenance, and emergencies.

Each operator shall include the following in its operating and maintenance plan:

(a) General. Each operator shall prepare and follow for each pipeline, a manual of written procedures for conducting operations and maintenance activities and for emergency response. For transmission lines, the manual must also include procedures for handling abnormal operations. This manual must be reviewed and updated by the operator at intervals not exceeding 15 months, but at least once each calendar year. This manual must be prepared before operations of a pipeline system commence. Appropriate parts of the manual must be kept at locations where operations and maintenance activities are conducted.

(b) Maintenance and normal operations. The manual required by paragraph (a) of this section must include procedures for the following, if applicable, to provide safety during maintenance and operations.

(1) Operating, maintaining, and repairing the pipeline in accordance with each of the requirements of this subpart and Subpart M of this part.

(2) Controlling corrosion in accordance with the operations and maintenance requirements of Subpart I of this part.

(3) Making construction records, maps, and operating history available to appropriate operating personnel.

(4) Gathering of data needed for reporting incidents under Part 191 of this chapter in a timely and effective manner.

(5) Starting up and shutting down any part of the pipeline in a manner designed to assure operation within the MAOP limits prescribed by this part, plus the build-up allowed for operation of pressure-limiting and control devices.

(6) Maintaining compressor stations, including provisions for isolating units or sections of pipe and for purging before returning to service.

(7) Starting, operating and shutting down gas compressor units.

(8) Periodically reviewing the work done by operator personnel to determine the effectiveness and adequacy of the procedures used in normal operation and maintenance and modifying the procedure when deficiencies are found.

(9) Taking adequate precautions in excavated trenches to protect personnel from the hazards of unsafe accumulations of vapor or gas, and making available when needed at the excavation, emergency rescue equipment, including a breathing apparatus and, a rescue harness and line.

(10) Systematic and routine testing and inspection of pipe-type or bottle-type holders including –

(i) Provision for detecting external corrosion before the strength of the container has been impaired;

(ii) Periodic sampling and testing of gas in storage to determine the dew point of vapors contained in the stored gas which, if condensed, might cause internal corrosion or interfere with the safe operation of the storage plant; and,

(iii) Periodic inspection and testing of pressure limiting equipment to determine that it is in safe operating condition and has adequate capacity.

(11) Responding promptly to a report of a gas odor inside or near a building, unless the operator's emergency procedures under §192.615(a)(3) specifically apply to these reports.

(12) Implementing the applicable control room management procedures required by §192.631.

(c) Abnormal operation. For transmission lines, the manual required by paragraph (a) of this section must include procedures for the following to provide safety when operating design limits have been exceeded:

(1) Responding to, investigating, and correcting the cause of:

(i) Unintended closure of valves or shutdowns;

(ii) Increase or decrease in pressure or flow rate outside normal operating limits;

(iii) Loss of communications;

(iv) Operation of any safety device; and,

(v) Any other foreseeable malfunction of a component, deviation from normal operation, or personnel error which may result in a hazard to persons or property.

(2) Checking variations from normal operation after abnormal operation has ended at sufficient critical locations in the system to determine continued integrity and safe operation.

(3) Notifying responsible operator personnel when notice of an abnormal operation is received.

(4) Periodically reviewing the response of operator personnel to determine the effectiveness of the procedures controlling abnormal operation and taking corrective action where deficiencies are found.

(5) The requirements of this paragraph (c) do not apply to natural gas distribution operators that are operating transmission lines in connection with their distribution system.

(d) Safety-related condition reports. The manual required by paragraph (a) of this section must include instructions enabling personnel who perform operation and maintenance activities to recognize conditions that potentially may be safety-related conditions that are subject to the reporting requirements of §191.23 of this subchapter.

(e) Surveillance, emergency response, and accident investigation. The procedures required by §§ 192.613(a), 192.615, and 192.617 must be included in the manual required by paragraph (a) of this section

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-59, 53 FR 24942, July 1,1988; Amdt. 192-59C, 53 FR 26560, July 13, 1988; Amdt. 192-71, 59 FR 6579, Feb.

11, 1994; Amdt. 192-71A, 60 FR 14381, Mar. 17, 1995; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003: Amdt. 192-112, 74 FR 63310, Dec. 3, 2009]

§192.607 [Removed and Reserved]

[Part 192 - Org., Aug. 10, 1970, as amended by Amdt. 192-5, 36 FR 18194, Sept. 10, 1971; Amdt. 192-78, 61 FR 28770, June 6, 1996]

§192.609 Change in class location: Required study.

Whenever an increase in population density indicates a change in class location for a segment of an existing steel pipeline operating at a hoop stress that is more than 40 percent of SMYS, or indicates that the hoop stress corresponding to the established maximum allowable operating pressure for a segment of existing pipeline is not commensurate with the present class location, the operator shall immediately make a study to determine;

(a) The present class location for the segment involved.

(b) The design, construction, and testing procedures followed in the original construction, and a comparison of these procedures with those required for the present class location by the applicable provisions of this part.

(c) The physical condition of the segment to the extent it can be ascertained from available records;

(d) The operating and maintenance history of the segment;

(e) The maximum actual operating pressure and the corresponding operating hoop stress, taking pressure gradient into account, for the segment of pipeline involved; and,

(f) The actual area affected by the population density increase, and physical barriers or other factors which may limit further expansion of the more densely populated area.

[Part 192 - Org., Aug. 19, 1970]

§192.611 Change in class location: Confirmation or revision of maximum allowable operating pressure.

(a) If the hoop stress corresponding to the established maximum allowable operating pressure of a segment of pipeline is not commensurate with the present class location, and the segment is in satisfactory physical condition, the maximum allowable operating pressure of that segment of pipeline must be confirmed or revised according to one of the following requirements:

(1) If the segment involved has been previously tested in place for a period of not less than 8 hours:

(i) The maximum allowable operating pressure is 0.8 times the test pressure in Class 2 locations, 0.667 times the test pressure in Class 3 locations, or 0.555 times the test pressure in Class 4 locations. The corresponding hoop stress may not exceed 72 percent of the SMYS of the pipe in Class 2 locations, 60 percent of SMYS in Class 3 locations, or 50 percent of SMYS in Class 4 locations.

(ii) The alternative maximum allowable operating pressure is 0.8 times the test pressure in Class 2 locations and 0.667 times the test pressure in Class 3 locations. For pipelines operating at alternative maximum allowable pressure per §192.620, the corresponding hoop stress may not exceed 80 percent of the SMYS of the pipe in Class 2 locations and 67 percent of SMYS in Class 3 locations.

(2) The maximum allowable operating pressure of the segment involved must be

reduced so that the corresponding hoop stress is not more than that allowed by this part for new segments of pipelines in the existing class location.

(3) The segment involved must be tested in accordance with the applicable requirements of Subpart J of this part, and its maximum allowable operating pressure must then be established according to the following criteria:

(i) The maximum allowable operating pressure after the requalification test is 0.8 times the test pressure for Class 2 locations, 0.667 times the test pressure for Class 3 locations, and 0.555 times the test pressure for Class 4 locations.

(ii) The corresponding hoop stress may not exceed 72 percent of the SMYS of the pipe in Class 2 locations, 60 percent of SMYS in Class 3 locations, or 50 percent of SMYS in Class 4 locations.

(iii) For pipeline operating at an alternative maximum allowable operating pressure per §192.620, the alternative maximum allowable operating pressure after the requalification test is 0.8 times the test pressure for Class 2 locations and 0.667 times the test pressure for Class 3 locations. The corresponding hoop stress may not exceed 80 percent of the SMYS of the pipe in Class 2 locations and 67 percent of SMYS in Class 3 locations.

(b) The maximum allowable operating pressure confirmed or revised in accordance with this section, may not exceed the maximum allowable operating pressure established before the confirmation or revision.

(c) Confirmation or revision of the maximum allowable operating pressure of a segment of pipeline in accordance with this section does not preclude the application of §§ 192.553 and 192.555.

(d) Confirmation or revision of the maximum allowable operating pressure that is required as a result of a study under §192.609 must be completed within 24 months of the change in class location. Pressure reduction under paragraph (a) (1) or (2) of this section within the 24-month period does not preclude establishing a maximum allowable operating pressure under paragraph (a)(3) of this section at a later date.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-5, 36 FR 18195, Sept. 10, 1971; Amdt. 192-53, 51 FR 34987, Oct. 1, 1986; Amdt. 192-63, 54 FR 24173, June 6, 1989; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-[107], 73 FR 62147, October 17, 2008]

§192.612 Underwater inspection and reburial of pipelines in the Gulf of Mexico and its inlets.

(a) Each operator shall prepare and follow a procedure to identify its pipelines in the Gulf of Mexico and its inlets in waters less than 15 feet (4.6 meters) deep as measured from mean low water that are at risk of being an exposed underwater pipeline or a hazard to navigation. The procedures must be in effect August 10, 2005.

(b) Each operator shall conduct appropriate periodic underwater inspections of its pipelines in the Gulf of Mexico and its inlets in waters less than 15 feet (4.6 meters) deep as measured from mean low water based on the identified risk.

(c) If an operator discovers that its pipeline is an exposed underwater pipeline or poses a hazard to navigation, the operator shall—

(1) Promptly, but not later than 24 hours after discovery, notify the National Response Center, telephone: 1-800-424-8802, of the location and, if available, the geographic coordinates of that pipeline.

(2) Promptly, but not later than 7 days after discovery, mark the location of the pipeline in accordance with 33 CFR part 64 at the ends of the pipeline segment and at intervals of not over 500 yards (457 meters) long, except that a pipeline segment less than 200 yards (183 meters) long need only be marked at the center; and

(3) Within 6 months after discovery, or not later than November 1 of the following year if the 6 month period is later than November 1 of the year of discovery, bury the pipeline so that the top of the pipe is 36 inches (914 millimeters) below the underwater natural bottom (as determined by recognized and generally accepted practices) for normal excavation or 18 inches (457 millimeters) for rock excavation.

(i) An operator may employ engineered alternatives to burial that meet or exceed the level of protection provided by burial.

(ii) If an operator cannot obtain required state or Federal permits in time to comply with this section, it must notify OPS; specify whether the required permit is State or Federal; and, justify the delay.

[Amdt. 192-67, 56 FR 63764, Dec. 5, 1991 as amended by Amdt 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-98, 69 FR 48400, Aug. 10, 2004]

§192.613 Continuing Surveillance.

(a) Each operator shall have a procedure for continuing surveillance of its facilities to determine and take appropriate action concerning changes in class location, failures, leakage history, corrosion, substantial changes in cathodic protection requirements, and other unusual operating and maintenance conditions.

(b) If a segment of pipeline is determined to be in unsatisfactory condition but no immediate hazard exists, the operator shall initiate a program to recondition or phase out the segment involved, or, if the segment cannot be reconditioned or phased out, reduce the maximum allowable operating pressure in accordance with §192.619(a) and (b).

[Part 192 - Org., Aug. 19, 1970]

§192.614 Damage prevention program.

(a) Except as provided in paragraphs (d) and (e) of this section, each operator of a buried pipeline shall carry out, in accordance with this section, a written program to prevent damage to that pipeline from excavation activities. For the purpose of this section, the term "excavation activities" includes excavation, blasting, boring, tunneling, backfilling, the removal of above ground structures by either explosive or mechanical means, and other earth moving operations.

(b) An operator may comply with any of the requirements of paragraph (c) of this section through participation in a public service program, such as a one-call system, but such participation does not relieve the operator of responsibility for compliance with this section. However, an operator must perform the duties of paragraph (c)(3) of this section through participation in a one-call system, if that one-call system is a qualified one-call system. In areas that are covered by more than one qualified one-call system, an operator need only join one of the qualified one-call systems if there is a central telephone number for excavators to call for excavation activities, or if the one-call systems in those areas communicate with one another. An operator's pipeline system must be covered by a qualified one-call system where there is one in place. For the purpose of this section, a one-call system is considered a "qualified one-call system" if it meets the requirements of section (b)(1) or (b)(2) of this section.

(1) The state has adopted a one-call damage prevention program under §198.37 of this chapter, or

(2) The one-call system:

(i) Is operated in accordance with §198.39 of this chapter;

(ii) Provides a pipeline operator an opportunity similar to a voluntary participant to have a part in management responsibilities; and

(iii) Assesses a participating pipeline operator a fee that is proportionate to the costs of the one-call system's coverage of the operator's pipeline.

(c) The damage prevention program required by paragraph (a) of this section must, at a minimum:

(1) Include the identity, on a current basis, of persons who normally engage in excavation activities in the area in which the pipeline is located.

(2) Provides for notification of the public in the vicinity of the pipeline and actual notification of the persons identified in paragraph (c)(1) of this section of the following as often as needed to make them aware of the damage prevention program:

(i) The program's existence and purpose; and

(ii) How to learn the location of underground pipelines before excavation activities are begun.

(3) Provide a means of receiving and recording notification of planned excavation activities.

(4) If the operator has buried pipelines in the area of excavation activity, provide for actual notification of persons who give notice of their intent to excavate of the type of temporary marking to be provided and how to identify the markings.

(5) Provide for temporary marking of buried pipelines in the area of excavation activity before, as far as practical, the activity begins.

(6) Provide as follows for inspection of pipelines that an operator has reason to believe could be damaged by excavation activities:

(i) The inspection must be done as frequently as necessary during and after the activities to verify the integrity of the pipeline; and

(ii) In the case of blasting, any inspection must include leakage surveys.

(d) A damage prevention program under this section is not required for the following pipelines:

(1) Pipelines located offshore.

(2) Pipelines, other than those located offshore, in Class 1 or 2 locations until September 20, 1995.

(3) Pipelines to which access is physically controlled by the operator.

(e) Pipelines operated by persons other than municipalities (including operators of master meters) whose primary activity does not include the transportation of gas need not comply with the following:

(1) The requirement of paragraph (a) of this section that the damage prevention program be written; and

(2) The requirements of paragraphs (c)(1) and (c)(2) of this section.

[Amdt. 192-40, 47 FR 13818, Apr. 1, 1982; Amdt. 192-57, 52 FR 32798, Aug. 31, 1987; Amdt. 192-73, 60 FR 14646, Mar. 20, 1995; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-82, 62 FR 61695, Nov. 19, 1997; Amdt. 192-84, 63 FR 7721, Feb. 17, 1998; Amdt. 192-84A, 63 FR 38757, July 20, 1998]

§192.615 Emergency plans.

(a) Each operator shall establish written procedures to minimize the hazard resulting from a gas pipeline emergency. At a minimum, the procedures must provide for the following:

(1) Receiving, identifying, and classifying notices of events which require immediate response by the operator.

(2) Establishing and maintaining adequate means of communication with appropriate fire, police, and other public officials.

(3) Prompt and effective response to a notice of each type of emergency, including the following:

(i) Gas detected inside or near a building.

(ii) Fire located near or directly involving a pipeline facility.

(iii) Explosion occurring near or directly involving a pipeline facility.

(iv) Natural disaster.

(4) The availability of personnel, equipment, tools, and materials, as needed at the scene of an emergency.

(5) Actions directed toward protecting people first and then property.

(6) Emergency shutdown and pressure reduction in any section of the operator's pipeline system necessary to minimize hazards to life or property.

(7) Making safe any actual or potential hazard to life or property.

(8) Notifying appropriate fire, police, and other public officials of gas pipeline emergencies and coordinating with them both planned responses and actual responses during an emergency.

(9) Safely restoring any service outage.

(10) Beginning action under §192.617, if applicable, as soon after the end of the emergency as possible.

(11) Actions required to be taken by a controller during an emergency in accordance with §192.631.

(b) Each operator shall:

(1) Furnish its supervisors who are responsible for emergency action a copy of that portion of the latest edition of the emergency procedures established under paragraph (a) of this section as necessary for compliance with those procedures.

(2) Train the appropriate operating personnel to assure that they are knowledgeable of the emergency procedures and verify that the training is effective.

(3) Review employee activities to determine whether the procedures were effectively followed in each emergency.

(c) Each operator shall establish and maintain liaison with appropriate fire, police, and other public officials to:

(1) Learn the responsibility and resources of each government organization that may respond to a gas pipeline emergency;

(2) Acquaint the officials with the operator's ability in responding to a gas pipeline emergency;

(3) Identify the types of gas pipeline emergencies of which the operator notifies the officials; and,

(4) Plan how the operator and officials can engage in mutual assistance to minimize hazards to life or property.

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-24, 41 FR 13586, Mar. 31, 1976; Amdt. 192-71, 59 FR 6585, Feb. 11, 1994: Amdt. 192-112, 74 FR 63310, Dec. 3, 2009]

§192.616 Public awareness.

(a) Except for an operator of a master meter or petroleum gas system covered under paragraph (j) of this section, each pipeline operator must develop and implement a written continuing public education program that follows the guidance provided in the American Petroleum Institute's (API) Recommended Practice (RP) 1162 (IBR, see §192.7).

(b) The operator's program must follow the general program recommendations of API RP 1162 and assess the unique attributes and characteristics of the operator's pipeline and facilities.

(c) The operator must follow the general program recommendations, including baseline and supplemental requirements of API RP 1162, unless the operator provides justification in its program or procedural manual as to why compliance with all or certain provisions of the recommended practice is not practicable and not necessary for safety.

(d) The operator's program must specifically include provisions to educate the public, appropriate government organizations, and persons engaged in excavation related activities on:

(1) Use of a one-call notification system prior to excavation and other damage prevention activities;

(2) Possible hazards associated with unintended releases from a gas pipeline facility;

(3) Physical indications that such a release may have occurred;

(4) Steps that should be taken for public safety in the event of a gas pipeline release; and

(5) Procedures for reporting such an event.

(e) The program must include activities to advise affected municipalities, school districts, businesses, and residents of pipeline facility locations.

(f) The program and the media used must be as comprehensive as necessary to reach all areas in which the operator transports gas.

(g) The program must be conducted in English and in other languages commonly understood by a significant number and concentration of the non-English speaking population in the operator's area.

(h) Operators in existence on June 20, 2005, must have completed their written programs no later than June 20, 2006. The operator of a master meter or petroleum gas system covered under paragraph (j) of this section must complete development of its written procedure by June 13, 2008. Upon request, operators must submit their completed programs to PHMSA or, in the case an intrastate pipeline facility operator, the appropriate State agency.

(i) The operator's program documentation and evaluation results must be available for periodic review by appropriate regulatory agencies.

(j) Unless the operator transports gas as a primary activity, the operator of a master meter or petroleum gas system is not required to develop a public awareness program as prescribed in paragraphs (a) through (g) of this section. Instead the operator must develop and implement a written procedure to provide its customers public awareness messages twice annually. If the master meter or petroleum gas system is located on property the operator does not control, the operator must provide similar messages twice annually to persons controlling the property. The public awareness message must include:

(1) A description of the purpose and reliability of the pipeline;

(2) An overview of the hazards of the pipeline and prevention measures used;

(3) Information about damage prevention;

(4) How to recognize and respond to a leak; and

(5) How to get additional information.

[Amdt. 192-71, 59 FR 6575, Feb. 11, 1994 as amended by Amdt. 192-99, 70 FR 28833, May 19, 2005; Amdt. 192-99A, 70 FR 35041, June 16, 2005; Amdt. 192-[105], 72 FR 70808, Dec. 13, 2007]

§192.617 Investigation of failures.

Each operator shall establish procedures for analyzing accidents and failures, including the selection of samples of the failed facility or equipment for laboratory examination, where appropriate, for the purpose of determining the causes of the failure and minimizing the possibility of a recurrence.

[Part 192 - Org., Aug. 19, 1970]

§192.619 Maximum allowable operating pressure: Steel or plastic pipelines.

(a) No person may operate a segment of steel or plastic pipeline at a pressure that exceeds a maximum allowable operating pressure determined under paragraph (c) or (d) of this section, or the lowest of the following:

(1) The design pressure of the weakest element in the segment, determined in accordance with Subparts C and D of this part. However, for steel pipe in pipelines being converted under §192.14 or uprated under subpart K of this part, if any variable necessary to determine the design pressure under the design formula (§192.105) is unknown, one of the following pressures is to be used as design pressure:

(i) Eighty percent of the first test pressure that produces yield under section N5 of Appendix N of ASME B31.8 (incorporated by reference, *see* § 192.7), reduced by the appropriate factor in paragraph (a)(2)(ii) of this section; or

(ii) If the pipe is 12¾ inches (324 mm) or less in outside diameter and is not tested to yield under this paragraph, 200 p.s.i. (1379 kPa) gage.

(2) The pressure obtained by dividing the pressure to which the segment was tested after construction as follows:

(i) For plastic pipe in all locations, the test pressure is divided by a factor of 1.5.

(ii) For steel pipe operated at 100 p.s.i. (689 kPa) gage or more, the test pressure is divided by a factor determined in accordance with the following table:

	Factors[1], segment		
Class location	Installed before Nov. 12, 1970	Installed after Nov. 11, 1970	Covered under §192.14
1	1.1	1.1	1.25
2	1.25	1.25	1.25
3	1.4	1.5	1.5
4	1.4	1.5	1.5

[1] For offshore segments installed, uprated or converted after July 31, 1977, that are not located on an offshore platform, the factor is 1.25. For segments installed, uprated or converted after July 31, 1977, that are located on an offshore platform or on a platform in inland navigable waters, including a pipe riser, the factor is 1.5.

(3) The highest actual operating pressure to which the segment was subjected during the 5 years preceding the applicable date in the second column. This pressure restriction applies unless the segment was tested according to the requirements in paragraph (a)(2) of this section after the applicable date in the third column or the segment was uprated according to the requirements in subpart K of this part:

Pipeline segment	Pressure date	Test date
—Onshore gathering line that first became subject to this part (other than §192.612) after April 13, 2006. —Onshore transmission line that was a gathering line not subject to this part before March 15, 2006.	March 15, 2006, or date line becomes subject to this part, whichever is later.	5 years preceding applicable date in second column.
Offshore gathering lines.	July 1, 1976.	July 1, 1971.
All other pipelines.	July 1, 1970.	July 1, 1965.

(4) The pressure determined by the operator to be the maximum safe pressure after considering the history of the segment, particularly known corrosion and the actual operating pressure.

(b) No person may operate a segment to which paragraph (a)(4) of this section is applicable, unless overpressure protective devices are installed on the segment in a manner that will prevent the maximum allowable operating pressure from being exceeded, in accordance with §192.195.

(c) The requirements on pressure restrictions in this section do not apply in the following instance. An operator may operate a segment of pipeline found to be in satisfactory condition, considering its operating and maintenance history, at the highest actual operating pressure to which the segment was subjected during the 5 years preceding the applicable date in the second column of the table in paragraph (a)(3) of this section. An operator must still comply with §192.611.

(d) The operator of a pipeline segment of steel pipeline meeting the conditions prescribed in §192.620(b) may elect to operate the segment at a maximum allowable operating pressure determined under §192.620(a).

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-3, 35 FR 17559, Nov. 17, 1970; Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-27A, 41 FR 47252, Oct. 28, 1976; Amdt. 192-30, 42 FR 60146, Nov. 25, 1977; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt 192-85, 63 FR 37500, July 13, 1998, Amdt. 192-102, 71 FR 13289, Mar. 15, 2006; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-[107], 73 FR 62147, October 17, 2008]

§192.620 Alternative maximum allowable operating pressure for certain steel pipelines.

(a) *How does an operator calculate the alternative maximum allowable operating pressure?* An operator calculates the alternative maximum allowable operating pressure by using different factors in the same formulas used for calculating maximum allowable operating pressure under §192.619(a) as follows:

(1) In determining the alternative design pressure under §192.105, use a design factor determined in accordance with §192.111(b), (c), or (d) or, if none of these paragraphs apply, in accordance with the following table:

Class Location	Alternative design factor (F)
1	0.80
2	0.67
3	0.56

(i) For facilities installed prior to December 22, 2008, for which §192.111(b), (c), or (d) apply, use the following design factors as alternatives for the factors specified in those paragraphs: §192.111(b)–0.67 or less; 192.111(c) and (d)–0.56 or less.

(ii) [Reserved]

(2) The alternative maximum allowable operating pressure is the lower of the following:

(i) The design pressure of the weakest element in the pipeline segment, determined under subparts C and D of this part.

(ii) The pressure obtained by dividing the pressure to which the pipeline segment was tested after construction by a factor determined in the following table:

Class Location	Alternative test factor
1	1.25
2	[1]1.50
3	1.50

[1]For Class 2 alternative maximum allowable operating pressure segments installed prior to December 22, 2008, the alternative test factor is 1.25.

(b) *When may an operator use the alternative maximum allowable operating pressure calculated under paragraph (a) of this section?* An operator may use an alternative maximum allowable operating pressure calculated under paragraph (a) of this section if the following conditions are met:

(1) The pipeline segment is in a Class 1, 2, or 3 location;

(2) The pipeline segment is constructed of steel pipe meeting the additional design requirements in §192.112;

(3) A supervisory control and data acquisition system provides remote monitoring and control of the pipeline segment. The control provided must include monitoring of pressures and flows, monitoring compressor start-ups and shut-downs, and remote closure of valves per paragraph (d)(3) of this section;

(4) The pipeline segment meets the additional construction requirements described in §192.328;

(5) The pipeline segment does not contain any mechanical couplings used in place of girth welds;

(6) If a pipeline segment has been previously operated, the segment has not experienced any failure during normal operations indicative of a systemic fault in material as determined by a root cause analysis, including metallurgical examination of the failed pipe. The results of this root cause analysis must be reported to each PHMSA pipeline safety regional office where the pipeline is in service at least 60 days prior to operation at the alternative MAOP. An operator must also notify a State pipeline safety authority when the pipeline is located in a State where PHMSA has an interstate agent agreement, or an intrastate pipeline is regulated by that State; and

(7) At least 95 percent of girth welds on a segment that was constructed prior to December 22, 2008, must have been non-destructively examined in accordance with §192.243(b) and (c).

(c) *What is an operator electing to use the alternative maximum allowable operating pressure required to do?* If an operator elects to use the alternative maximum allowable operating pressure calculated under paragraph (a) of this section for a pipeline segment, the operator must do each of the following:

(1) For pipelines already in service, Nnotify each the PHMSA pipeline safety regional office where the pipeline is in service of the intention to use its election with respect to a segment at least 180 days before operating at the alternative maximum allowable operating pressure at least 180 days before operating at the alternative MAOP. For new pipelines, notify the PHMSA pipeline safety regional office of planned alternative MAOP design and operation at least 60 days prior to the earliest start date of either pipe manufacturing or construction activities. An operator must also notify the a Sstate pipeline safety authority when the pipeline is located in a Sstate where PHMSA has an interstate agent agreement, or where an intrastate pipeline is regulated by that Sstate.

(2) Certify, by signature of a senior executive officer of the company, as follows:

(i) The pipeline segment meets the conditions described in paragraph (b) of this section; and

(ii) The operating and maintenance procedures include the additional operating and maintenance requirements of paragraph (d) of this section; and

(iii) The review and any needed program upgrade of the damage prevention program required by paragraph (d)(4)(v) of this section has been completed.

(3) Send a copy of the certification required by paragraph (c)(2) of this section to each PHMSA pipeline safety regional office where the pipeline is in service 30 days prior to operating at the alternative MAOP. An operator must also send a copy to a State pipeline safety authority when the pipeline is located in a State where PHMSA has an interstate agent agreement, or an intrastate pipeline is regulated by that State.

(4) For each pipeline segment, do one of the following:

(i) Perform a strength test as described in §192.505 at a test pressure calculated under paragraph (a) of this section or

(ii) For a pipeline segment in existence prior to December 22, 2008, certify, under paragraph (c)(2) of this section, that the strength test performed under §192.505 was conducted at a test pressure calculated under paragraph (a) of this section, or conduct a new strength test in accordance with paragraph (c)(4)(i) of this section.

(5) Comply with the additional operation and maintenance requirements described in paragraph (d) of this section.

(6) If the performance of a construction task associated with implementing alternative MAOP that occurs after December 22, 2008, can affect the integrity of the pipeline segment, treat that task as a "covered task", notwithstanding the definition in §192.801(b) and implement the requirements of subpart N as appropriate.

(7) Maintain, for the useful life of the pipeline, records demonstrating compliance with paragraphs (b), (c)(6), and (d) of this section.

(8) A Class 1 and Class 2 pipeline location can be upgraded one class due to class changes per §192.611(a)(3)(i). All class location changes from Class 1 to Class 2 and from Class 2 to Class 3 must have all anomalies evaluated and remediated per: The "original pipeline class grade" §192.620(d)(11) anomaly repair requirements; and all anomalies with a wall loss equal to or greater than 40 percent must be excavated and remediated. Pipelines in Class 4 may not operate at an alternative MAOP.

(d) *What additional operation and maintenance requirements apply to operation at the alternative maximum allowable operating pressure?* In addition to compliance with other applicable safety standards in this part, if an operator establishes a maximum allowable operating pressure for a pipeline segment under paragraph (a) of this section, an operator must comply with the additional operation and maintenance requirements as follows:

To address increased risk of a maximum allowable operating pressure based on higher stresslevels in the following areas:	Take the following additional step:
(1) Identifying and evaluating threats.	Develop a threat matrix consistent with § 192.917 to do the following: (i) Identify and compare the increased risk of operating the pipeline at the increased stress level under this section with conventional operation; and (ii) Describe and implement procedures used to mitigate the risk
(2) Notifying the public.	(i) Recalculate the potential impact circle as defined in § 192.903 to reflect use of the alternative maximum operating pressure calculated under paragraph (a) of this section and pipeline operating conditions; and (ii) In implementing the public education program required under § 192.616, perform the following: (A) Include persons occupying property within 220 yards of the centerline and within the potential impact circle within the targeted audience; and (B) Include information about the integrity management activities performed under this section within the message provided to the audience.
(3) Responding to an emergency in an area defined as a high consequence area in	(i) Ensure that the identification of high consequence areas reflects the larger potential impact circle recalculated under paragraph (d)(2)(i) of this section.

§192.903.	(ii) If personnel response time to mainline valves on either side of the high consequence area exceeds one hour (under normal driving conditions and speed limits) from the time the event is identified in the control room, provide remote valve control through a supervisory control and data acquisition (SCADA) system, other leak detection system, or an alternative method of control. (iii) Remote valve control must include the ability to close and monitor the valve position (open or closed), and monitor pressure upstream and downstream.(iv) A line break valve control system using differential pressure, rate of pressure drop or other widely-accepted method is an acceptable alternative to remote valve control.
(4) Protecting the right-of-way.	(i) Patrol the right-of-way at intervals not exceeding 45 days, but at least 12 times each calendar year, to inspect for excavation activities, ground movement, wash outs, leakage, or other activities or conditions affecting the safety operation of the pipeline. (ii) Develop and implement a plan to monitor for and mitigate occurrences of unstable soil and ground movement. (iii) If observed conditions indicate the possible loss of cover, perform a depth of cover study and replace cover as necessary to restore the depth of cover or apply alternative means to provide protection equivalent to the originally-required depth of cover. (iv) Use line-of-sight line markers satisfying the requirements of §192.707(d) except in agricultural areas, large water crossings or swamp, steep terrain, or where prohibited by Federal Energy Regulatory Commission orders, permits, or local law. (v) Review the damage prevention program under § 192.614(a) in light of national consensus practices, to ensure the program provides adequate protection of the right-of-way. Identify the standards or practices considered in the review, and meet or exceed those standards or practices by incorporating appropriate changes into the program. (vi) Develop and implement a right- of-way management plan to protect the pipeline segment from damage due to excavation activities.
(5) Controlling internal corrosion.	(i) Develop and implement a program to monitor for and mitigate the presence of, deleterious gas stream constituents. (ii) At points where gas with potentially deleterious contaminants enters the pipeline, use filter separators or separators and gas quality monitoring equipment. (iii) Use gas quality monitoring equipment that includes a moisture analyzer, chromatograph, and periodic hydrogen sulfide sampling. (iv) Use cleaning pigs and sample accumulated liquids. Use inhibitors when corrosive gas or liquids are present. (v) Address deleterious gas stream constituents as follows: (A) Limit carbon dioxide to 3 percent by volume; (B) Allow no free water and otherwise limit water to seven pounds per million cubic feet of gas; and (C) Limit hydrogen sulfide to 1.0 grain per hundred cubic feet (16 ppm) of gas, where the hydrogen sulfide is greater than 0.5 grain per hundred cubic feet (8 ppm) of gas, implement a pigging and inhibitor injection program to address deleterious gas stream constituents, in-

	cluding follow-up sampling and quality testing of liquids at receipt points. (vi) Review the program at least quarterly based on the gas stream experience and implement adjustments to monitor for, and mitigate the presence of, deleterious gas stream constituents.
(6) Controlling interference that can impact external corrosion.	(i) Prior to operating an existing pipeline segment at an alternate maximum allowable operating pressure calculated under this section, or within six months after placing a new pipeline segment in service at an alternate maximum allowable operating pressure calculated under this section, address any interference currents on the pipeline segment. (ii) To address interference currents, perform the following: (A) Conduct an interference survey to detect the presence and level of any electrical current that could impact external corrosion where interference is suspected; (B) Analyze the results of the survey; and (C) Take any remedial action needed within 6 months after completing the survey to protect the pipeline segment from deleterious current.
(7) Confirming external corrosion control through indirect assessment.	(i) Within six months after placing the cathodic protection of a new pipeline segment in operation, or within six months after certifying a segment under §192.620(c)(1) of an existing pipeline segment under this section, assess the adequacy of the cathodic protection through an indirect method such as close- interval survey, and the integrity of the coating using direct current voltage gradient (DCVG) or alternating current voltage gradient (ACVG). (ii) Remediate any construction damaged coating with a voltage drop classified as moderate or severe (IR drop greater than 35% for DCVG or 50 dB[mu]v for ACVG) under section 4 of NACE RP-0502-2002 (incorporated by reference, see §192.7). (iii) Within six months after completing the baseline internal inspection required under paragraph (d)(9) of this section, integrate the results of the indirect assessment required under paragraph (d)(7)(i) of this section with the results of the baseline internal inspection and take any needed remedial actions. (iv) For all pipeline segments in high consequence areas, perform periodic assessments as follows: (A) Conduct periodic close interval surveys with current interrupted to confirm voltage drops in association with periodic assessments under subpart O of this part. (B) Locate pipe-to-soil test stations at half-mile intervals within each high consequence area ensuring at least one station is within each high consequence area, if practicable. (C) Integrate the results with those of the baseline and periodic assessments for integrity done under paragraphs (d)(9) and (d)(10) of this section.
(8) Controlling external corrosion through cathodic protection.	(i) If an annual test station reading indicates cathodic protection below the level of protection required in subpart I of this part, complete remedial action within six months of the failed reading or notify each PHMSA pipeline safety regional office where the pipeline is in service

	demonstrating that the integrity of the pipeline is not compromised if the repair takes longer than 6 months. An operator must also notify a State pipeline safety authority when the pipeline is located in a State where PHMSA has an interstate agent agreement, or an intrastate pipeline is regulated by that State; and (ii) After remedial action to address a failed reading, confirm restoration of adequate corrosion control by a close interval survey on either side of the affected test station to the next test station unless the reason for the failed reading is determined to be a rectifier connection or power input problem that can be remediated and otherwise verified. (iii) If the pipeline segment has been in operation, the cathodic protection system on the pipeline segment must have been operational within 12 months of the completion of construction.
(9) Conducting a baseline assessment of integrity.	(i) Except as provided in paragraph (d)(9)(iii) of this section, for a new pipeline segment operating at the new alternative maximum allowable operating pressure, perform a baseline internal inspection of the entire pipeline segment as follows: (A) Assess using a geometry tool after the initial hydrostatic test and backfill and within six months after placing the new pipeline segment in service; and (B) Assess using a high resolution magnetic flux tool within three years after placing the new pipeline segment in service at the alternative maximum allowable operating pressure. (ii) Except as provided in paragraph (d)(9)(iii) of this section, for an existing pipeline segment, perform a baseline internal assessment using a geometry tool and a high resolution magnetic flux tool before, but within two years prior to, raising pressure to the alternative maximum allowable operating pressure as allowed under this section. (iii) If headers, mainline valve by- passes, compressor station piping, meter station piping, or other short portion of a pipeline segment operating at alternative maximum allowable operating pressure cannot accommodate a geometry tool and a high resolution magnetic flux tool, use direct assessment (per §192.925, §192.927 and/or §192.929) or pressure testing (per subpart J of this part) to assess that portion.
(10) Conducting periodic assessments of integrity.	(i) Determine a frequency for subsequent periodic integrity assessments as if all the alternative maximum allowable operating pressure pipeline segments were covered by subpart O of this part and (ii) Conduct periodic internal inspections using a high resolution magnetic flux tool on the frequency determined under paragraph (d)(10)(i) of this section, or (iii) Use direct assessment (per § 192.925, § 192.927 and/ or § 192.929) or pressure testing (per subpart J of this part) for periodic assessment of a portion of a segment to the extent permitted for a baseline assessment under paragraph (d)(9)(iii) of this section.
(11) Making repairs.	(i) Perform the following when evaluating an anomaly: (A) Use the most conservative calculation for determining remaining strength or an alternative validated calculation based on pipe diameter, wall thickness, grade, operating pressure, operating stress level, and operating temperature: and

	(B) Take into account the tolerances of the tools used for the inspection. (ii) Repair a defect immediately if any of the following apply: (A) The defect is a dent discovered during the baseline assessment for integrity under paragraph (d)(9) of this section and the defect meets the criteria for immediate repair in §192.309(b). (B) The defect meets the criteria for immediate repair in §192.933(d). (C) The alternative maximum allowable operating pressure was based on a design factor of 0.67 under paragraph (a) of this section and the failure pressure is less than 1.25 times the alternative maximum allowable operating pressure. (D) The alternative maximum allowable operating pressure was based on a design factor of 0.56 under paragraph (a) of this section and the failure pressure is less than or equal to 1.4 times the alternative maximum allowable operating pressure. (iii) If paragraph (d)(11)(ii) of this section does not require immediate repair, repair a defect within one year if any of the following apply: (A) The defect meets the criteria for repair within one year in §192.933(d). (B) The alternative maximum allowable operating pressure was based on a design factor of 0.80 under paragraph (a) of this section and the failure pressure is less than 1.25 times the alternative maximum allowable operating pressure. (C) The alternative maximum allowable operating pressure was based on a design factor of 0.67 under paragraph (a) of this section and the failure pressure is less than 1.50 times the alternative maximum allowable operating pressure. (D) The alternative maximum allowable operating pressure was based on a design factor of 0.56 under paragraph (a) of this section and the failure pressure is less than or equal to 1.80 times the alternative maximum allowable operating pressure. (iv) Evaluate any defect not required to be repaired under paragraph (d)(11)(ii) or (iii) of this section to determine its growth rate, set the maximum interval for repair or re-inspection, and repair or re-inspect within that interval.

(e) Is there any change in overpressure protection associated with operating at the alternative maximum allowable operating pressure? Notwithstanding the required capacity of pressure relieving and limiting stations otherwise required by §192.201, if an operator establishes a maximum allowable operating pressure for a pipeline segment in accordance with paragraph (a) of this section, an operator must:

(1) Provide overpressure protection that limits mainline pressure to a maximum of 104 percent of the maximum allowable operating pressure; and

(2) Develop and follow a procedure for establishing and maintaining accurate set points for the supervisory control and data acquisition system.

Amdt. 192-[107], 73 FR 62147, October 17, 2008; Amdt. 192-111, 74 FR 62503, Nov. 30, 2009; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.621 Maximum allowable operating pressure: High-pressure distribution systems.

(a) No person may operate a segment of a high pressure distribution system at a pressure that exceeds the lowest of the following pressures, as applicable:

(1) The design pressure of the weakest element in the segment, determined in accordance with Subparts C and D of this part.

(2) 60 p.s.i. (414 kPa) gage, for a segment of a distribution system otherwise designated to operate at over 60 p.s.i. (414 kPa) gage, unless the service lines in the segment are equipped with service regulators or other pressure limiting devices in series that meet the requirements of §192.197(c).

(3) 25 p.s.i. (172 kPa) gage in segments of cast iron pipe in which there are unreinforced bell and spigot joints.

(4) The pressure limits to which a joint could be subjected without the possibility of its parting.

(5) The pressure determined by the operator to be the maximum safe pressure after considering the history of the segment, particularly known corrosion and the actual operating pressures.

(b) No person may operate a segment of pipeline to which paragraph (a)(5) of this section applies, unless overpressure protective devices are installed on the segment in a manner that will prevent the maximum allowable operating pressure from being exceeded, in accordance with §192.195.

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.623 Maximum and minimum allowable operating pressure: Low-pressure distribution systems.

(a) No person may operate a low-pressure distribution system at a pressure high enough to make unsafe the operation of any connected and properly adjusted low-pressure gas burning equipment.

(b) No person may operate a low pressure distribution system at a pressure lower than the minimum pressure at which the safe and continuing operation of any connected and properly adjusted low-pressure gas burning equipment can be assured.

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-75, 61 FR 18512, Apr. 26, 1996]

§192.625 Odorization of gas.

(a) A combustible gas in a distribution line must contain a natural odorant or be odorized so that at a concentration in air of one-fifth of the lower explosive limit, the gas is readily detectable by a person with a normal sense of smell.

(b) After December 31, 1976, a combustible gas in a transmission line in a Class 3 or Class 4 location must comply with the requirements of paragraph (a) of this section unless:

(1) At least 50 percent of the length of the line downstream from that location is in a Class 1 or Class 2 location;

(2) The line transports gas to any of the following facilities which received gas without an odorant from that line before May 5, 1975:

(i) An underground storage field;

(ii) A gas processing plant;

(iii) A gas dehydration plant; or

(iv) An industrial plant using gas in a process where the presence of an odorant:

(A) Makes the end product unfit for the purpose for which it is intended;

(B) Reduces the activity of a catalyst; or

(C) Reduces the percentage completion of a chemical reaction;

(3) In the case of a lateral line which transports gas to a distribution center, at least 50 percent of the length of that line is in a Class 1 or Class 2 location; or,

(4) The combustible gas is hydrogen intended for use as a feedstock in a manufacturing process.

(c) In the concentrations in which it is used, the odorant in combustible gases must comply with the following:

(1) The odorant may not be deleterious to persons, materials, or pipe.

(2) The products of combustion from the odorant may not be toxic when breathed nor may they be corrosive or harmful to those materials to which the products of combustion will be exposed.

(d) The odorant may not be soluble in water to an extent greater than 2.5 parts to 100 parts by weight.

(e) Equipment for odorization must introduce the odorant without wide variations in the level of odorant.

(f) To assure the proper concentration of odorant in accordance with this section, each operator must conduct periodic sampling of combustible gases using an instrument capable of determining the percentage of gas in air at which the odor becomes readily detectable. Operators of master meter systems may comply with this requirement by–

(1) Receiving written verification from their gas source that the gas has the proper concentration of odorant; and

(2) Conducting periodic "sniff" tests at the extremities of the system to confirm that the gas contains odorant.

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-2, 35 FR 17335, Nov. 11, 1970; Amdt. 192-6, 36 FR 25423, Dec. 31, 1971; Amdt. 192-7, 37 FR 17970, Sept. 2, 1972; Amdt. 192-14, 38 FR 14943, June 7, 1973; Amdt. 192-15, 38 FR 35471, Dec. 28, 1973; Amdt. 192-16, 39 FR 45253, Dec. 31, 1974; Amdt. 192-21, 40 FR 20279, May 9, 1975; Amdt. 192-58, 53 FR 1633, Jan. 21, 1988; Amdt. 192-76, 61 FR 26121, May 24, 1996; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.627 Tapping pipelines under pressure.

Each tap made on a pipeline under pressure must be performed by a crew qualified to make hot taps.

[Part 192 - Org., Aug. 19, 1970]

§192.629 Purging of pipelines.

(a) When a pipeline is being purged of air by use of gas, the gas must be released into one end of the line in a moderately rapid and continuous flow. If gas cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the gas.

(b) When a pipeline is being purged of gas by use of air, the air must be released into one end of the line in a moderately rapid and continuous flow. If air cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the air.

[Part 192 - Org., Aug. 19, 1970]

§192.631 Control room management.

(a) *General.*

(1) This section applies to each operator of a pipeline facility with a controller working in a control room who monitors and controls all or part of a pipeline facility through a SCADA system. Each operator must have and follow written control room management procedures that implement the requirements of this section, except that for each control room where an operator's activities are limited to either or both of:

(i) Distribution with less than 250,000 services, or

(ii) Transmission without a compressor station, the operator must have and follow written procedures that implement only paragraphs (d) (regarding fatigue), (i) (regarding compliance validation), and (j) (regarding compliance and deviations) of this section.

(2) The procedures required by this section must be integrated, as appropriate, with operating and emergency procedures required by Sec. §192.605 and 192.615. An operator must develop the procedures no later than August 1, 2011, and must implement the procedures according to the following schedule. The procedures required by paragraphs (b), (c)(5), (d)(2) and (d)(3), (f) and (g) of this section must be implemented no later than October 1, 2011. The procedures required by paragraphs (c)(1) through (4), (d)(1), (d)(4), and (e) must be implemented no later than August 1, 2012. The training procedures required by paragraph (h) must be implemented no later than August 1, 2012, except that any training required by another paragraph of this section must be implemented no later than the deadline for that paragraph.

(b) *Roles and responsibilities.* Each operator must define the roles and responsibilities of a controller during normal, abnormal, and emergency operating conditions. To provide for a controller's prompt and appropriate response to operating conditions, an operator must define each of the following:

(1) A controller's authority and responsibility to make decisions and take actions during normal operations;

(2) A controller's role when an abnormal operating condition is detected, even if the controller is not the first to detect the condition, including the controller's responsibility to take specific actions and to communicate with others;

(3) A controller's role during an emergency, even if the controller is not the first to detect the emergency, including the controller's responsibility to take specific actions and to communicate with others; and

(4) A method of recording controller shift-changes and any hand-over of responsibility between controllers.

(c) *Provide adequate information.* Each operator must provide its controllers with the information, tools, processes and procedures necessary for the controllers to carry out the roles and responsibilities the operator has defined by performing each of the following:

(1) Implement sections 1, 4, 8, 9, 11.1, and 11.3 of API RP 1165 (incorporated by reference, see §192.7) whenever a SCADA system is added, expanded or replaced, unless the operator demonstrates that certain provisions of sections 1, 4, 8, 9, 11.1, and 11.3 of API RP 1165 are not practical for the SCADA system used;

(2) Conduct a point-to-point verification between SCADA displays and related field equipment when field equipment is added or moved and when other changes that affect pipeline safety are made to field equipment or SCADA displays;

(3) Test and verify an internal communication plan to provide adequate means for manual operation of the pipeline safely, at least once each calendar year, but at intervals not to exceed 15 months;

(4) Test any backup SCADA systems at least once each calendar year, but at intervals not to exceed 15 months; and

(5) Establish and implement procedures for when a different controller assumes responsibility, including the content of information to be exchanged.

(d) *Fatigue mitigation*. Each operator must implement the following methods to reduce the risk associated with controller fatigue that could inhibit a controller's ability to carry out the roles and responsibilities the operator has defined:

(1) Establish shift lengths and schedule rotations that provide controllers off-duty time sufficient to achieve eight hours of continuous sleep;

(2) Educate controllers and supervisors in fatigue mitigation strategies and how off-duty activities contribute to fatigue;

(3) Train controllers and supervisors to recognize the effects of fatigue; and

(4) Establish a maximum limit on controller hours-of-service, which may provide for an emergency deviation from the maximum limit if necessary for the safe operation of a pipeline facility.

(e) *Alarm management*. Each operator using a SCADA system must have a written alarm management plan to provide for effective controller response to alarms. An operator's plan must include provisions to:

(1) Review SCADA safety-related alarm operations using a process that ensures alarms are accurate and support safe pipeline operations;

(2) Identify at least once each calendar month points affecting safety that have been taken off scan in the SCADA host, have had alarms inhibited, generated false alarms, or that have had forced or manual values for periods of time exceeding that required for associated maintenance or operating activities;

(3) Verify the correct safety-related alarm set-point values and alarm descriptions at least once each calendar year, but at intervals not to exceed 15 months;

(4) Review the alarm management plan required by this paragraph at least once each calendar year, but at intervals not exceeding 15 months, to determine the effectiveness of the plan;

(5) Monitor the content and volume of general activity being directed to and required of each controller at least once each calendar year, but at intervals not to exceed 15 months, that will assure controllers have sufficient time to analyze and react to incoming alarms; and

(6) Address deficiencies identified through the implementation of paragraphs (e)(1) through (e)(5) of this section.

(f) *Change management*. Each operator must assure that changes that could affect control room operations are coordinated with the control room personnel by performing each of the following:

(1) Establish communications between control room representatives, operator's management, and associated field personnel when planning and implementing physical changes to pipeline equipment or configuration;

(2) Require its field personnel to contact the control room when emergency conditions exist and when making field changes that affect control room operations; and

(3) Seek control room or control room management participation in planning prior to implementation of significant pipeline hydraulic or configuration changes.

(g) *Operating experience*. Each operator must assure that lessons learned from its operating experience are incorporated, as appropriate, into its control room management procedures by performing each of the following:

(1) Review incidents that must be reported pursuant to 49 CFR part 191 to determine if control room actions contributed

to the event and, if so, correct, where necessary, deficiencies related to:

(i) Controller fatigue;

(ii) Field equipment;

(iii) The operation of any relief device;

(iv) Procedures;

(v) SCADA system configuration; and

(vi) SCADA system performance.

(2) Include lessons learned from the operator's experience in the training program required by this section.

(h) *Training*. Each operator must establish a controller training program and review the training program content to identify potential improvements at least once each calendar year, but at intervals not to exceed 15 months. An operator's program must provide for training each controller to carry out the roles and responsibilities defined by the operator. In addition, the training program must include the following elements:

(1) Responding to abnormal operating conditions likely to occur simultaneously or in sequence;

(2) Use of a computerized simulator or non-computerized (tabletop) method for training controllers to recognize abnormal operating conditions;

(3) Training controllers on their responsibilities for communication under the operator's emergency response procedures;

(4) Training that will provide a controller a working knowledge of the pipeline system, especially during the development of abnormal operating conditions; and

(5) For pipeline operating setups that are periodically, but infrequently used, providing an opportunity for controllers to review relevant procedures in advance of their application.

(i) *Compliance validation*. Upon request, operators must submit their procedures to PHMSA or, in the case of an intrastate pipeline facility regulated by a State, to the appropriate State agency.

(j) *Compliance and deviations*. An operator must maintain for review during inspection:

(1) Records that demonstrate compliance with the requirements of this section; and

(2) Documentation to demonstrate that any deviation from the procedures required by this section was necessary for the safe operation of a pipeline facility.

[Amdt. 192-112, 74 FR 63310, Dec. 3, 2009 as amended by Amdt. 192-112c, 75 FR 5536, Feb. 3, 2010; Amdt. 192-117, 76 FR35130, June 16, 2011]

Subpart M–Maintenance

§192.701 Scope.

This subpart prescribes minimum requirements for maintenance of pipeline facilities.

[Part 192 - Org., Aug. 19, 1970]

§192.703 General.

(a) No person may operate a segment of pipeline, unless it is maintained in accordance with this subpart.

(b) Each segment of pipeline that becomes unsafe must be replaced, repaired, or removed from service.

(c) Hazardous leaks must be repaired promptly.

[Part 192 - Org., Aug. 19, 1970]

§192.705 Transmission lines: Patrolling.

(a) Each operator shall have a patrol program to observe surface conditions on and adjacent to the transmission line right-of-way for indications of leaks, construction activity, and other factors affecting safety and operation.

(b) The frequency of patrols is determined by the size of the line, the operating pressures, the class location, terrain, weather, and other relevant factors, but intervals between patrols may not be longer than prescribed in the following table:

Class location of line	Maximum interval between patrols	
	At highway and railroad crossings	At all other places
1, 2	7½ months; but at least twice each calendar year.	15 months; but at least once each calendar year.
3	4½ months; but at least four times each calendar year.	7½ months; but at least twice each calendar year.
4	4½ months; but at least four times each calendar year.	4½ months; but at least four times each calendar year.

(c) Methods of patrolling include walking, driving, flying or other appropriate means of traversing the right-of-way.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-21, 40 FR 20283, May 9, 1975; Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; Amdt. 192-78, 61 FR 28770, June 6, 1996]

§192.706 Transmission lines: Leakage surveys.

Leakage surveys of a transmission line must be conducted at intervals not exceeding 15 months, but at least once each calendar year. However, in the case of a transmission line which transports gas in conformity with §192.625 without an odor or odorant, leakage surveys using leak detector equipment must be conducted–

(a) In Class 3 locations, at intervals not exceeding 7½ months, but at least twice each calendar year; and

(b) In Class 4 locations, at intervals not exceeding 4½ months, but at least four times each calendar year.

[Amdt. 192-21, 40 FR 20283, May 9, 1975, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; Amdt. 192-71, 59 FR 6575, Feb. 11, 1994]

§192.707 Line markers for mains and transmission lines.

(a) *Buried pipelines.* Except as provided in paragraph (b) of this section, a line marker must be placed and maintained as close as practical over each buried main and transmission line:

(1) At each crossing of a public road and railroad; and

(2) Wherever necessary to identify the location of the transmission line or main to reduce the possibility of damage or interference.

(b) *Exceptions for buried pipelines.* Line markers are not required for the following pipelines:

(1) Mains and transmission lines located offshore, or at crossings of or under waterways and other bodies of water.

(2) Mains in Class 3 or Class 4 locations where a damage prevention program is in effect under §192.614.

(3) Transmission lines in Class 3 or 4 locations until March 20, 1996.

(4) Transmission lines in Class 3 or 4 locations where placement of a line marker is impractical.

(c) *Pipelines above ground.* Line markers must be placed and maintained along each section of a main and transmission line that is located above ground in an area accessible to the public.

(d) *Marker warning.* The following must be written legibly on a background of sharply contrasting color on each line marker:

(1) The word "Warning," "Caution," or "Danger" followed by the words "Gas (or name of gas transported) Pipeline" all of which, except for markers in heavily developed urban areas, must be in letters at least 1 inch (25 millimeters) high with ¼ inch (6.4 millimeters) stroke.

(2) The name of the operator and telephone number (including area code) where the operator can be reached at all times.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-20, 40 FR 13505, Mar. 27, 1975; Amdt. 192-20A, 41 FR 56808, Dec. 30, 1976; Amdt. 192-27, 41 FR 39752, Aug. 16, 1976; Amdt. 192-40, 47 FR 13818, Apr. 1, 1982; Amdt. 192-44, 48 FR 25206, June 6, 1983; Amdt. 192-73, 60 FR 14646, Mar. 20, 1995; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.709 Transmission lines: Recordkeeping.

Each operator shall maintain the following records for transmission lines for the periods specified:

(a) The date, location, and description of each repair made to pipe (including pipe-to-pipe connections) must be retained for as long as the pipe remains in service.

(b) The date, location, and description of each repair made to parts of the pipeline system other than pipe must be retained for at least 5 years. However, repairs generated by patrols, surveys, inspections, or tests required by subparts L and M of this part must be retained in accordance with paragraph (c) of this section.

(c) A record of each patrol, survey, inspection, and test required by subparts L and M of this part must be retained for at least 5 years or until the next patrol, survey, inspection, or test is completed, whichever is longer.

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-78, 61 FR 28770, June 6, 1996]

§192.711 Transmission lines: General requirements for repair procedures.

(a) *Temporary repairs*. Each operator shall take immediate temporary measures to protect the public whenever:

(1) A leak, imperfection, or damage that impairs its serviceability is found in a segment of steel transmission line operating at or above 40 percent of the SMYS; and

(2) It is not feasible to make a permanent repair at the time of discovery.

(b) *Permanent repairs*. An operator must make permanent repairs on its pipeline system according to the following:

(1) Non integrity management repairs: The operator must make permanent repairs as soon as feasible.

(2) Integrity management repairs: When an operator discovers a condition on a pipeline covered under Subpart O-Gas Transmission Pipeline Integrity Management, the operator must remediate the condition as prescribed by §192.933(d).

(c) *Welded patch*. Except as provided in §192.717(b)(3), no operator may use a welded patch as a means of repair.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27B, 45 FR 3272, Jan. 17, 1980; Amdt. 192-88, 64 FR 69660, Dec. 14, 1999 ; Amdt. 192-114, 74 FR 48593, Aug 11, 2010]

§192.713 Transmission lines: Permanent field repair of imperfections and damages.

(a) Each imperfection or damage that impairs the serviceability of pipe in a steel transmission line operating at or above 40 percent of SMYS must be--

(1) Removed by cutting out and replacing a cylindrical piece of pipe; or

(2) Repaired by a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe.

(b) Operating pressure must be at a safe level during repair operations.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-88, 64 FR 69660, Dec. 14, 1999]

§192.715 Transmission lines: Permanent field repair of welds.

Each weld that is unacceptable under §192.241(c) must be repaired as follows:

(a) If it is feasible to take the segment of transmission line out of service, the weld must be repaired in accordance with the applicable requirements of §192.245.

(b) A weld may be repaired in accordance with §192.245 while the segment of transmission line is in service if:

(1) The weld is not leaking:

(2) The pressure in the segment is reduced so that it does not produce a stress that is more than 20 percent of the SMYS of the pipe; and

(3) Grinding of the defective area can be limited so that at least 1/8-inch (3.2 millimeters) thickness in the pipe weld remains.

(c) A defective weld which cannot be repaired in accordance with paragraph (a) or (b) of this section must be repaired by installing a full encirclement welded split sleeve of appropriate design.

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.717 Transmission lines: Permanent field repair of leaks.

Each permanent field repair of a leak on a transmission line must be made by--

(a) Removing the leak by cutting out and replacing a cylindrical piece of pipe; or

(b) Repairing the leak by one of the following methods:

(1) Install a full encirclement welded split sleeve of appropriate design, unless the transmission line is joined by mechanical couplings and operates at less than 40 percent of SMYS.

(2) If the leak is due to a corrosion pit, install a properly designed bolt-on-leak clamp.

(3) If the leak is due to a corrosion pit and on pipe of not more than 40,000 psi (267 Mpa) SMYS, fillet weld over the pitted area a steel plate patch with rounded corners, of the same or greater thickness than the pipe, and not more than one-half of the diameter of the pipe in size.

(4) If the leak is on a submerged offshore pipeline or submerged pipeline in inland navigable waters, mechanically apply a full encirclement split sleeve of appropriate design.

(5) Apply a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-11, 37 FR 21816, Oct. 14, 1972; Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-88, 64 FR 69660, Dec. 14, 1999]

§192.719 Transmission lines: Testing of repairs.

(a) Testing of replacement pipe. If a segment of transmission line is repaired by cutting out the damaged portion of the pipe as a cylinder, the replacement pipe must be tested to the pressure required for a new line installed in the same location. This test may be made on the pipe before it is installed.

(b) Testing of repairs made by welding. Each repair made by welding in accordance with §§ 192.713, 192.715, and 192.717 must be examined in accordance with §192.241.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-54, 51 FR 41634, Nov. 18, 1986]

§192.721 Distribution systems: Patrolling.

(a) The frequency of patrolling mains must be determined by the severity of the conditions which could cause failure or leakage, and the consequent hazards to public safety.

(b) Mains in places or on structures where anticipated physical movement or external loading could cause failure or leakage must be patrolled–

(1) In business districts, at intervals not exceeding 4½ months, but at least four times each calendar year; and

(2) Outside business districts, at intervals not exceeding 7½ months, but at least twice each calendar year.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; Amdt. 192-78, 61 FR 28770, June 6, 1996]

§192.723 Distribution systems: Leakage surveys.

(a) Each operator of a distribution system shall conduct periodic leakage surveys in accordance with this section.

(b) The type and scope of the leakage control program must be determined by the nature of the operations and the local conditions, but it must meet the following minimum requirements:

(1) A leakage survey with leak detector equipment must be conducted in business districts, including tests of the atmosphere in gas, electric, telephone, sewer, and water system manholes, at cracks in pavement and sidewalks, and at other locations providing an opportunity for finding gas leaks, at intervals not exceeding 15 months, but at least once each calendar year.

(2) A leakage survey with leak detector equipment must be conducted outside business districts as frequently as necessary, but at least once every 5 calendar years at intervals not exceeding 63 months. However, for cathodically unprotected distribution lines subject to §192.465(e) on which electrical surveys for corrosion are impractical, a leakage survey must be conducted at least once every 3 calendar years at intervals not exceeding 39 months.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; Amdt. 192-70, 58 FR 54524, Oct. 22, 1993; Amdt. 192-71, 59 FR 6575, Feb. 11, 1994; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-94A, 69 FR 54591, Sept. 9, 2004]

§192.725 Test requirements for reinstating service lines.

(a) Except as provided in paragraph (b) of this section, each disconnected service line must be tested in the same manner as a new service line, before being reinstated.

(b) Each service line temporarily disconnected from the main must be tested from the point of disconnection to the service line valve in the same manner as a new service line, before reconnecting. However, if provisions are made to maintain continuous service, such as by installation of a bypass, any part of the original service line used to maintain continuous service need not be tested.

[Part 192 - Org., Aug. 19, 1970]

§192.727 Abandonment or deactivation of facilities.

(a) Each operator shall conduct abandonment or deactivation of pipelines in accordance with the requirements of this section.

(b) Each pipeline abandoned in place must be disconnected from all sources and supplies of gas; purged of gas; in the case of offshore pipelines, filled with water or inert materials; and sealed at the ends. However, the pipeline need not be purged when the volume of gas is so small that there is no potential hazard.

(c) Except for service lines, each inactive pipeline that is not being maintained under this part must be disconnected from all sources and supplies of gas; purged of gas; in the case of offshore pipelines, filled with water or inert materials; and sealed at the ends. However, the pipeline need not be purged when the volume of gas is so small that there is no potential hazard.

(d) Whenever service to a customer is discontinued, one of the following must be complied with:

(1) The valve that is closed to prevent the flow of gas to the customer must be provided with a locking device or other means designed to prevent the opening of the valve by persons other than those authorized by the operator.

(2) A mechanical device or fitting that will prevent the flow of gas must be installed in the service line or in the meter assembly.

(3) The customer's piping must be physically disconnected from the gas supply and the open pipe ends sealed.

(e) If air is used for purging, the operator shall insure that a combustible mixture is not present after purging.

(f) Each abandoned vault must be filled with a suitable compacted material.

(g) For each abandoned offshore pipeline facility or each abandoned onshore pipeline facility that crosses over, under or through a commercially navigable waterway, the last operator of that facility must file a report upon abandonment of that facility.

(1) The preferred method to submit data on pipeline facilities abandoned after October 10, 2000 is to the National Pipeline Mapping System (NPMS) in accordance with the NPMS "Standards for Pipeline and Liquefied Natural Gas Operator Submissions." To obtain a copy of the NPMS Standards, please refer to the NPMS homepage at www.npms.PHMSA.dot.gov or contact the NPMS National Repository at 703-317-3073. A digital data format is preferred, but hard copy submissions are acceptable if they comply with the NPMS Standards. In addition to the NPMS-required attributes, operators must submit the date of abandonment, diameter, method of abandonment, and certification that, to the best of the operator's knowledge, all of the reasonably available information requested was provided and, to the best of the operator's knowledge, the abandonment was completed in accordance with applicable laws. Refer to the NPMS Standards for details in preparing your data for submission. The NPMS Standards also include details of how to submit data. Alternatively, operators may submit reports by mail, fax or e-mail to the Office of Pipeline Safety, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, Information Resources Manager, PHP-10, 1200 New Jersey Avenue, SE., Washington, DC 20590-0001; fax (202) 366-4566; e-mail *InformationResourcesManager@PHMSA.dot.gov*. The information in the report must contain all reasonably available information related to the facility, including information in the possession of a third party. The report must contain the location, size, date, method of abandonment, and a certification that the facility has been abandoned in accordance with all applicable laws.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-8, 37 FR 20694, Oct. 3, 1972, Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-71, 59 FR 6575, Feb. 11, 1994; Amdt. 192-89, 65 FR 54440, Sept. 8, 2000; Amdt. 192-89A, 65 FR 57861, Sept. 26, 2000; 70 FR 11135, Mar. 8, 2005; Amdt. 192-103c, 72 FR 4655, Feb. 1, 2007; Amdt. 192-[106], 73 FR 16562, Mar. 28, 2008; Amdt. 192-[109], 74 FR 2889, January 16, 2009.]

§192.729 [Removed]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-71, 59 FR 6575, Feb. 11, 1994]

§192.731 Compressor stations: Inspection and testing of relief devices.

(a) Except for rupture discs, each pressure relieving device in a compressor station must be inspected and tested in accordance with §§ 192.739 and 192.743, and must be operated periodically to determine that it opens at the correct set pressure.

(b) Any defective or inadequate equipment found must be promptly repaired or replaced.

(c) Each remote control shutdown device must be inspected and tested at intervals not exceeding 15 months, but at least once each calendar year, to determine that it functions properly.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982]

§192.733 [Removed]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-71, 59 FR 6575, Feb. 11, 1994]

§192.735 Compressor stations: Storage of combustible materials.

(a) Flammable or combustible materials in quantities beyond those required for everyday use, or other than those normally used in compressor buildings, must be stored a safe distance from the compressor building.

(b) Above ground oil or gasoline storage tanks must be protected in accordance with National Fire Protection Association Standard No. 30 NFPA-30 (incorporated by reference, *see* §192.7).

[Part 192 - Org., Aug. 19, 1970; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.736 Compressor stations: Gas detection.

(a) Not later than September 16, 1996, each compressor building in a compressor station must have a fixed gas detection and alarm system, unless the building is–

(1) Constructed so that at least 50 percent of its upright side area is permanently open; or

(2) Located in an unattended field compressor station of 1,000 horsepower (746 kilowatts) or less.

(b) Except when shutdown of the system is necessary for maintenance under paragraph (c) of this section, each gas detection and alarm system required by this section must–

(1) Continuously monitor the compressor building for a concentration of gas in air of not more than 25 percent of the lower explosive limit; and

(2) If that concentration of gas is detected, warn persons about to enter the building and persons inside the building of the danger.

(c) Each gas detection and alarm system required by this section must be maintained to function properly. The maintenance must include performance tests.

[Amdt. 192-69, 58 FR 48460, Sept. 16, 1993 as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.737 [Removed]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-71, 59 FR 6575, Feb. 11, 1994]

§192.739 Pressure limiting and regulating stations: Inspection and testing.

(a) Each pressure limiting station, relief device (except rupture discs), and pressure regulating station and its equipment must be subjected at intervals not exceeding 15 months, but at least once each calendar year, to inspections and tests to determine that it is–

(1) In good mechanical condition;

(2) Adequate from the standpoint of capacity and reliability of operation for the service in which it is employed;

(3) Except as provided in paragraph (b) of this section, set to control or relieve at the correct pressure consistent with the pressure limits of §192.201(a); and

(4) Properly installed and protected from dirt, liquids, or other conditions that might prevent proper operation.

(b) For steel pipelines whose MAOP is determined under §192.619(c), if the MAOP is 60 psi (414 kPa) gage or more, the control or relief pressure limit is as follows:

If the MAOP produces a hoop stress that is:	Then the pressure limit is:
Greater than 72 percent of SMYS	MAOP plus 4 percent.
Unknown as a percentage of SMYS	A pressure that will prevent unsafe operation of the pipeline considering its operating and maintenance history and MAOP.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003; Amdt. 192-96, 69 FR 27861, May 17, 2004]

§192.741 Pressure limiting and regulating stations: Telemetering or recording gauges.

(a) Each distribution system supplied by more than one district pressure regulating station must be equipped with telemetering or recording pressure gauges to indicate the gas pressure in the district.

(b) On distribution systems supplied by a single district pressure regulating station, the operator shall determine the necessity of installing telemetering or recording gauges in the district, taking into consideration the number of customers supplied, the operating pressures, the capacity of the installation, and other operating conditions.

(c) If there are indications of abnormally high- or low-pressure, the regulator and the auxiliary equipment must be inspected and the necessary measures employed to correct any unsatisfactory operating conditions.

[Part 192 - Org., Aug. 19, 1970]

§192.743 Pressure limiting and regulating stations: Capacity of relief devices.

(a) Pressure relief devices at pressure limiting stations and pressure regulating stations must have sufficient capacity to protect the facilities to which they are connected. Except as provided in §192.739(b), the capacity must be consistent with the pressure limits of §192.201(a). This capacity must be determined at intervals not exceeding 15 months, but at least once each calendar year, by testing the devices in place or by review and calculations.

(b) If review and calculations are used to determine if a device has sufficient capacity, the calculated capacity must be compared with the rated or experimentally determined relieving capacity of the device for the conditions under which it operates. After the initial calculations, subsequent calculations need not be made if the annual review documents that parameters have not changed to cause the rated or experimentally determined relieving capacity to be insufficient.

(c) If a relief device is of insufficient capacity, a new or additional device must be installed to provide the capacity required by paragraph (a) of this section.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; and Amdt. 192-55, 51 FR 41633. Nov. 18, 1986; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003; Amdt. 192-96, 69 FR 27861, May 17, 2004]

§192.745 Valve maintenance: Transmission lines.

(a) Each transmission line valve that might be required during any emergency must be inspected and partially operated at intervals not exceeding 15 months, but at least once each calendar year.

(b) Each operator must take prompt remedial action to correct any valve found inoperable, unless the operator designates an alternative valve.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.747 Valve maintenance: Distribution systems.

(a) Each valve, the use of which may be necessary for the safe operation of a distribution system, must be checked and serviced at intervals not exceeding 15 months, but at least once each calendar year.

(b) Each operator must take prompt remedial action to correct any valve found inoperable, unless the operator designates an alternative valve.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.749 Vault maintenance.

(a) Each vault housing pressure regulating and pressure limiting equipment, and having a volumetric internal content of 200 cubic feet (5.66 cubic meters) or more, must be inspected at intervals not exceeding 15 months, but at least once each calendar year, to determine that it is in good physical condition and adequately ventilated.

(b) If gas is found in the vault, the equipment in the vault must be inspected for leaks, and any leaks found must be repaired.

(c) The ventilating equipment must also be inspected to determine that it is functioning properly.

(d) Each vault cover must be inspected to assure that it does not present a hazard to public safety.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; Amdt. 192-85, 63 FR 37500, July 13, 1998]

§192.751 Prevention of accidental ignition.

Each operator shall take steps to minimize the danger of accidental ignition of gas in any structure or area where the presence of gas constitutes a hazard of fire or explosion, including the following:

(a) When a hazardous amount of gas is being vented into open air, each potential source of ignition must be removed from the area and a fire extinguisher must be provided.

(b) Gas or electric welding or cutting may not be performed on pipe or on pipe components that contain a combustible mixture of gas and air in the area of work.

(c) Post warning signs, where appropriate.

[Part 192 - Org., Aug. 19, 1970]

§192.753 Caulked bell and spigot joints.

(a) Each cast iron caulked bell and spigot joint that is subject to pressures of more than 25 psi (172kPa) gage must be sealed with:

(1) A mechanical leak clamp; or

(2) A material or device which:

(i) Does not reduce the flexibility of the joint;

(ii) Permanently bonds, either chemically or mechanically, or both, with the bell and spigot metal surfaces or adjacent pipe metal surfaces; and,

(iii) Seals and bonds in a manner that meets the strength, environmental, and chemical compatibility requirements of §§ 192.53(a) and (b) and 192.143.

(b) Each cast iron caulked bell and spigot joint that is subject to pressures of 25 psi (172kPa) gage or less and is exposed for any reason must be sealed by a means other than caulking.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-43, 47 FR 46850, Oct. 21, 1982; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-93, 68 FR 53895, Sept. 15, 2003]

§192.755 Protecting cast-iron pipelines.

When an operator has knowledge that the support for a segment of a buried cast-iron pipeline is disturbed:

(a) That segment of the pipeline must be protected, as necessary, against damage during the disturbance by:

(1) Vibrations from heavy construction equipment, trains, trucks, buses, or blasting;

(2) Impact forces by vehicles;

(3) Earth movement;

(4) Apparent future excavations near the pipeline; or

(5) Other foreseeable outside forces which may subject that segment of the pipeline to bending stress.

(b) As soon as feasible, appropriate steps must be taken to provide permanent protection for the disturbed segment from damage that might result from external loads, including compliance with applicable requirements of §§ 192.317(a), 192.319, and 192.361 (b)–(d).

[Amdt. 192-23, 41 FR 13589, Mar. 31, 1976]

§192.761 [Removed]

[Amdt. 192-90, 67 FR 50824, Aug. 6, 2002 as amended by Amdt. 192-95, 16 FR 69778, Dec. 15, 2003]

Subpart N–Qualification of Pipeline Personnel

§192.801 Scope.

(a) This subpart prescribes the minimum requirements for operator qualification of individuals performing covered tasks on a pipeline facility.

(b) For the purpose of this subpart, a covered task is an activity, identified by the operator, that:

(1) Is performed on a pipeline facility;

(2) Is an operations or maintenance task;

(3) Is performed as a requirement of this part; and

(4) Affects the operation or integrity of the pipeline.

[Amdt. 192-86, 64 FR 46853, Aug. 27, 1999]

§192.803 Definitions.

Abnormal operating condition means a condition identified by the operator that may indicate a malfunction of a component or deviation from normal operations that may:

(a) Indicate a condition exceeding design limits; or

(b) Result in a hazard(s) to persons, property, or the environment.

Evaluation means a process, established and documented by the operator, to determine an individual's ability to perform a covered task by any of the following:

(a) Written examination;

(b) Oral examination;

(c) Work performance history review;

(d) Observation during:

(1) Performance on the job,

(2) On the job training, or

(3) Simulations;

(e) Other forms of assessment.

Qualified means that an individual has been evaluated and can:

(a) Perform assigned covered tasks; and

(b) Recognize and react to abnormal operating conditions.

[Amdt. 192-86, 64 FR 46853, Aug. 27, 1999 as amended by Amdt. 192-86A, 66 FR 43523, Aug. 20, 2001]

§192.805 Qualification program.

Each operator shall have and follow a written qualification program. The program shall include provisions to:

(a) Identify covered tasks;

(b) Ensure through evaluation that individuals performing covered tasks are qualified;

(c) Allow individuals that are not qualified pursuant to this subpart to perform a covered task if directed and observed by an individual that is qualified;

(d) Evaluate an individual if the operator has reason to believe that the individual's performance of a covered task contributed to an incident as defined in Part 191;

(e) Evaluate an individual if the operator has reason to believe that the individual is no longer qualified to perform a covered task;

(f) Communicate changes that affect covered tasks to individuals performing those covered tasks;

(g) Identify those covered tasks and the intervals at which evaluation of the individual's qualifications is needed;

(h) After December 16, 2004, provide training, as appropriate, to ensure that individuals performing covered tasks have the necessary knowledge and skills to perform the tasks in a manner that ensures the safe operation of pipeline facilities; and

(i) After December 16, 2004, notify the Administrator or a state agency participating under 49 U.S.C. Chapter 601 if the operator significantly modifies the program after the Aadministrator or state agency has verified that it complies with this section. Notifications to PHMSA may be submitted by electronic mail to *InformationResourcesManager@dot.gov*, or by mail to ATTN: Information Resources Manager DOT/PHMSA/OPS, East Building, 2nd Floor, E22–321, New Jersey Avenue SE., Washington, DC 20590.

[Amdt. 192-86, 64 FR 46853, Aug. 27, 1999 as amended by Amdt. 192-100, 70 FR 10322, Mar. 3, 2005; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.807 Recordkeeping.

Each operator shall maintain records that demonstrate compliance with this subpart.

(a) Qualification records shall include:

(1) Identification of qualified individual(s);

(2) Identification of the covered tasks the individual is qualified to perform;

(3) Date(s) of current qualification; and

(4) Qualification method(s).

(b) Records supporting an individual's current qualification shall be maintained while the individual is performing the covered task. Records of prior qualification and records of individuals no longer performing covered tasks shall be retained for a period of five years.

[Amdt. 192-86, 64 FR 46853, Aug. 27, 1999]

§192.809 General.

(a) Operators must have a written qualification program by April 27, 2001. The program must be available for review by the Administrator or by a state agency participating under 49 U.S.C. Chapter 601 if the program is under the authority of that state agency.

(b) Operators must complete the qualification of individuals performing covered tasks by October 28, 2002.

(c) Work performance history review may be used as a sole evaluation method for individuals who were performing a covered task prior to October 26, 1999.

(d) After October 28, 2002, work performance history may not be used as a sole evaluation method.

(e) After December 16, 2004, observation of on-the-job performance may not be used as the sole method of evaluation.

[Amdt. 192-86, 64 FR 46853, Aug. 27, 1999 as amended by Amdt. 192-86A, 66 FR 43523, Aug. 20, 2001; Amdt. 192-100, 70 FR 10322, Mar. 3, 2005]

Subpart O—Gas Transmission Pipeline Integrity Management

§192.901 What do the regulations in this subpart cover?

This subpart prescribes minimum requirements for an integrity management program on any gas transmission pipeline covered under this part. For gas transmission pipelines constructed of plastic, only the requirements in §§ 192.917, 192.921, 192.935 and 192.937 apply.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003]

§192.903 What definitions apply to this subpart?

The following definitions apply to this subpart:

Assessment is the use of testing techniques as allowed in this subpart to ascertain the condition of a covered pipeline segment.

Confirmatory direct assessment is an integrity assessment method using more focused application of the principles and techniques of direct assessment to identify internal and external corrosion in a covered transmission pipeline segment.

Covered segment or covered pipeline segment means a segment of gas transmission pipeline located in a high consequence area. The terms gas and transmission line are defined in §192.3.

Direct assessment is an integrity assessment method that utilizes a process to evaluate certain threats (i.e., external corrosion, internal corrosion and stress corrosion cracking) to a covered pipeline segment's integrity. The process includes the gathering and integration of risk factor data, indirect examination or analysis to identify areas of suspected corrosion, direct examination of the pipeline in these areas, and post assessment evaluation.

High consequence area means an area established by one of the methods described in paragraphs (1) or (2) as follows:

(1) An area defined as—

(i) A Class 3 location under §192.5; or

(ii) A Class 4 location under §192.5; or

(iii) Any area in a Class 1 or Class 2 location where the potential impact radius is greater than 660 feet (200 meters), and the area within a potential impact circle contains 20 or more buildings intended for human occupancy; or

(iv) Any area in a Class 1 or Class 2 location where the potential impact circle contains an identified site.

(2) The area within a potential impact circle containing—

(i) 20 or more buildings intended for human occupancy, unless the exception in paragraph (4) applies; or

(ii) An identified site.

(3) Where a potential impact circle is calculated under either method (1) or (2) to establish a high consequence area, the length of the high consequence area extends axially along the length of the pipeline from the outermost edge of the first potential impact circle that contains either an identified site or 20 or more buildings intended for human occupancy to the outermost edge of the last contiguous potential impact circle that contains either an identified site or 20 or more buildings intended for human occupancy. (See Figure E.I.A. in appendix E.)

(4) If in identifying a high consequence area under paragraph (1)(iii) of this defini-

tion or paragraph (2)(i) of this definition, the radius of the potential impact circle is greater than 660 feet (200 meters), the operator may identify a high consequence area based on a prorated number of buildings intended for human occupancy within a distance 660 feet (200 meters) from the centerline of the pipeline until December 17, 2006. If an operator chooses this approach, the operator must prorate the number of buildings intended for human occupancy based on the ratio of an area with a radius of 660 feet (200 meters) to the area of the potential impact circle (*i.e.*, the prorated number of buildings intended for human occupancy is equal to [20 x (660 feet [or 200 meters]/potential impact radius in feet [or meters])^2]).

Identified site means each of the following areas:

(a) An outside area or open structure that is occupied by twenty (20) or more persons on at least 50 days in any twelve (12)-month period. (The days need not be consecutive.) Examples include but are not limited to, beaches, playgrounds, recreational facilities, camping grounds, outdoor theaters, stadiums, recreational areas near a body of water, or areas outside a rural building such as a religious facility); or

(b) A building that is occupied by twenty (20) or more persons on at least five (5) days a week for ten (10) weeks in any twelve (12)-month period. (The days and weeks need not be consecutive.) Examples include, but are not limited to, religious facilities, office buildings, community centers, general stores, 4-H facilities, or roller skating rinks); or

(c) A facility occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate. Examples include but are not limited to hospitals, prisons, schools, day-care facilities, retirement facilities or assisted-living facilities.

Potential impact circle is a circle of radius equal to the potential impact radius (PIR).

Potential impact radius (PIR) means the radius of a circle within which the potential failure of a pipeline could have significant impact on people or property. PIR is determined by the formula r = 0.69* (square root of ($p*d^2$)), where `r' is the radius of a circular area in feet surrounding the point of failure, `p' is the maximum allowable operating pressure (MAOP) in the pipeline segment in pounds per square inch and `d' is the nominal diameter of the pipeline in inches.

Note: 0.69 is the factor for natural gas. This number will vary for other gases depending upon their heat of combustion. An operator transporting gas other than natural gas must use section 3.2 of ASME/ANSI B31.8S–2001 (Supplement to ASME B31.8; incorporated by reference, see § 192.7) (incorporated by reference, *see* § 192.7) to calculate the impact radius formula.

Remediation is a repair or mitigation activity an operator takes on a covered segment to limit or reduce the probability of an undesired event occurring or the expected consequences from the event.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-95C, 69 FR 29903, May 26, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-103c, 72 FR 4655, Feb. 1, 2007; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.905 How does an operator identify a high consequence area?

(a) *General.* To determine which segments of an operator's transmission pipeline system are covered by this subpart, an operator must identify the high consequence areas. An operator must use method (1) or (2) from the definition in §192.903 to identify a high consequence area. An operator may apply one method to its entire pipeline system, or an operator may apply one method to individual portions of the pipeline system. An operator must describe in its integrity management program which method it is applying to each portion of the operator's pipeline system. The description must include the potential impact radius when utilized to establish a high consequence area. (*See* appendix E.I. for guidance on identifying high consequence areas.)

(b)(1) *Identified sites.* An operator must identify an identified site, for purposes of this subpart, from information the operator has obtained from routine operation and maintenance activities and from public officials with safety or emergency response or planning responsibilities who indicate to the operator that they know of locations that meet the identified site criteria. These public officials could include officials on a local emergency planning commission or relevant Native American tribal officials.

(2) If a public official with safety or emergency response or planning responsibilities informs an operator that it does not have the information to identify an identified site, the operator must use one of the following sources, as appropriate, to identify these sites.

(i) Visible marking (*e.g.*, a sign); or

(ii) The site is licensed or registered by a Federal, State, or local government agency; or

(iii) The site is on a list (including a list on an internet web site) or map maintained by or available from a Federal, State, or local government agency and available to the general public.

(c) *Newly identified areas.* When an operator has information that the area around a pipeline segment not previously identified as a high consequence area could satisfy any of the definitions in §192.903, the operator must complete the evaluation using method (1) or (2). If the segment is determined to meet the definition as a high consequence area, it must be incorporated into the operator's baseline assessment plan as a high consequence area within one year from the date the area is identified.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003]

§192.907 What must an operator do to implement this subpart?

(a) *General.* No later than December 17, 2004, an operator of a covered pipeline segment must develop and follow a written integrity management program that contains all the elements described in §192.911 and that addresses the risks on each covered transmission pipeline segment. The initial integrity management program must consist, at a minimum, of a framework that describes the process for implementing each program element, how relevant decisions will be made and by whom, a time line for completing the work to implement the program element, and how information gained from experience will be continuously incorporated into the program. The framework will evolve into a more detailed and comprehensive program. An operator must make continual improvements to the program.

(b) *Implementation Standards.* In carrying out this subpart, an operator must follow the requirements of this subpart and of ASME/ANSI B31.8S (incorporated by reference, *see* §192.7) and its appendices, where specified. An operator may follow an equivalent standard or practice only when the operator demonstrates the alternative standard or practice provides an equivalent level of safety to the public and property. In the event of a conflict between this subpart and ASME/ANSI B31.8S, the requirements in this subpart control.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-103, 71 FR 33402, June 8, 2006]

§192.909 How can an operator change its integrity management program?

(a) *General.* An operator must document any change to its program and the reasons for the change before implementing the change.

(b) *Notification.* An operator must notify OPS, in accordance with §192.949, of any change to the program that may substantially affect the program's implementation or may significantly modify the program or schedule for carrying out the program elements. An operator must also notify a State or local pipeline safety authority when either a covered segment is located in a State where OPS has an interstate agent agreement, or an intrastate covered segment is regulated by that State. An operator must provide the notification within 30 days after adopting this type of change into its program.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004]

§192.911 What are the elements of an integrity management program?

An operator's initial integrity management program begins with a framework (*see* §192.907) and evolves into a more detailed and comprehensive integrity management program, as information is gained and incorporated into the program. An operator must make continual improvements to its program. The initial program framework and subsequent program must, at minimum, contain the following elements. (When indicated, refer to ASME/ANSI B31.8S (incorporated by reference, *see* §192.7) for more detailed information on the listed element.)

(a) An identification of all high consequence areas, in accordance with §192.905.

(b) A baseline assessment plan meeting the requirements of §192.919 and §192.921.

(c) An identification of threats to each covered pipeline segment, which must include data integration and a risk assessment. An operator must use the threat identification and risk assessment to prioritize covered segments for assessment (§192.917) and to evaluate the merits of additional preventive and mitigative measures (§192.935) for each covered segment.

(d) A direct assessment plan, if applicable, meeting the requirements of §192.923, and depending on the threat assessed, of §§ 192.925, 192.927, or 192.929.

(e) Provisions meeting the requirements of §192.933 for remediating conditions found during an integrity assessment.

(f) A process for continual evaluation and assessment meeting the requirements of §192.937.

(g) If applicable, a plan for confirmatory direct assessment meeting the requirements of §192.931.

(h) Provisions meeting the requirements of §192.935 for adding preventive and mitigative measures to protect the high consequence area.

(i) A performance plan as outlined in ASME/ANSI B31.8S, section 9 that includes performance measures meeting the requirements of §192.945.

(j) Record keeping provisions meeting the requirements of §192.947.

(k) A management of change process as outlined in ASME/ANSI B31.8S, section 11.

(l) A quality assurance process as outlined in ASME/ANSI B31.8S, section 12.

(m) A communication plan that includes the elements of ASME/ANSI B31.8S, section 10, and that includes procedures for addressing safety concerns raised by—

(1) OPS; and

(2) A State or local pipeline safety authority when a covered segment is located in a State where OPS has an interstate agent agreement.

(n) Procedures for providing (when requested), by electronic or other means, a copy of the operator's risk analysis or integrity management program to—

(1) OPS; and

(2) A State or local pipeline safety authority when a covered segment is located in a State where OPS has an interstate agent agreement.

(o) Procedures for ensuring that each integrity assessment is being conducted in a manner that minimizes environmental and safety risks.

(p) A process for identification and assessment of newly-identified high consequence areas. (See §192.905 and §192.921.)

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006]

§192.913 When may an operator deviate its program from certain requirements of this subpart?

(a) *General.* ASME/ANSI B31.8S (incorporated by reference, *see* §192.7) provides the essential features of a performance-based or a prescriptive integrity management program. An operator that uses a performance-based approach that satisfies the requirements for exceptional performance in paragraph (b) of this section may deviate from certain requirements in this subpart, as provided in paragraph (c) of this section.

(b) *Exceptional performance.* An operator must be able to demonstrate the exceptional performance of its integrity management program through the following actions.

(1) To deviate from any of the requirements set forth in paragraph (c) of this section, an operator must have a performance-based integrity management program that meets or exceed the performance-based requirements of ASME/ANSI B31.8S and includes, at a minimum, the following elements—

(i) A comprehensive process for risk analysis;

(ii) All risk factor data used to support the program;

(iii) A comprehensive data integration process;

(iv) A procedure for applying lessons learned from assessment of covered pipeline segments to pipeline segments not covered by this subpart;

(v) A procedure for evaluating every incident, including its cause, within the operator's sector of the pipeline industry for implications both to the operator's pipeline system and to the operator's integrity management program;

(vi) A performance matrix that demonstrates the program has been effective in ensuring the integrity of the covered segments by controlling the identified threats to the covered segments;

(vii) Semi-annual performance measures beyond those required in §192.945 that are part of the operator's performance plan. (See §192.911(i).) An operator must submit these measures, by electronic or other means, on a semi-annual frequency to OPS in accordance with §192.951; and

(viii) An analysis that supports the desired integrity reassessment interval and the remediation methods to be used for all covered segments.

(2) In addition to the requirements for the performance-based plan, an operator must—

(i) Have completed at least two integrity assessments on each covered pipeline segment the operator is including under the performance-based approach, and be able to demonstrate that each assessment effectively addressed the identified threats on the covered segment.

(ii) Remediate all anomalies identified in the more recent assessment according to the requirements in §192.933, and incorporate the results and lessons learned from the more recent assessment into the operator's data integration and risk assessment.

(c) *Deviation.* Once an operator has demonstrated that it has satisfied the requirements of paragraph (b) of this section, the operator may deviate from the prescriptive requirements of ASME/ANSI B31.8S and of this subpart only in the following instances.

(1) The time frame for reassessment as provided in §192.939 except that reassessment by some method allowed under this subpart (e.g., confirmatory direct assessment) must be carried out at intervals no longer than seven years;

(2) The time frame for remediation as provided in §192.933 if the operator demonstrates the time frame will not jeopardize the safety of the covered segment.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006]

§192.915 What knowledge and training must personnel have to carry out an integrity management program?

(a) *Supervisory personnel.* The integrity management program must provide that each supervisor whose responsibilities relate to the integrity management program possesses and maintains a thorough knowledge of the integrity management program and of the elements for which the supervisor is responsible. The program must provide that any person who qualifies as a supervisor for the integrity management program has appropriate training or experience in the area for which the person is responsible.

(b) *Persons who carry out assessments and evaluate assessment results.* The integrity management program must provide criteria for the qualification of any person—

(1) Who conducts an integrity assessment allowed under this subpart; or

(2) Who reviews and analyzes the results from an integrity assessment and evaluation; or

(3) Who makes decisions on actions to be taken based on these assessments.

(c) *Persons responsible for preventive and mitigative measures.* The integrity management program must provide criteria for the qualification of any person—

(1) Who implements preventive and mitigative measures to carry out this subpart, including the marking and locating of buried structures; or

(2) Who directly supervises excavation work carried out in conjunction with an integrity assessment.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003]

§192.917 How does an operator identify potential threats to pipeline integrity and use the threat identification in its integrity program?

(a) *Threat identification.* An operator must identify and evaluate all potential threats to each covered pipeline segment. Potential threats that an operator must consider include, but are not limited to, the threats listed in ASME/ANSI B31.8S (incorporated by reference, *see* §192.7), section 2, which are grouped under the following four categories:

(1) Time dependent threats such as internal corrosion, external corrosion, and stress corrosion cracking;

(2) Static or resident threats, such as fabrication or construction defects;

(3) Time independent threats such as third party damage and outside force damage; and

(4) Human error.

(b) *Data gathering and integration.* To identify and evaluate the potential threats to a covered pipeline segment, an operator must gather and integrate existing data and information on the entire pipeline that could be relevant to the covered segment. In performing this data gathering and integration, an operator must follow the requirements in ASME/ANSI B31.8S, section 4. At a minimum, an operator must gather and evaluate the set of data specified in Appendix A to ASME/ANSI B31.8S, and consider both on the covered segment and similar non-covered segments, past incident history, corrosion control records, continuing surveillance records, patrolling records, maintenance history, internal inspection records and all other conditions specific to each pipeline.

(c) *Risk assessment.* An operator must conduct a risk assessment that follows ASME/ANSI B31.8S, section 5, and considers the identified threats for each covered segment. An operator must use the risk assessment to prioritize the covered segments for the baseline and continual reassessments (§§ 192.919, 192.921, 192.937), and to determine what additional preventive and mitigative measures are needed (§192.935) for the covered segment.

(d) *Plastic transmission pipeline.* An operator of a plastic transmission pipeline must assess the threats to each covered segment using the information in sections 4 and 5 of ASME B31.8S, and consider any threats unique to the integrity of plastic pipe.

(e) *Actions to address particular threats*. If an operator identifies any of the following threats, the operator must take the following actions to address the threat.

(1) *Third party damage.* An operator must utilize the data integration required in paragraph (b) of this section and ASME/ANSI B31.8S, Appendix A7 to determine the susceptibility of each covered segment to the threat of third party damage. If an operator identifies the threat of third party damage, the operator must implement comprehensive additional preventive measures in accordance with §192.935 and monitor the effectiveness of the preventive measures. If, in conducting a baseline assessment under §192.921, or a reassessment under §192.937, an operator uses an internal inspection tool or external corrosion direct assessment, the operator must integrate data from these assessments with data related to any encroachment or foreign line crossing on the covered segment, to define where

potential indications of third party damage may exist in the covered segment.

An operator must also have procedures in its integrity management program addressing actions it will take to respond to findings from this data integration.

(2) *Cyclic fatigue.* An operator must evaluate whether cyclic fatigue or other loading condition (including ground movement, suspension bridge condition) could lead to a failure of a deformation, including a dent or gouge, or other defect in the covered segment. An evaluation must assume the presence of threats in the covered segment that could be exacerbated by cyclic fatigue. An operator must use the results from the evaluation together with the criteria used to evaluate the significance of this threat to the covered segment to prioritize the integrity baseline assessment or reassessment.

(3) *Manufacturing and construction defects.* If an operator identifies the threat of manufacturing and construction defects (including seam defects) in the covered segment, an operator must analyze the covered segment to determine the risk of failure from these defects. The analysis must consider the results of prior assessments on the covered segment. An operator may consider manufacturing and construction related defects to be stable defects if the operating pressure on the covered segment has not increased over the maximum operating pressure experienced during the five years preceding identification of the high consequence area. If any of the following changes occur in the covered segment, an operator must prioritize the covered segment as a high risk segment for the baseline assessment or a subsequent reassessment.

(i) Operating pressure increases above the maximum operating pressure experienced during the preceding five years;

(ii) MAOP increases; or

(iii) The stresses leading to cyclic fatigue increase.

(4) *ERW pipe.* If a covered pipeline segment contains low frequency electric resistance welded pipe (ERW), lap welded pipe or other pipe that satisfies the conditions specified in ASME/ANSI B31.8S, Appendices A4.3 and A4.4, and any covered or noncovered segment in the pipeline system with such pipe has experienced seam failure, or operating pressure on the covered segment has increased over the maximum operating pressure experienced during the preceding five years, an operator must select an assessment technology or technologies with a proven application capable of assessing seam integrity and seam corrosion anomalies. The operator must prioritize the covered segment as a high risk segment for the baseline assessment or a subsequent reassessment.

(5) *Corrosion.* If an operator identifies corrosion on a covered pipeline segment that could adversely affect the integrity of the line (conditions specified in §192.933), the operator must evaluate and remediate, as necessary, all pipeline segments (both covered and non-covered) with similar material coating and environmental characteristics. An operator must establish a schedule for evaluating and remediating, as necessary, the similar segments that is consistent with the operator's established operating and maintenance procedures under part 192 for testing and repair.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006]

§192.919 What must be in the baseline assessment plan?

An operator must include each of the following elements in its written baseline assessment plan:

(a) Identification of the potential threats to each covered pipeline segment and the information supporting the threat identification. (See §192.917.);

(b) The methods selected to assess the integrity of the line pipe, including an explanation of why the assessment method was selected to address the identified threats to each covered segment. The integrity assessment method an operator uses must be based on the threats identified to the covered segment. (See §192.917.) More than one method may be required to address all the threats to the covered pipeline segment;

(c) A schedule for completing the integrity assessment of all covered segments, including risk factors considered in establishing the assessment schedule;

(d) If applicable, a direct assessment plan that meets the requirements of §§ 192.923, and depending on the threat to be addressed, of §192.925, §192.927, or §192.929; and

(e) A procedure to ensure that the baseline assessment is being conducted in a manner that minimizes environmental and safety risks.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003]

§192.921 How is the baseline assessment to be conducted?

(a) *Assessment methods.* An operator must assess the integrity of the line pipe in each covered segment by applying one or more of the following methods depending on the threats to which the covered segment is susceptible. An operator must select the method or methods best suited to address the threats identified to the covered segment (See §192.917).

(1) Internal inspection tool or tools capable of detecting corrosion, and any other threats to which the covered segment is susceptible. An operator must follow ASME/ANSI B31.8S (incorporated by reference, *see* §192.7), section 6.2 in selecting the appropriate internal inspection tools for the covered segment.

(2) Pressure test conducted in accordance with subpart J of this part. An operator must use the test pressures specified in Table 3 of section 5 of ASME/ANSI B31.8S, to justify an extended reassessment interval in accordance with §192.939.

(3) Direct assessment to address threats of external corrosion, internal corrosion, and stress corrosion cracking. An operator must conduct the direct assessment in accordance with the requirements listed in §192.923 and with, as applicable, the requirements specified in §§ 192.925, 192.927 or 192.929;

(4) Other technology that an operator demonstrates can provide an equivalent understanding of the condition of the line pipe. An operator choosing this option must notify the Office of Pipeline Safety (OPS) 180 days before conducting the assessment, in accordance with §192.949. An operator must also notify a State or local pipeline safety authority when either a covered segment is located in a State where OPS has an interstate agent agreement, or an intrastate covered segment is regulated by that State.

(b) *Prioritizing segments.* An operator must prioritize the covered pipeline segments for the baseline assessment according to a risk analysis that considers the potential threats to each covered segment. The risk analysis must comply with the requirements in §192.917.

(c) *Assessment for particular threats.* In choosing an assessment method for the baseline assessment of each covered segment, an operator must take the actions required in §192.917(e) to address particular threats that it has identified.

(d) *Time period.* An operator must prioritize all the covered segments for assessment in accordance with §192.917 (c) and paragraph (b) of this section. An operator must assess at least 50% of the covered segments beginning with the highest risk segments, by December 17, 2007. An operator must complete the baseline assessment of all covered segments by December 17, 2012.

(e) *Prior assessment.* An operator may use a prior integrity assessment conducted before December 17, 2002 as a baseline assessment for the covered segment, if the integrity assessment meets the baseline requirements in this subpart and subsequent remedial actions to address the conditions listed in §192.933 have been carried out. In addition, if an operator uses this prior assessment as its baseline assessment, the operator must reassess the line pipe in the covered segment according to the requirements of §192.937 and §192.939.

(f) *Newly identified areas.* When an operator identifies a new high consequence area (see §192.905), an operator must complete the baseline assessment of the line pipe in the newly identified high consequence area within ten (10) years from the date the area is identified.

(g) *Newly installed pipe.* An operator must complete the baseline assessment of a newly-installed segment of pipe covered by this subpart within ten (10) years from the date the pipe is installed. An operator may conduct a pressure test in accordance with paragraph (a)(2) of this section, to satisfy the requirement for a baseline assessment.

(h) *Plastic transmission pipeline.* If the threat analysis required in §192.917(d) on a plastic transmission pipeline indicates that a covered segment is susceptible to failure from causes other than third-party damage, an operator must conduct a baseline assessment of the segment in accordance with the requirements of this section and of §192.917. The operator must justify the use of an alternative assessment method that will address the identified threats to the covered segment.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, Apr. 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006]

§192.923 How is direct assessment used and for what threats?

(a) *General.* An operator may use direct assessment either as a primary assessment method or as a supplement to the other assessment methods allowed under this subpart. An operator may only use direct assessment as the primary assessment method to address the identified threats of external corrosion (ECDA), internal corrosion (ICDA), and stress corrosion cracking (SCCDA).

(b) *Primary method.* An operator using direct assessment as a primary assessment method must have a plan that complies with the requirements in—

(1) Section 192.925 and ASME/ANSI B31.8S (incorporated by reference, *see* § 192.7); section 6.4, and NACE SP0502 (incorporated by reference, *see* § 192.7), if addressing external corrosion (ECDA).

(2) Section 192.927 and ASME/ANSI B31.8S (incorporated by reference, *see* § 192.7), section 6.4, appendix B2, if addressing internal corrosion (IC).

(3) Section 192.929 and ASME/ANSI B31.8S (incorporated by reference, see

§ 192.7), appendix A3, if addressing stress corrosion cracking (SCCDA).

(c) *Supplemental method.* An operator using direct assessment as a supplemental assessment method for any applicable threat must have a plan that follows the requirements for confirmatory direct assessment in §192.931.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.925 What are the requirements for using External Corrosion Direct Assessment (ECDA)?

(a) *Definition.* ECDA is a four-step process that combines preassessment, indirect inspection, direct examination, and post assessment to evaluate the threat of external corrosion to the integrity of a pipeline.

(b) *General requirements.* An operator that uses direct assessment to assess the threat of external corrosion must follow the requirements in this section, in ASME/ANSI B31.8S (incorporated by reference, *see* §192.7), section 6.4, and in NACE SP0502-2008 (incorporated by reference, *see* §192.7). An operator must develop and implement a direct assessment plan that has procedures addressing pre-assessment, indirect inspection examination, direct examination, and post-assessment. If the ECDA detects pipeline coating damage, the operator must also integrate the data from the ECDA with other information from the data integration (§192.917(b)) to evaluate the covered segment for the threat of third party damage, and to address the threat as required by §192.917(e)(1).

(1) *Preassessment.* In addition to the requirements in ASME/ANSI B31.8S section 6.4 and NACE SP0502, section 3, the plan's procedures for preassessment must include—

(i) Provisions for applying more restrictive criteria when conducting ECDA for the first time on a covered segment; and

(ii) The basis on which an operator selects at least two different, but complementary indirect assessment tools to assess each ECDA Region. If an operator utilizes an indirect inspection method that is not discussed in Appendix A of NACE SP0502, the operator must demonstrate the applicability, validation basis, equipment used, application procedure, and utilization of data for the inspection method.

(2) *Indirect inspection examination.* In addition to the requirements in ASME/ANSI B31.8S, section 6.4 and NACE SP0502–2008, section 4, the plan's procedures for indirect inspection examination of the ECDA regions must include—

(i) Provisions for applying more restrictive criteria when conducting ECDA for the first time on a covered segment;

(ii) Criteria for identifying and documenting those indications that must be considered for excavation and direct examination. Minimum identification criteria include the known sensitivities of assessment tools, the procedures for using each tool, and the approach to be used for decreasing the physical spacing of indirect assessment tool readings when the presence of a defect is suspected;

(iii) Criteria for defining the urgency of excavation and direct examination of each indication identified during the indirect examination. These criteria must specify how an operator will define the urgency of excavating the indication as immediate, scheduled or monitored; and

(iv) Criteria for scheduling excavation of indications for each urgency level.

(3) *Direct examination.* In addition to the requirements in ASME/ANSI B31.8S section 6.4 and NACE SP0502, section 5, the plan's procedures for direct examination of indications from the indirect examination must include—

(i) Provisions for applying more restrictive criteria when conducting ECDA for the first time on a covered segment;

(ii) Criteria for deciding what action should be taken if either:

(A) Corrosion defects are discovered that exceed allowable limits (Section 5.5.2.2 of NACE RP0502), or

(B) Root cause analysis reveals conditions for which ECDA is not suitable (Section 5.6.2 of NACE RP0502);

(iii) Criteria and notification procedures for any changes in the ECDA Plan, including changes that affect the severity classification, the priority of direct examination, and the time frame for direct examination of indications; and

(iv) Criteria that describe how and on what basis an operator will reclassify and reprioritize any of the provisions that are specified in section 5.9 of NACE SP0502.

(4) *Post assessment and continuing evaluation.* In addition to the requirements in ASME/ANSI B31.8S section 6.4 and NACE SP0502, section 6, the plan's procedures for post assessment of the effectiveness of the ECDA process must include—

(i) Measures for evaluating the long-term effectiveness of ECDA in addressing external corrosion in covered segments; and

(ii) Criteria for evaluating whether conditions discovered by direct examination of indications in each ECDA region indicate a need for reassessment of the covered segment at an interval less than that specified in § 192.939. (See Appendix D of NACE SP0502.)

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95C, 69 FR 29903, May 26, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006 ; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015; Amdt. 192-120, 80 FR 12763, March 11, 2015]

§192.927 What are the requirements for using Internal Corrosion Direct Assessment (ICDA)?

(a) *Definition.* Internal Corrosion Direct Assessment (ICDA) is a process an operator uses to identify areas along the pipeline where fluid or other electrolyte introduced during normal operation or by an upset condition may reside, and then focuses direct examination on the locations in covered segments where internal corrosion is most likely to exist. The process identifies the potential for internal corrosion caused by microorganisms, or fluid with CO_2, O_2, hydrogen sulfide or other contaminants present in the gas.

(b) *General requirements*. An operator using direct assessment as an assessment method to address internal corrosion in a covered pipeline segment must follow the requirements in this section and in ASME/ANSI B31.8S (incorporated by reference, *see* §192.7), section 6.4 and appendix B2. The ICDA process described in this section applies only for a segment of pipe transporting nominally dry natural gas, and not for a segment with electrolyte nominally present in the gas stream. If an operator uses ICDA to assess a covered segment operating with electrolyte present in the gas stream, the operator must develop a plan that demonstrates how it will conduct ICDA in the segment to effectively address internal corrosion, and must provide notification in accordance with §192.921 (a)(4) or §192.937(c)(4).

(c) *The ICDA plan.* An operator must develop and follow an ICDA plan that provides for preassessment, identification of ICDA regions and excavation locations, detailed examination of pipe at excavation locations, and post-assessment evaluation and monitoring.

(1) *Preassessment.* In the preassessment stage, an operator must gather and integrate data and information needed to evaluate the feasibility of ICDA for the covered segment, and to support use of a model to identify the locations along the pipe segment where electrolyte may accumulate, to identify ICDA regions, and to identify areas within the covered segment where liquids may potentially be entrained. This data and information includes, but is not limited to—

(i) All data elements listed in appendix A2 of ASME/ANSI B31.8S;

(ii) Information needed to support use of a model that an operator must use to identify areas along the pipeline where internal corrosion is most likely to occur. (See paragraph (a) of this section.) This information, includes, but is not limited to, location of all gas input and withdrawal points on the line; location of all low points on covered segments such as sags, drips, inclines, valves, manifolds, dead-legs, and traps; the elevation profile of the pipeline in sufficient detail that angles of inclination can be calculated for all pipe segments; and the diameter of the pipeline, and the range of expected gas velocities in the pipeline;

(iii) Operating experience data that would indicate historic upsets in gas conditions, locations where these upsets have occurred, and potential damage resulting from these upset conditions; and

(iv) Information on covered segments where cleaning pigs may not have been used or where cleaning pigs may deposit electrolytes.

(2) *ICDA region identification.* An operator's plan must identify where all ICDA Regions are located in the transmission system, in which covered segments are located. An ICDA Region extends from the location where liquid may first enter the pipeline and encompasses the entire area along the pipeline where internal corrosion may occur and where further evaluation is needed. An ICDA Region may encompass one or more covered segments. In the identification process, an operator must use the model in GRI 02-0057, "Internal Corrosion Direct Assessment of Gas Transmission Pipelines—Methodology," (incorporated by reference, *see* §192.7). An operator may use another model if the operator demonstrates it is equivalent to the one shown in GRI 02-0057. A model must consider changes in pipe diameter, locations where gas enters a line (potential to introduce liquid) and locations down stream of gas draw-offs (where gas velocity is reduced) to define the critical pipe angle of inclination above which water film cannot be transported by the gas.

(3) *Identification of locations for excavation and direct examination.* An operator's plan must identify the locations where internal corrosion is most likely in each ICDA region. In the location identification process, an operator must identify a minimum of two locations for excavation within each ICDA Region within a covered segment and must perform a direct examination for internal corrosion at each location, using ultrasonic thickness measurements, radiography, or other generally accepted measurement technique. One location must be the low point (e.g., sags, drips, valves, manifolds, dead-legs, traps) within the covered segment nearest to the beginning of the ICDA Region. The second location must be further downstream, within a covered segment, near the end of the ICDA Region. If corrosion exists at either location, the operator must—

(i) Evaluate the severity of the defect (remaining strength) and remediate the defect in accordance with §192.933;

(ii) As part of the operator's current integrity assessment either perform additional excavations in each covered segment within the ICDA region, or use an alternative assessment method allowed by this subpart to assess the line pipe in each covered segment within the ICDA region for internal corrosion; and

(iii) Evaluate the potential for internal corrosion in all pipeline segments (both covered and non-covered) in the operator's pipeline system with similar characteristics to the ICDA region containing the covered segment in which the corrosion was found, and as appropriate, remediate the conditions the operator finds in accordance with §192.933.

(4) *Post-assessment evaluation and monitoring.* An operator's plan must provide for evaluating the effectiveness of the ICDA process and continued monitoring of covered segments where internal corrosion has been identified. The evaluation and monitoring process includes—

(i) Evaluating the effectiveness of ICDA as an assessment method for addressing internal corrosion and determining whether a covered segment should be reassessed at more frequent intervals than those specified in §192.939. An operator must carry out this evaluation within a year of conducting an ICDA; and

(ii) Continually monitoring each covered segment where internal corrosion has been identified using techniques such as coupons, UT sensors or electronic probes, periodically drawing off liquids at low points and chemically analyzing the liquids for the presence of corrosion products. An operator must base the frequency of the monitoring and liquid analysis on results from all integrity assessments that have been conducted in accordance with the requirements of this subpart, and risk factors specific to the covered segment. If an operator finds any evidence of corrosion products in the covered segment, the operator must take prompt action in accordance with one of the two following required actions and remediate the conditions the operator finds in accordance with §192.933.

(A) Conduct excavations of covered segments at locations downstream from where the electrolyte might have entered the pipe; or

(B) Assess the covered segment using another integrity assessment method allowed by this subpart.

(5) *Other requirements.* The ICDA plan must also include—

(i) Criteria an operator will apply in making key decisions (e.g., ICDA feasibility, definition of ICDA Regions, conditions requiring excavation) in implementing each stage of the ICDA process;

(ii) Provisions for applying more restrictive criteria when conducting ICDA for the first time on a covered segment and that become less stringent as the operator gains experience; and

(iii) Provisions that analysis be carried out on the entire pipeline in which covered segments are present, except that application of the remediation criteria of §192.933 may be limited to covered segments.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006]

§192.929 What are the requirements for using Direct Assessment for Stress Corrosion Cracking (SCCDA)?

(a) *Definition.* Stress Corrosion Cracking Direct Assessment (SCCDA) is a process to assess a covered pipe segment for the presence of SCC primarily by systematically gathering and analyzing excavation data for pipe having similar operational characteristics and residing in a similar physical environment.

(b) *General requirements*. An operator using direct assessment as an integrity assessment method to address stress corrosion cracking in a covered pipeline segment must have a plan that provides, at minimum, for—

(1) Data gathering and integration. An operator's plan must provide for a systematic process to collect and evaluate data for all covered segments to identify whether the conditions for SCC are present and to prioritize the covered segments for assessment. This process must include gathering and evaluating data related to SCC at all sites an operator excavates during the conduct of its pipeline operations where the criteria in ASME/ANSI B31.8S (incorporated by reference, *see* §192.7), appendix A3.3 indicate the potential for SCC. This data includes at minimum, the data specified in ASME/ANSI B31.8S, appendix A3.

(2) Assessment method. The plan must provide that if conditions for SCC are identified in a covered segment, an operator must assess the covered segment using an integrity assessment method specified in ASME/ANSI B31.8S, appendix A3, and remediate the threat in accordance with ASME/ANSI B31.8S, appendix A3, section A3.4.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006]

§192.931 How may Confirmatory Direct Assessment (CDA) be used?

An operator using the confirmatory direct assessment (CDA) method as allowed in §192.937 must have a plan that meets the requirements of this section and of §§ 192.925 (ECDA) and §192.927 (ICDA).

(a) *Threats.* An operator may only use CDA on a covered segment to identify damage resulting from external corrosion or internal corrosion.

(b) *External corrosion plan.* An operator's CDA plan for identifying external corrosion must comply with §192.925 with the following exceptions.

(1) The procedures for indirect examination may allow use of only one indirect examination tool suitable for the application.

(2) The procedures for direct examination and remediation must provide that—

(i) All immediate action indications must be excavated for each ECDA region; and

(ii) At least one high risk indication that meets the criteria of scheduled action must be excavated in each ECDA region.

(c) *Internal corrosion plan.* An operator's CDA plan for identifying internal corrosion must comply with §192.927 except that the plan's procedures for identifying locations for excavation may require excavation of only one high risk location in each ICDA region.

(d) *Defects requiring near-term remediation.* If an assessment carried out under paragraph (b) or (c) of this section reveals any defect requiring remediation prior to the next scheduled assessment, the operator must schedule the next assessment in accordance with NACE RP 0502 (incorporated by reference *see* §192.7), section 6.2 and 6.3. If the defect requires immediate remediation, then the operator must reduce pressure consistent with §192.933 until the operator has completed reassessment using one of the assessment techniques allowed in §192.937.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.933 What actions must be taken to address integrity issues?

(a) *General requirements.* An operator must take prompt action to address all anomalous conditions the operator discovers through the integrity assessment. In addressing all conditions, an operator must evaluate all anomalous conditions and remediate those that could reduce a pipeline's integrity. An operator must be able to demonstrate that the remediation of the condition will ensure the condition is unlikely to pose a threat to the integrity of the pipeline until the next reassessment of the covered segment.

(1) *Temporary pressure reduction.* If an operator is unable to respond within the time limits for certain conditions specified in this section, the operator must temporarily reduce the operating pressure of the pipeline or take other action that ensures the safety of the covered segment. An operator must determine any temporary reduction in operating pressure required by this section using ASME/ANSI B31G (incorporated by reference, *see* §192.7) Pipeline Research Council, International, PR-3-805 (R-STRENG) (incorporated by reference, *see* § 192.7); or by reducing the operating pressure to a level not exceeding 80 percent of the level at the time the condition was discovered. An operator must notify PHMSA in accordance with § 192.949 if it cannot meet the schedule for evaluation and remediation required under paragraph (c) of this section and cannot provide safety through a temporary reduction in operating pressure or through another action. An operator must also notify a State pipeline safety authority when either a covered segment is located in a State where PHMSA has an interstate agent agreement or an intrastate covered segment is regulated by that State.

(2) *Long-term pressure reduction.* When a pressure reduction exceeds 365 days, the operator must notify PHMSA under §192.949 and explain the reasons for the remediation delay. This notice must include a technical justification that the continued pressure reduction will not jeopardize the integrity of the pipeline. The operator also must notify a State pipeline safety authority when either a covered segment is located in a State where PHMSA has an interstate agent agreement, or an intrastate covered segment is regulated by that State.

(b) *Discovery of condition.* Discovery of a condition occurs when an operator has adequate information about a condition to determine that the condition presents a potential threat to the integrity of the pipeline. A condition that presents a potential threat includes, but is not limited to, those conditions that require remediation or monitoring listed under paragraphs (d)(1) through (d)(3) of this section. An operator must promptly, but no later than 180 days after conducting an integrity assessment, obtain sufficient information about a condition to make that determination, unless the operator demonstrates that the 180-day period is impracticable.

(c) *Schedule for evaluation and remediation.* An operator must complete remediation of a condition according to a schedule prioritizing the conditions for evaluation and remediation. Unless a special requirement for remediating certain conditions applies, as provided in paragraph (d) of this section, an operator must follow the schedule in ASME/ANSI B31.8S (incorporated by reference, see §192.7), section 7, Figure 4. If an operator cannot meet the schedule for any condition, the operator must explain the reasons why it cannot meet the schedule and how the changed schedule will not jeopardize public safety.

(d) *Special requirements for scheduling remediation.*—(1) Immediate repair conditions. An operator's evaluation and remediation schedule must follow ASME/ANSI B31.8S, section 7 in providing for immediate repair conditions. To maintain safety, an operator must temporarily reduce operating pressure in accordance with paragraph (a) of this section or shut down the pipeline until the operator completes the repair of these conditions. An operator must treat the following conditions as immediate repair conditions:

(i) A calculation of the remaining strength of the pipe shows a predicted failure pressure less than or equal to 1.1 times the maximum allowable operating pressure at the location of the anomaly. Suitable remaining strength calculation methods include ASME/ANSI B31G (incorporated by reference, *see* § 192.7), PRCI PR-3-8-5 (R-STRENG) (incorporated by reference, *see* § 192.7), or an alternative equivalent method of remaining strength calculation.

(ii) A dent that has any indication of metal loss, cracking or a stress riser.

(iii) An indication or anomaly that in the judgment of the person designated by the operator to evaluate the assessment results requires immediate action.

(2) *One-year conditions.* Except for conditions listed in paragraph (d)(1) and (d)(3) of this section, an operator must remediate any of the following within one year of discovery of the condition:

(i) A smooth dent located between the 8 o'clock and 4 o'clock positions (upper ⅔ of the pipe) with a depth greater than 6% of the pipeline diameter (greater than 0.50 inches in depth for a pipeline diameter less than Nominal Pipe Size (NPS) 12).

(ii) A dent with a depth greater than 2% of the pipeline's diameter (0.250 inches in depth for a pipeline diameter less than NPS 12) that affects pipe curvature at a girth weld or at a longitudinal seam weld.

(3) *Monitored conditions.* An operator does not have to schedule the following conditions for remediation, but must record and monitor the conditions during subsequent risk assessments and integrity assessments for any change that may require remediation:

(i) A dent with a depth greater than 6% of the pipeline diameter (greater than 0.50 inches in depth for a pipeline diameter less than NPS 12) located between the 4 o'clock position and the 8 o'clock position (bottom ⅓ of the pipe).

(ii) A dent located between the 8 o'clock and 4 o'clock positions (upper ⅔ of the pipe) with a depth greater than 6% of the pipeline diameter (greater than 0.50 inches in depth for a pipeline diameter less than Nominal Pipe Size (NPS) 12), and engineering analyses of the dent demonstrate critical strain levels are not exceeded.

(iii) A dent with a depth greater than 2% of the pipeline's diameter (0.250 inches in depth for a pipeline diameter less than NPS 12) that affects pipe curvature at a girth weld or a longitudinal seam weld, and engineering analyses of the dent and girth or seam weld demonstrate critical strain levels are not exceeded. These analyses must consider weld properties.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-104, 72 FR 39012, July 17, 2007; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.935 What additional preventive and mitigative measures must an operator take?

(a) *General requirements.* An operator must take additional measures beyond those already required by Part 192 to prevent a pipeline failure and to mitigate the consequences of a pipeline failure in a high consequence area. An operator must base the additional measures on the threats the operator has identified to each pipeline segment. (*See* §192.917) An operator must conduct, in accordance with one of the risk assessment approaches in ASME/ANSI B31.8S (incorporated by reference, *see* §192.7), section 5, a risk analysis of its pipeline to identify additional measures to protect the high consequence area and enhance public safety. Such additional measures include, but are not limited to, installing Automatic Shut-off Valves or Remote Control Valves, installing computerized monitoring and leak detection systems, replacing pipe segments with pipe of heavier wall thickness, providing additional training to personnel on response procedures, conducting drills with local emergency responders and implementing additional inspection and maintenance programs.

(b) *Third party damage and outside force damage*—(1) *Third party damage.* An operator must enhance its damage prevention program, as required under §192.614 of this part, with respect to a covered segment to prevent and minimize the consequences of a release due to third party damage. Enhanced measures to an existing damage prevention program include, at a minimum—

(i) Using qualified personnel (*see* §192.915) for work an operator is conducting that could adversely affect the integrity of a covered segment, such as marking, locating, and direct supervision of known excavation work.

(ii) Collecting in a central database information that is location specific on excavation damage that occurs in covered and non covered segments in the transmission system and the root cause analysis to support identification of targeted additional preventative and mitigative measures in the high consequence areas. This information must include recognized damage that is not required to be reported as an incident under part 191.

(iii) Participating in one-call systems in locations where covered segments are present.

(iv) Monitoring of excavations conducted on covered pipeline segments by pipeline personnel. If an operator finds physical evidence of encroachment involving excavation that the operator did not monitor near a covered segment, an operator must either excavate the area near the encroachment or conduct an above ground survey using methods defined in NACE SP0502 (incorporated by reference, *see* §192.7). An operator must excavate, and remediate, in accordance with ANSI/ASME B31.8S and §192.933 any indication of coating holidays or discontinuity warranting direct examination.

(2) *Outside force damage*. If an operator determines that outside force (e.g., earth movement, floods, unstable suspension bridge) is a threat to the integrity of a covered segment, the operator must take measures to minimize the consequences to the covered segment from outside force damage. These measures include, but are not limited to, increasing the frequency of aerial, foot or other methods of patrols, adding external protection, reducing external stress, and relocating the line.

(c) *Automatic shut-off valves (ASV) or Remote control valves (RCV)*. If an operator determines, based on a risk analysis, that an ASV or RCV would be an efficient means of adding protection to a high consequence area in the event of a gas release, an operator must install the ASV or RCV. In making that determination, an operator must, at least, consider the following factors—swiftness of leak detection and pipe shutdown capabilities, the type of gas being transported, operating pressure, the rate of potential release, pipeline profile, the potential for ignition, and location of nearest response personnel.

(d) *Pipelines operating below 30% SMYS.* An operator of a transmission pipeline operating below 30% SMYS located in a high consequence area must follow the requirements in paragraphs (d)(1) and (d)(2) of this section. An operator of a transmission pipeline operating below 30% SMYS located in a Class 3 or Class 4 area but not in a high consequence area must follow the requirements in paragraphs (d)(1), (d)(2) and (d)(3) of this section.

(1) Apply the requirements in paragraphs (b)(1)(i) and (b)(1)(iii) of this section to the pipeline; and

(2) Either monitor excavations near the pipeline, or conduct patrols as required by §192.705 of the pipeline at bi-monthly intervals. If an operator finds any indication of unreported construction activity, the operator must conduct a follow up investigation to determine if mechanical damage has occurred.

(3) Perform semi-annual leak surveys (quarterly for unprotected pipelines or cathodically protected pipe where electrical surveys are impractical).

(e) *Plastic transmission pipeline.* An operator of a plastic transmission pipeline must apply the requirements in paragraphs (b)(1)(i), (b)(1)(iii) and (b)(1)(iv) of this section to the covered segments of the pipeline.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.937 What is a continual process of evaluation and assessment to maintain a pipeline's integrity?

(a) *General.* After completing the baseline integrity assessment of a covered segment, an operator must continue to assess the line pipe of that segment at the intervals specified in §192.939 and periodically evaluate the integrity of each covered pipeline segment as provided in paragraph (b) of this section. An operator must reassess a covered segment on which a prior assessment is credited as a baseline under §192.921(e) by no later than December 17, 2009. An operator must reassess a covered segment on which a baseline assessment is conducted during the baseline period specified in §192.921(d) by no later than seven years after the baseline assessment of that covered segment unless the evaluation under paragraph (b) of this section indicates earlier reassessment.

(b) *Evaluation.* An operator must conduct a periodic evaluation as frequently as needed to assure the integrity of each covered segment. The periodic evaluation must be based on a data integration and risk assessment of the entire pipeline as specified in §192.917. For plastic transmission pipelines, the periodic evaluation is based on the threat analysis specified in 192.917(d). For all other transmission pipelines, the evaluation must consider the past and present integrity assessment results, data integration and risk assessment information (§192.917), and decisions about remediation (§192.933) and additional preventive and mitigative actions (§192.935). An operator must use the results from this evaluation to identify the threats specific to each covered segment and the risk represented by these threats.

(c) *Assessment methods.* In conducting the integrity reassessment, an operator must assess the integrity of the line pipe in the covered segment by any of the following methods as appropriate for the threats to which the covered segment is susceptible (*see* §192.917), or by confirmatory direct assessment under the conditions specified in §192.931.

(1) Internal inspection tool or tools capable of detecting corrosion, and any other threats to which the covered segment is susceptible. An operator must follow ASME/ANSI B31.8S (incorporated by reference, *see* §192.7), section 6.2 in selecting the appropriate internal inspection tools for the covered segment.

(2) Pressure test conducted in accordance with subpart J of this part. An operator must use the test pressures specified in Table 3 of section 5 of ASME/ANSI B31.8S, to justify an extended reassessment interval in accordance with §192.939.

(3) Direct assessment to address threats of external corrosion, internal corrosion, or stress corrosion cracking. An operator must conduct the direct assessment in accordance with the requirements listed in §192.923 and with as applicable, the requirements specified in §§ 192.925, 192.927 or 192.929;

(4) Other technology that an operator demonstrates can provide an equivalent understanding of the condition of the line pipe. An operator choosing this option must notify the Office of Pipeline Safety (OPS) 180 days before conducting the assessment, in accordance with §192.949. An operator must also notify a State or local pipeline safety authority when either a covered segment is located in a State where OPS has an interstate agent agreement, or an intrastate covered segment is regulated by that State.

(5) Confirmatory direct assessment when used on a covered segment that is scheduled for reassessment at a period longer than seven years. An operator using this reassessment method must comply with §192.931.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006]

§192.939 What are the required reassessment intervals?

An operator must comply with the following requirements in establishing the reassessment interval for the operator's covered pipeline segments.

(a) *Pipelines operating at or above 30% SMYS.* An operator must establish a reassessment interval for each covered segment operating at or above 30% SMYS in accordance with the requirements of this section. The maximum reassessment interval by an allowable reassessment method is seven years. If an operator establishes a reassessment interval that is greater than seven years, the operator must, within the seven-year period, conduct a confirmatory direct assessment on the covered segment, and then conduct the follow-up reassessment at the interval the operator has established. A reassessment carried out using confirmatory direct assessment must be done in accordance with §192.931. The table that follows this section sets forth the maximum allowed reassessment intervals.

(1) *Pressure test or internal inspection or other equivalent technology.* An operator that uses pressure testing or internal inspection as an assessment method must establish the reassessment interval for a covered pipeline segment by—

(i) Basing the interval on the identified threats for the covered segment (see §192.917) and on the analysis of the results from the last integrity assessment and from the data integration and risk assessment required by §192.917; or

(ii) Using the intervals specified for different stress levels of pipeline (operating at or above 30% SMYS) listed in ASME/ANSI B31.8S (incorporated by reference, *see* § 192.7), section 5, Table 3.

(2) *External Corrosion Direct Assessment.* An operator that uses ECDA that meets the requirements of this subpart must determine the reassessment interval according to the requirements in paragraphs 6.2 and 6.3 of NACE SP0502 (incorporated by reference, *see* §192.7).

(3) *Internal Corrosion or SCC Direct Assessment.* An operator that uses ICDA or SCCDA in accordance with the requirements of this subpart must determine the reassessment interval according to the following method. However, the reassessment interval cannot exceed those specified for direct assessment in ASME/ANSI B31.8S, section 5, Table 3.

(i) Determine the largest defect most likely to remain in the covered segment and the corrosion rate appropriate for the pipe, soil and protection conditions;

(ii) Use the largest remaining defect as the size of the largest defect discovered in the SCC or ICDA segment; and

(iii) Estimate the reassessment interval as half the time required for the largest defect to grow to a critical size.

(b) *Pipelines Operating Below 30% SMYS.* An operator must establish a reassessment interval for each covered segment operating below 30% SMYS in accordance with the requirements of this section. The maximum reassessment interval by an allowable reassessment method is seven years. An operator must establish reassessment by at least one of the following—

(1) Reassessment by pressure test, internal inspection or other equivalent technology following the requirements in paragraph (a)(1) of this section except that the stress level referenced in paragraph (a)(1)(ii) of this section would be adjusted to reflect the lower operating stress level. If an established interval is more than seven years, the operator must conduct by the seventh year of the interval either a confirmatory direct assessment in accordance with §192.931, or a low stress reassessment in accordance with §192.941.

(2) Reassessment by ECDA following the requirements in paragraph (a)(2) of this section.

(3) Reassessment by ICDA or SCCDA following the requirements in paragraph (a)(3) of this section.

(4) Reassessment by confirmatory direct assessment at 7-year intervals in accordance with §192.931, with reassessment by one of the methods listed in paragraphs (b)(1) through (b)(3) of this section by year 20 of the interval.

(5) Reassessment by the low stress assessment method at 7-year intervals in accordance with §192.941 with reassessment by one of the methods listed in paragraphs (b)(1) through (b)(3) of this section by year 20 of the interval.

(6) The following table sets forth the maximum reassessment intervals. Also refer to Appendix E.II for guidance on Assessment Methods and Assessment Schedule for Transmission Pipelines Operating Below 30% SMYS. In case of conflict between the rule and the guidance in the Appendix, the requirements of the rule control. An operator must comply with the following requirements in establishing a reassessment interval for a covered segment:

Maximum Reassessment Interval

Assessment Method	Pipeline operating at or above 50% SMYS	Pipeline operating at or above 30% SMYS, up to 50% SMYS	Pipeline operating below 30% SMYS
Internal Inspection Tool, Pressure Test or Direct Assessment	10 years(*)	15 years(*)	20 years(**)
Confirmatory Direct Assessment	7 years	7 years	7 years
Low Stress Reassessment	Not applicable	Not applicable	7 years + ongoing actions specified in §192.941

(*) A Confirmatory direct assessment as described in § 192.931 must be conducted by year 7 in a 10-year interval and years 7 and 14 of a 15-year interval.
(**) A low stress reassessment or Confirmatory direct assessment must be conducted by years 7 and 14 of the interval.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; Amdt. 192-119, 80 FR 168, January 5, 2015]

§192.941 What is a low stress reassessment?

(a) *General.* An operator of a transmission line that operates below 30% SMYS may use the following method to reassess a covered segment in accordance with §192.939. This method of reassessment addresses the threats of external and internal corrosion. The operator must have conducted a baseline assessment of the covered segment in accordance with the requirements of §§ 192.919 and 192.921.

(b) *External corrosion.* An operator must take one of the following actions to address external corrosion on the low stress covered segment.

(1) *Cathodically protected pipe.* To address the threat of external corrosion on cathodically protected pipe in a covered segment, an operator must perform an electrical survey (i.e. indirect examination tool/method) at least every 7 years on the covered segment. An operator must use the results of each survey as part of an overall evaluation of the cathodic protection and corrosion threat for the covered segment. This evaluation must consider, at minimum, the leak repair and inspection records, corrosion monitoring records, exposed pipe inspection records, and the pipeline environment.

(2) *Unprotected pipe or cathodically protected pipe where electrical surveys are impractical.* If an electrical survey is impractical on the covered segment an operator must—

(i) Conduct leakage surveys as required by §192.706 at 4-month intervals; and

(ii) Every 18 months, identify and remediate areas of active corrosion by evaluating leak repair and inspection records, corrosion monitoring records, exposed pipe inspection records, and the pipeline environment.

(c) *Internal corrosion.* To address the threat of internal corrosion on a covered segment, an operator must—

(1) Conduct a gas analysis for corrosive agents at least once each calendar year;

(2) Conduct periodic testing of fluids removed from the segment. At least once each calendar year test the fluids removed from each storage field that may affect a covered segment; and

(3) At least every seven (7) years, integrate data from the analysis and testing required by paragraphs (c)(1)-(c)(2) with applicable internal corrosion leak records, incident reports, safety-related condition reports, repair records, patrol records, exposed pipe reports, and test records, and define and implement appropriate remediation actions.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004]

§192.943 When can an operator deviate from these reassessment intervals?

(a) *Waiver from reassessment interval in limited situations.* In the following limited instances, OPS may allow a waiver from a reassessment interval required by §192.939 if OPS finds a waiver would not be inconsistent with pipeline safety.

(1) *Lack of internal inspection tools.* An operator who uses internal inspection as an assessment method may be able to justify a longer reassessment period for a covered segment if internal inspection tools are not available to assess the line pipe. To justify this, the operator must demonstrate that it cannot obtain the internal inspection tools within the required reassessment period and that the actions the operator is taking in the interim ensure the integrity of the covered segment.

(2) Maintain product supply. An operator may be able to justify a longer reassessment period for a covered segment if the operator demonstrates that it cannot maintain local product supply if it conducts the reassessment within the required interval.

(b) *How to apply.* If one of the conditions specified in paragraph (a) (1) or (a) (2) of this section applies, an operator may seek a waiver of the required reassessment interval. An operator must apply for a waiver in accordance with 49 U.S.C. 60118(c), at least 180 days before the end of the required reassessment interval, unless local product supply issues make the period impractical. If local product supply issues make the period impractical, an operator must apply for the waiver as soon as the need for the waiver becomes known.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004]

§192.945 What methods must an operator use to measure program effectiveness?

(a) *General.* An operator must include in its integrity management program methods to measure whether the program is effective in assessing and evaluating the integrity of each covered pipeline segment and in protecting the high consequence areas. These measures must include the four overall performance measures specified in ASME/ANSI B31.8S (incorporated by reference, see §192.7 of this part), section 9.4, and the specific measures for each identified threat specified in ASME/ANSI B31.8S, Appendix A. An operator must submit the four overall performance measures as part of the annual report required by §191.17 of this subchapter.

(b) *External Corrosion Direct assessment.* In addition to the general requirements for performance measures in paragraph (a) of this section, an operator using direct assessment to assess the external corrosion threat must define and monitor measures to determine the effectiveness of the ECDA process. These measures must meet the requirements of §192.925.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-115, 75 FR 72878, Nov 26, 2010]

§192.947 What records must an operator keep?

An operator must maintain, for the useful life of the pipeline, records that demonstrate compliance with the requirements of this subpart. At minimum, an operator must maintain the following records for review during an inspection.

(a) A written integrity management program in accordance with §192.907;

(b) Documents supporting the threat identification and risk assessment in accordance with §192.917;

(c) A written baseline assessment plan in accordance with §192.919;

(d) Documents to support any decision, analysis and process developed and used to implement and evaluate each element of the baseline assessment plan and integrity management program. Documents include those developed and used in support of any identification, calculation, amendment, modification, justification, deviation and determination made, and any action taken to implement and evaluate any of the program elements;

(e) Documents that demonstrate personnel have the required training, including a description of the training program, in accordance with §192.915;

(f) Schedule required by §192.933 that prioritizes the conditions found during an assessment for evaluation and remediation, including technical justifications for the schedule.

(g) Documents to carry out the requirements in §§ 192.923 through 192.929 for a direct assessment plan;

(h) Documents to carry out the requirements in §192.931 for confirmatory direct assessment;

(i) Verification that an operator has provided any documentation or notification required by this subpart to be provided to OPS, and when applicable, a State authority with which OPS has an interstate agent agreement, and a State or local pipeline safety authority that regulates a covered pipeline segment within that State.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004]

§192.949 How does an operator notify PHMSA?

An operator must provide file any notification report required by this subpart by– electronically to the Pipeline and Hazardous Materials Safety Administration in accordance with §191.7 of this sub-chapter.

(a) Sending the notification by electronic mail to *InformationResourcesManager@dot.gov*; or

(b) Sending the notification by mail to ATTN: Information Resources Manager, DOT/PHMSA/OPS, East Building, 2nd Floor, E22–321, 1200 New Jersey Ave. SE., Washington, DC 20590.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-100, 70 FR 11135, Mar. 8, 2005; Amdt. 192-103c, 72 FR 4655, Feb. 1, 2007; Amdt. 192-[106], 73 FR 16562, Mar. 28, 2008; Amdt. 192-[109], 74 FR 2889, January 16, 2009; Amdt. 192-115, 75 FR 72878, Nov 26, 2010; Amdt. 192-120, 80 FR 12762, March 11, 2015]

§192.951 Where does an operator file a report?

An operator must file any report required by this subpart electronically to the Pipeline and Hazardous Materials Safety Administration in accordance with §191.7 of this subchapter.

[Amdt. 192-95, 68 FR 69777, December 15, 2003 as amended by Amdt. 192 95A, 69 FR 2307, December 22, 2003; Amdt. 192-100, 70 FR 11135, Mar. 8, 2005; Amdt. 192-103c, 72 FR 4655, Feb. 1, 2007; Amdt. 192-[106], 73 FR 16562, Mar. 28, 2008; Amdt. 192-[109], 74 FR 2889, January 16, 2009; Amdt. 192-115, 75 FR 72878, Nov 26, 2010]

Editorial Note: All of Subpart P is new and therefore not underlined.

Subpart P–Gas Distribution Pipeline Integrity Management (IM)

§192.1001 What definitions apply to this subpart?

The following definitions apply to this subpart:

Excavation Damage means any impact that results in the need to repair or replace an underground facility due to a weakening, or the partial or complete destruction, of the facility, including, but not limited to, the protective coating, lateral support, cathodic protection or the housing for the line device or facility.

Hazardous Leak means a leak that represents an existing or probable hazard to persons or property and requires immediate repair or continuous action until the conditions are no longer hazardous.

Integrity Management Plan or IM Plan means a written explanation of the mechanisms or procedures the operator will use to implement its integrity management program and to ensure compliance with this subpart.

Integrity Management Program or IM Program means an overall approach by an operator to ensure the integrity of its gas distribution system.

Mechanical fitting means a mechanical device used to connect sections of pipe. The term "Mechanical fitting" applies only to:

(1) Stab Type fittings;
(2) Nut Follower Type fittings;
(3) Bolted Type fittings; or
(4) Other Compression Type fittings.

Small LPG Operator means an operator of a liquefied petroleum gas (LPG) distribution pipeline that serves fewer than 100 customers from a single source.

[Amdt. 192-113, 74 FR 63905, Dec. 4, 2009, Amdt. 192-116, 76 FR 5494, February 1, 2011]

§192.1003 What do the regulations in this subpart cover?

General. This subpart prescribes minimum requirements for an IM program for any gas distribution pipeline covered under this part, including liquefied petroleum gas systems. A gas distribution operator, other than a master meter operator or a small LPG operator, must follow the requirements in Sec. §192.1005-192.1013 of this subpart. A master meter operator or small LPG operator of a gas distribution pipeline must follow the requirements in §192.1015 of this subpart.

[Amdt. 192-113, 74 FR 63905, Dec. 4, 2009]

§192.1005 What must a gas distribution operator (other than a master meter or small LPG operator) do to implement this subpart?

No later than August 2, 2011 a gas distribution operator must develop and implement an integrity management program that includes a written integrity management plan as specified in §192.1007.

[Amdt. 192-113, 74 FR 63905, Dec. 4, 2009]

§192.1007 What are the required elements of an integrity management plan?

A written integrity management plan must contain procedures for developing and implementing the following elements:

(a) *Knowledge.* An operator must demonstrate an understanding of its gas distribution system developed from reasonably available information.

(1) Identify the characteristics of the pipeline's design and operations and the environmental factors that are necessary to assess the applicable threats and risks to its gas distribution pipeline.

(2) Consider the information gained from past design, operations, and maintenance.

(3) Identify additional information needed and provide a plan for gaining that information over time through normal activities conducted on the pipeline (for example, design, construction, operations or maintenance activities).

(4) Develop and implement a process by which the IM program will be reviewed periodically and refined and improved as needed.

(5) Provide for the capture and retention of data on any new pipeline installed. The data must include, at a minimum, the location where the new pipeline is installed and the material of which it is constructed.

(b) *Identify threats.* The operator must consider the following categories of threats to each gas distribution pipeline: Corrosion, natural forces, excavation damage, other outside force damage, material, or welds, equipment failure, incorrect operations, and other concerns that could threaten the integrity of its pipeline. An operator must consider reasonably available information to identify existing and potential threats. Sources of data may include, but are not limited to, incident and leak history, corrosion control records, continuing surveillance records, patrolling records, maintenance history, and excavation damage experience.

(c) *Evaluate and rank risk.* An operator must evaluate the risks associated with its distribution pipeline. In this evaluation, the operator must determine the relative importance of each threat and estimate and rank the risks posed to its pipeline. This evaluation must consider each applicable current and potential threat, the likelihood of failure associated with each threat, and the potential consequences of such a failure. An operator may subdivide its pipeline into regions with similar characteristics (e.g., contiguous areas within a distribution pipeline consisting of mains, services and other appurtenances; areas with common materials or environmental factors), and for which similar actions likely would be effective in reducing risk.

(d) *Identify and implement measures to address risks.* Determine and implement measures designed to reduce the risks from failure of its gas distribution pipeline. These measures must include an effective leak management program (unless all leaks are repaired when found).

(e) *Measure performance, monitor results, and evaluate effectiveness.*

(1) Develop and monitor performance measures from an established baseline to evaluate the effectiveness of its IM program. An operator must consider the results of its performance monitoring in periodically re-evaluating the threats and risks. These performance measures must include the following:

(i) Number of hazardous leaks either eliminated or repaired as required by §192.703(c) of this subchapter (or total number of leaks if all leaks are repaired when found), categorized by cause;

(ii) Number of excavation damages;

(iii) Number of excavation tickets (receipt of information by the underground facility operator from the notification center);

(iv) Total number of leaks either eliminated or repaired, categorized by cause;

(v) Number of hazardous leaks either eliminated or repaired as required by §192.703(c) (or total number of leaks if all leaks are repaired when found), categorized by material; and

(vi) Any additional measures the operator determines are needed to evaluate the effectiveness of the operator's IM program in controlling each identified threat.

(f) *Periodic Evaluation and Improvement.* An operator must re-evaluate threats and risks on its entire pipeline and consider the relevance of threats in one location to other areas. Each operator must determine the appropriate period for conducting complete program evaluations based on the complexity of its system and changes in factors affecting the risk of failure. An operator must conduct a complete program re-evaluation at least every five years. The operator must consider the results of the performance monitoring in these evaluations.

(g) *Report results.* Report, on an annual basis, the four measures listed in paragraphs (e)(1)(i) through (e)(1)(iv) of this section, as part of the annual report required by §191.11. An operator also must report the four measures to the state pipeline safety authority if a state exercises jurisdiction over the operator's pipeline.

[Amdt. 192-113, 74 FR 63905, Dec. 4, 2009, Amdt. 192-116, FR 76 5494, Feb 1,2011]

§192.1009 What must an operator report when compression couplings fail?

(a) Except as provided in paragraph (b) of this section, each operator of a distribution pipeline system must submit a report on each mechanical fitting failure, excluding any failure that results only in a nonhazardous leak, on a Department of Transportation Form PHMSA F-7100.1-2. The report(s) must be submitted in accordance with § 191.12.

(b) The mechanical fitting failure reporting requirements in paragraph (a) of this section do not apply to the following:

(1) Master meter operators;
(2) Small LPG operator as defined in §192.1001; or
(3) LNG facilities.

[Amdt. 192-116. 76 FR 5494, Feb. 1, 2011]

§192.1011 What records must an operator keep?

An operator must maintain records demonstrating compliance with the requirements of this subpart for at least 10 years. The records must include copies of superseded integrity management plans developed under this subpart.

[Amdt. 192-113, 74 FR 63905, Dec. 4, 2009]

§192.1013 When may an operator deviate from required periodic inspections under this part?

(a) An operator may propose to reduce the frequency of periodic inspections and tests required in this part on the basis of the engineering analysis and risk assessment required by this subpart.

(b) An operator must submit its proposal to the PHMSA Associate Administrator for Pipeline Safety or, in the case of an intrastate pipeline facility regulated by the State, the appropriate State agency. The applicable oversight agency may accept the proposal on its own authority, with or without conditions and limitations, on a showing that the operator's proposal, which includes the adjusted interval, will provide an equal or greater overall level of safety.

(c) An operator may implement an approved reduction in the frequency of a periodic inspection or test only where the operator has developed and implemented an integrity management program that provides an equal or improved overall level of safety despite the reduced frequency of periodic inspections.

[Amdt. 192-113, 74 FR 63905, Dec. 4, 2009]

§192.1015 What must a master meter or small liquefied petroleum gas (LPG) operator do to implement this subpart?

(a) *General.* No later than August 2, 2011 the operator of a master meter system or a small LPG operator must develop and implement an IM program that includes a written IM plan as specified in paragraph (b) of this section. The IM program for these pipelines should reflect the relative simplicity of these types of pipelines.

(b) *Elements.* A written integrity management plan must address, at a minimum, the following elements:

(1) *Knowledge.* The operator must demonstrate knowledge of its pipeline, which, to the extent known, should include the approximate location and material of its pipeline. The operator must identify additional information needed and provide a plan for gaining knowledge over time through normal activities conducted on the pipeline (for example, design, construction, operations or maintenance activities).

(2) *Identify threats.* The operator must consider, at minimum, the following categories of threats (existing and potential): Corrosion, natural forces, excavation damage, other outside force damage, material or weld failure, equipment failure, and incorrect operation.

(3) *Rank risks.* The operator must evaluate the risks to its pipeline and estimate the relative importance of each identified threat.

(4) *Identify and implement measures to mitigate risks.* The operator must determine and implement measures designed to reduce the risks from failure of its pipeline.

(5) *Measure performance, monitor results, and evaluate effectiveness.* The operator must monitor, as a performance measure, the number of leaks eliminated or repaired on its pipeline and their causes.

(6) *Periodic evaluation and improvement.* The operator must determine the appropriate period for conducting IM program evaluations based on the complexity of its pipeline and changes in factors affecting the risk of failure. An operator must re-evaluate its entire program at least every five years. The operator must consider the results of the performance monitoring in these evaluations.

(c) *Records.* The operator must maintain, for a period of at least 10 years, the following records:

(1) A written IM plan in accordance with this section, including superseded IM plans;

(2) Documents supporting threat identification; and

(3) Documents showing the location and material of all piping and appurtenances that are installed after the effective date of the operator's IM program and, to the extent known, the location and material of all pipe and appurtenances that were existing on the effective date of the operator's program.

[Amdt. 192-113, 74 FR 63905, Dec. 4, 2009]

Appendix A–[Reserved]

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-3, 35 FR 17659, Nov. 17, 1970; Amdt. 192-12, 38 FR 4760, Feb. 22, 1973; Amdt. 192-17, 40 FR 6345, Feb. 11, 1975; Amdt. 192-17C, 40 FR 8188, Feb. 26, 1975; Amdt. 192-18, 40 FR 10181, Mar. 5, 1975; Amdt. 192-19, 40 FR 10471, Mar. 6, 1975; Amdt. 192-22, 41 FR 13589, Mar. 31, 1976; Amdt. 192-32, 43 FR 18553, May 1, 1978; Amdt. 192-34, 44 FR 42968, July 23, 1979; Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-41, 47 FR 41381, Sept. 20, 1982; Amdt. 192-42, 47 FR 44263, Oct. 7, 1982; Amdt 192-51, 51 FR 15333, Apr. 23, 1986; Amdt. 192-61, 53 FR 36793, Sept. 22, 1988; Amdt. 192-62, 54 FR 5625, Feb. 6, 1989; Amdt. 192-64, 54 FR 27881, July 3, 1989; Amdt. 192-65, 54 FR 32344, Aug. 7, 1989; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-76, 61 FR 26121, May 24, 1996; Amdt. 192-78, 61 FR 28770, June 6, 1996; Amdt. 192-78C, 61 FR 41019, Aug. 7, 1996; Amdt. 192-84, 63 FR 7721, Feb. 17, 1998; Amdt. 192-84A, 63 FR 38757, July 20, 1998; Amdt. 192-95, 16 FR 69778, Dec. 15, 2003; Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-94, 69 FR 32886, June 14, 2004]

Appendix B–Qualification of Pipe

I. *Listed Pipe Specification*

ANSI/API Specification 5L—Steel pipe, "Specification for Line Pipe" (incorporated by reference, *see* § 192.7).

ASTM A53/A53M—Steel pipe, "Standard Specification for Pipe, Steel Black and Hot-Dipped, Zinc-Coated, Welded and Seamless" (incorporated by reference, *see* § 192.7).

ASTM A106/A106M—Steel pipe, "Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service" (incorporated by reference, *see* § 192.7)

ASTM A333/A333M—Steel pipe, "Standard Specification for Seamless and Welded Steel Pipe for Low Temperature Service" (incorporated by reference, *see* § 192.7)

ASTM A381—Steel pipe, "Standard specification for Metal-Arc-Welded Steel Pipe for Use with High-Pressure Transmission Systems" (incorporated by reference, *see* § 192.7)

ASTM A671/A671M—Steel pipe, "Standard Specification for Electric-Fusion-Welded Pipe for Atmospheric and Lower Temperatures" (incorporated by reference, *see* § 192.7)

ASTM A672/A672M—Steel pipe, "Standard Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures" (incorporated by reference, *see* § 192.7)

ASTM A691/A691M—Steel pipe, "Standard Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High Pressure Service at High Temperatures" (incorporated by reference, *see* § 192.7)

ASTM D2513-99, "Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings," (incorporated by reference, *see* § 192.7)

ASTM D2513-09a—Polyethylene thermoplastic piping and tubing, "Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings," (incorporated by reference, *see* § 192.7).

ASTM D2517—Thermosetting plastic pipe and tubing, "Standard Specification Reinforced Epoxy Resin Gas Pressure Pipe and Fittings," (incorporated by reference, *see* § 192.7)

II. *Steel pipe of unknown or unlisted specification.*

A. *Bending properties.* For pipe 2 inches (51 millimeters) or less in diameter, a length of pipe must be cold bent through at least 90 degrees around a cylindrical mandrel that has a diameter 12 times the diameter of the pipe, without developing cracks at any portion and without opening the longitudinal weld.

For pipe more than 2 inches (51 millimeters) in diameter, the pipe must meet the requirements of the flattening tests set forth in ASTM A53ASTM A53/A53M, except that the number of tests must be at least equal to the minimum required in paragraph II-D of this appendix to determine yield strength.

B. *Weldability.* A girth weld must be made in the pipe by a welder who is qualified under subpart E of this part. The weld must be made under the most severe conditions under which welding will be allowed in the field and by means of the same procedure that will be used in the field. On pipe more than 4 inches (102 millimeters) in diameter, at least one test weld must be made for each 100 lengths of pipe. On pipe 4 inches (102 millimeters) or less in diameter, at least one test weld must be made for each 400 lengths of pipe. The weld must be tested in accordance with API Standard 1104 (incorporated by reference, *see* §192.7). If the requirements of API Standard

1104 cannot be met, weldability may be established by making chemical tests for carbon and manganese, and proceeding in accordance with section IX of the ASME Boiler and Pressure Vessel Code (incorporated by reference, *see* §192.7). The same number of chemical tests must be made as are required for testing a girth weld.

C. *Inspection.* The pipe must be clean enough to permit adequate inspection. It must be visually inspected to ensure that it is reasonably round and straight and there are no defects which might impair the strength or tightness of the pipe.

D. *Tensile properties.* If the tensile properties of the pipe are not known, the minimum yield strength may be taken as 24,000 p.s.i. (165 MPa) or less, or the tensile properties may be established by performing tensile test as set forth in API Specification 5L (incorporated by reference, *see* §192.7).

Number of Tensile Tests-All Sizes	
10 lengths or less	1 set of tests for each length.
11 to 100 lengths	1 set of tests for each 5 lengths, but not less than 10 tests.
Over 100 lengths	1 set of tests for each 10 lengths but not less than 20 tests.

If the yield-tensile ratio, based on the properties determined by those tests, exceeds 0.85, the pipe may be used only as provided in §192.55(c).

III. *Steel pipe manufactured before November 12, 1970, to earlier editions of listed specifications.* Steel pipe manufactured before November 12, 1970, in accordance with a specification of which a later edition is listed in section I of this appendix, is qualified for use under this part if the following requirements are met:

A. *Inspection.* The pipe must be clean enough to permit adequate inspection. It must be visually inspected to ensure that it is reasonably round and straight and that there are no defects which might impair the strength or tightness of the pipe.

B. *Similarity of specification requirements.* The edition of the listed specification under which the pipe was manufactured must have substantially the same requirements with respect to the following properties as a later edition of that specification listed in section I of this appendix:

(1) Physical (mechanical) properties of pipe, including yield and tensile strength, elongation, and yield to tensile ratio, and testing requirements to verify those properties.

(2) Chemical properties of pipe and testing requirements to verify those properties.

C. *Inspection or test of welded pipe.* On pipe with welded seams, one of the following requirements must be met:

(1) The edition of the listed specification to which the pipe was manufactured must have substantially the same requirements with respect to nondestructive inspection of welded seams and the standards for acceptance or rejection and repair as a later edition of the specification listed in section I of this appendix.

(2) The pipe must be tested in accordance with Subpart J of this part to at least 1.25 times the maximum allowable operating pressure if it is to be installed in a class 1 location and to at least 1.5 times the maximum allowable operating pressure if it is to be installed in a class 2, 3, or 4 location. Notwithstanding any shorter time period permitted under Subpart J of this part, the test pressure must be maintained for at least 8 hours.

PART 192 – TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE: MINIMUM FEDERAL SAFETY STANDARDS

[Part 192 - Org., Aug. 19, 1970; as amended by Amdt. 192-3, 35 FR 17659, Nov. 17, 1970; Amdt. 192-12, 38 FR 4760, Feb. 22, 1973; Amdt. 192-19, 40 FR 10471, Mar. 6, 1975; Amdt. 192-22, 41 FR 13589, Mar. 31, 1976; Amdt. 192-32, 43 FR 18553, May 1, 1978; Amdt. 192-37, 46 FR 10157, Feb. 2, 1981; Amdt. 192-41, 47 FR 41381, Sept. 20, 1982; Amdt. 192-51, 51 FR 15333, Apr. 23, 1986; Amdt. 192-62, 54 FR 5625, Feb. 6, 1989; Amdt. 192-65, 54 FR 32344, Aug. 7, 1989; Amdt. 192-68, 58 FR 14519, Mar. 18, 1993; Amdt. 192-76A, 61 FR 36825, July 15, 1996; Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-94, 69 FR 32886, June 14, 2004; Amdt. 192-103, 71 FR 33402, June 8, 2006; Amdt. 192-114, 74 FR 48593, Aug 11, 2010; 192-119, 80 FR 168, January 5, 2015]

Appendix C–Qualification of Welders for Low Stress Level Pipe

I. *Basic test.* The test is made on pipe 12 inches (305 millimeters) or less in diameter. The test weld must be made with the pipe in a horizontal fixed position so that the test weld includes at least one section of overhead position welding. The beveling, root opening, and other details must conform to the specifications of the procedure under which the welder is being qualified. Upon completion, the test weld is cut into four coupons and subjected to a root bend test. If, as a result of this test, two or more of the four coupons develop a crack in the weld material, or between the weld material and base metal, that is more than 1/8-inch (3.2 millimeters) long in any direction, the weld is unacceptable. Cracks that occur on the corner of the specimen during testing are not considered. A welder who successfully passes a butt-weld qualification test under this section shall be qualified to weld on all pipe diameters less than or equal to 12 inches.

II. *Additional tests for welders of service line connections to mains.* A service line connection fitting is welded to a pipe section with the same diameter as a typical main. The weld is made in the same position as it is made in the field. The weld is unacceptable if it shows a serious undercutting or if it has rolled edges. The weld is tested by attempting to break the fitting off the run pipe. The weld is unacceptable if it breaks and shows incomplete fusion, overlap, or poor penetration at the junction of the fitting and run pipe.

III. *Periodic tests for welders of small service lines.* Two samples of the welder's work, each about 8 inches (203 millimeters) long with the weld located approximately in the center, are cut from steel service line and tested as follows:

(1) One sample is centered in a guided bend testing machine and bent to the contour of the die for a distance of 2 inches (51 millimeters) on each side of the weld. If the sample shows any breaks or cracks after removal from the bending machine, it is unacceptable.

(2) The ends of the second sample are flattened and the entire joint subjected to a tensile strength test. If failure occurs adjacent to or in the weld metal, the weld is unacceptable. If a tensile strength testing machine is not available, this sample must also pass the bending test prescribed in subparagraph (1) of this paragraph.

[Part 192 - Org., Aug. 19, 1970 as amended by Amdt. 192-85, 63 FR 37500, July 13, 1998; Amdt. 192-94, 69 FR 32886, June 14, 2004]

Appendix D–Criteria for Cathodic Protection and Determination of Measurements

I. *Criteria for cathodic protection–*

A. Steel, cast iron, and ductile iron structures.

(1) A negative (cathodic) voltage of at least 0.85 volt, with reference to a saturated copper-copper sulfate half cell. Determination of this voltage must be made with the protective current applied, and in accordance with sections II and IV of this appendix.

(2) A negative (cathodic) voltage shift of at least 300 millivolts. Determination of this voltage shift must be made with the protective current applied, and in accordance with sections II and IV of this appendix. This criterion of voltage shift applies to structures not in contact with metals of different anodic potentials.

(3) A minimum negative (cathodic) polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined in accordance with sections III and IV of this appendix.

(4) A voltage at least as negative (cathodic) as that originally established at the beginning of the Tafel segment of the E-log-I curve. This voltage must be measured in accordance with section IV of this appendix.

(5) A net protective current from the electrolyte into the structure surface as measured by an earth current technique applied at predetermined current discharge (anodic) points of the structure.

B. Aluminum structures.

(1) Except as provided in paragraphs (3) and (4) of this paragraph, a minimum negative (cathodic) voltage shift of 150 millivolts, produced by the application of protective current. The voltage shift must be determined in accordance with sections II and IV of this appendix.

(2) Except as provided in paragraphs (3) and (4) of this paragraph, a minimum negative (cathodic) polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined in accordance with sections III and IV of this appendix.

(3) Notwithstanding the alternative minimum criteria in paragraphs (1) and (2) of this paragraph, aluminum, if cathodically protected at voltages in excess of 1.20 volts as measured with reference to a copper-copper sulfate half cell, in accordance with section IV of this appendix, and compensated for the voltage (IR) drops other than those across the structure-electrolyte boundary may suffer corrosion resulting from the build-up of alkali on the metal surface. A voltage in excess of 1.20 volts may not be used unless previous test results indicate no appreciable corrosion will occur in the particular environment.

(4) Since aluminum may suffer from corrosion under high pH conditions, and since application of cathodic protection tends to increase the pH at the metal surface, careful investigation or testing must be made before applying cathodic protection to stop pitting attack on aluminum structures in environments with a natural pH in excess of 8.

C. Copper structures. A minimum negative (cathodic) polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined in accordance with sections III and IV of this appendix.

D. Metals of different anodic potentials. A negative (cathodic) voltage, measured in accordance with section IV of this appendix, equal to that required for the most anodic metal in the system must be maintained. If amphoteric structures are involved that could be damaged by high alkalinity covered by paragraphs (3) and (4) of paragraph B of this section, they must be electrically isolated with insulating flanges, or the equivalent.

II. *Interpretation of voltage measurement*. Voltage (IR) drops other than those across the structure electrolyte boundary must be considered for valid interpretation of the voltage measurement in paragraphs A(1) and (2) and paragraph B(1) of section I of the appendix.

III. *Determination of polarization voltage shift*. The polarization voltage shift must be determined by interrupting the protective current and measuring the polarization decay. When the current is initially interrupted, an immediate voltage shift occurs. The voltage reading after the immediate shift must be used as the base reading from which to measure polarization decay in paragraphs A(3), B(2), and C of section I of this appendix.

IV. *Reference half cells.*

A. Except as provided in paragraphs B and C of this section, negative (cathodic) voltage must be measured between the structure surface and a saturated copper-copper sulfate half cell contacting the electrolyte.

B. Other standard reference half cells may be substituted for the saturated copper-copper sulfate half cell. Two commonly used reference half cells are listed below along with their voltage equivalent to -0.85 volt as referred to a saturated copper-copper sulfate half cell:

(1) Saturated KC1 calomel half cell: -0.78 volt.

(2) Silver-silver chloride half cell used in sea water: -0.80 volt.

C. In addition to the standard reference half cells, an alternate metallic material or structure may be used in place of the saturated copper-copper sulfate half cell if its potential stability is assured and if its voltage equivalent referred to a saturated copper-copper sulfate half cell is established.

[Amdt. 192-4, 36 FR 12297, June 30, 1971]

Appendix E to Part 192—Guidance on Determining High Consequence Areas and on Carrying Out Requirements in the Integrity Management Rule

I. Guidance on Determining a High Consequence Area

To determine which segments of an operator's transmission pipeline system are covered for purposes of the integrity management program requirements, an operator must identify the high consequence areas. An operator must use method (1) or (2) from the definition in §192.903 to identify a high consequence area. An operator may apply one method to its entire pipeline system, or an operator may apply one method to individual portions of the pipeline system. (Refer to figure E.I.A for a diagram of a high consequence area)

[Amdt. 192-95, 16 FR 69778, Dec. 15, 2003, as amended by Amdt. 192-95B, 69 FR 18227, April 6, 2004; Amdt. 192-95C, 69 FR 29903, May 26, 2004]

Determining High Consequence Area

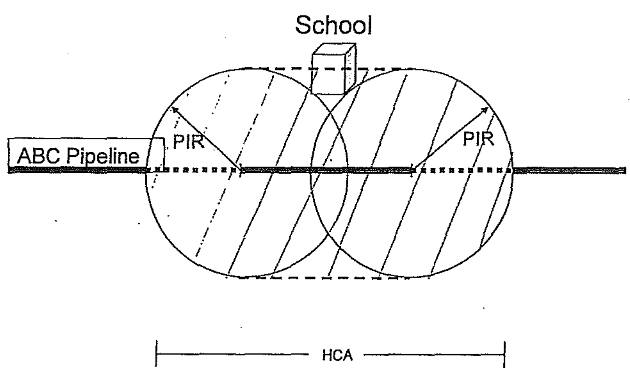

Figure E.I.A

II. Guidance on Assessment Methods and Additional Preventive and Mitigative Measures for Transmission Pipelines

(a) Table E.II.1 gives guidance to help an operator implement requirements on additional preventive and mitigative measures for addressing time dependent and independent threats for a transmission pipeline operating below 30% SMYS *not* in an HCA (i.e. outside of potential impact circle) but located within a Class 3 or Class 4 Location.

(b) Table E.II.2 gives guidance to help an operator implement requirements on assessment methods for addressing time dependent and independent threats for a transmission pipeline in an HCA.

(c) Table E.II.3 gives guidance on preventative & mitigative measures addressing time dependent and independent threats for transmission pipelines that operate below 30% SMYS, in HCAs.

[Amdt. 192-95, 16 FR 69778, Dec. 15, 2003, as amended by Amdt. 192-95B, 69 FR 18227, April 6, 2004]

Table E.II.1: Preventative & Mitigative Measures for Transmission Pipelines Operating Below 30% SMYS not in an HCA but in a Class 3 and 4 Location

Threat	Existing 192 Requirements		Additional (to 192 requirements)
	Primary	Secondary	Preventive and Mitigative Measures
External Corrosion	455-(Gen. Post 1971), 457-(Gen. Pre-1971) 459-(Examination), 461-(Ext. coating) 463-(CP), 465-(Monitoring) 467-(Elect isolation), 469-Test stations) 471-(Test leads), 473-(Interference) 479-(Atmospheric), 481-(Atmospheric) 485-(Remedial), 705-(Patrol) 706-(Leak survey), 711 (Repair B gen.) 717-(Repair B perm.)	603-(Gen Oper) 613-(Surveillance)	For Cathodically Protected Transmission Pipeline: $ Perform semi-annual leak surveys. For Unprotected Transmission Pipelines or for Cathodically Protected Pipe where Electrical Surveys are Impractical: $ Perform quarterly leak surveys
Internal Corrosion	475-(Gen IC), 477-(IC monitoring) 485-(Remedial), 705-(Patrol) 706-(Leak survey), 711 (Repair B gen.) 717-(Repair B perm.)	53(a)-(Materials) 603-(Gen Oper) 613-(Surveillance)	$ Perform semi-annual leak surveys.
3rd Party Damage	103-(Gen. Design), 111-(Design factor) 317-(Hazard prot), 327-(Cover) 614-(Dam. Prevent), 616-(Public education) 705-(Patrol), 707-(Line markers) 711 (Repair B gen.), 717-(Repair B perm.)	615B(Emerg. Plan)	$ Participation in state one-call system, $ Use of qualified operator employees and contractors to perform marking and locating of buried structures and in direct supervision of excavation work, AND $ Either monitoring of excavations near operator=s transmission pipelines, or bi-monthly patrol of transmission pipelines in class 3 and 4 locations. Any indications of unreported construction activity would require a follow up investigation to determine if mechanical damage occurred.

Table E.II.2 Assessment Requirements for Transmission Pipelines in HCAs (Re-assessment intervals are maximum allowed)

	Re-Assessment Requirements (see Note 3)					
	At or above 50% SMYS		At or above 30% SMYS up to 50% SMYS		Below 30% SMYS	
Baseline Assessment Method (see Note 3)	Max Re-Assessment Interval	Assessment Method	Max Re-Assessment Interval	Assessment Method	Max Re-Assessment Interval	Assessment Method
Pressure Testing	7	CDA	7	CDA	Ongoing	Preventative & Mitigative (P&M) Measures (see Table E.II.3), (see Note 2)
	10	Pressure Test or ILI or DA				
		Repeat inspection cycle every 10 years	15(see Note 1)	Pressure Test or ILI or DA (see Note 1)		
				Repeat inspection cycle every 15 years	20	Pressure Test or ILI or DA
						Repeat inspection cycle every 20 years
In-Line Inspection	7	CDA	7	CDA	Ongoing	Preventative & Mitigative (P&M) Measures (see Table E.II.3), (see Note 2)
	10	ILI or DA or Pressure Test				
		Repeat inspection cycle every 10 years	15(see Note 1)	ILI or DA or Pressure est (see Note 1)		
				Repeat inspection cycle every 15 years	20	ILI or DA or Pressure Test
						Repeat inspection cycle every 20 years
Direct Assessment	7	CDA	7	CDA	Ongoing	Preventative & Mitigative (P&M) Measures (see Table E.II.3), (see Note 2)
	10	DA or ILI or Pressure Test				
		Repeat inspection cycle every 10 years	15(see Note 1)	DA or ILI or Pressure Test (see Note 1)		
				Repeat inspection cycle every 15 years	20	DA or ILI or Pressure Test
						Repeat inspection cycle every 20 years
Note 1:	Operator may choose to utilize CDA at year 14, then utilize ILI, Pressure Test, or DA at year 15 as allowed under ASME B31.8S					
Note 2:	Operator may choose to utilize CDA at year 7 and 14 in lieu of P&M					
Note 3:	Operator may utilize "other technology that an operator demonstrates can provide an equivalent understanding of the condition of line pipe"					

Table E.II.3 Preventative & Mitigative Measures addressing Time Dependent and Independent Threats for Transmission Pipelines that Operate Below 30% SMYS , in HCAs

Threat	Existing 192 Requirements		Additional (to 192 requirements) Preventive & Mitigative Measures
	Primary	Secondary	
External Corrosion	455-(Gen. Post 1971) 457-(Gen. Pre-1971) 459-(Examination) 461-(Ext. coating) 463-(CP) 465-(Monitoring) 467-(Elect isolation) 469-Test stations) 471-(Test leads) 473-(Interference) 479-(Atmospheric) 481-(Atmospheric) 485-(Remedial) 705-(Patrol) 706-(Leak survey) 711 (Repair B gen.) 717-(Repair B perm.)	603-(Gen Oper) 613-(Surveil)	For Cathodically Protected Trmn. Pipelines $ Perform an electrical survey (*i.e.* indirect examination tool/method) at least every 7 years. Results are to be utilized as part of an overall evaluation of the CP system and corrosion threat for the covered segment. Evaluation shall include consideration of leak repair and inspection records, corrosion monitoring records, exposed pipe inspection records, and the pipeline environment. For Unprotected Trmn. Pipelines or for Cathodically Protected Pipe where Electrical Surveys are Impracticable • Conduct quarterly leak surveys AND • Every 1½ years, determine areas of active corrosion by evaluation of leak repair and inspection records, corrosion monitoring records, exposed pipe inspection records, and the pipeline environment.
Internal Corrosion	475-(Gen IC) 477-(IC monitoring) 485-(Remedial) 705-(Patrol) 706-(Leak survey) 711 (Repair B gen.) 717-(Repair B perm.)	53(a)-(Materials) 603-(Gen Oper) 613-(Surveil)	• Obtain and review gas analysis data each calendar year for corrosive agents from transmission pipelines in HCAs, • Periodic testing of fluid removed from pipelines. Specifically, once each calendar year from each storage field that may affect transmission pipelines in HCAs, AND • At least every 7 years, integrate data obtained with applicable internal corrosion leak records, incident reports, safety related condition reports, repair records, patrol records, exposed pipe reports, and test records.
3rd Party Damage	103-(Gen. Design) 111-(Design factor) 317-(Hazard prot) 327-(Cover) 614-(Dam. Prevent) 616-(Public educat) 705-(Patrol) 707-(Line markers) 711 (Repair B gen.) 717-(Repair B perm.)	615 B (Emerg Plan)	• Participation in State One-call system • Use of qualified operator employees and contractors to perform marking and locating of buried structures and in direct supervision of excavation work, AND • Either monitoring of excavations near operator=s transmission pipelines, or bi-monthly patrol of transmission pipelines in HCAs or class 3 and 4 locations. Any indications of unreported construction activity would require a follow up investigation to determine if mechanical damage occurred.

EXHIBIT 7

ASME B31.8S-2016
(Revision of ASME B31.8S-2014)

Managing System Integrity of Gas Pipelines

ASME Code for Pressure Piping, B31 Supplement to ASME B31.8

AN INTERNATIONAL PIPING CODE®

The American Society of Mechanical Engineers

EXHIBIT 8

REPORT_RECEIVED_DATE	IYEAR	REPORT_N	LOCAL_DATETIME	INCIDENT_RESULTED	COMMODI	CAUSE
3/26/2010	2010	20100007	3/5/2010 12:30	REASONS OTHER THAN RELEASE OF GA	NATURAL (	OTHER OUTSIDE FORCE DAMAGE
9/1/2010	2010	20100053	8/6/2010 10:38	REASONS OTHER THAN RELEASE OF GA	OTHER GA!	EXCAVATION DAMAGE
9/2/2010	2010	20100054	8/7/2010 19:00	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
10/13/2010	2010	20100070	9/9/2010 18:11	UNINTENTIONAL RELEASE OF GAS	NATURAL (	MATERIAL FAILURE OF PIPE OR WELD
10/29/2010	2010	20100083	10/2/2010 13:15	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
12/29/2010	2010	20100109	11/29/2010 14:40	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
6/24/2011	2011	20110203	5/25/2011 12:42	REASONS OTHER THAN RELEASE OF GA	NATURAL (	INCORRECT OPERATION
7/11/2011	2011	20110239	6/13/2011 13:15	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
8/5/2011	2011	20110273	7/10/2011 10:31	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
10/7/2011	2011	20110374	9/9/2011 11:19	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
10/19/2011	2011	20110378	9/19/2011 18:45	UNINTENTIONAL RELEASE OF GAS	NATURAL (	CORROSION FAILURE
4/5/2012	2012	20120035	3/8/2012 11:45	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
11/3/2012	2012	20120110	10/4/2012 17:52	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
12/11/2012	2012	20120122	11/10/2012 14:24	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
12/28/2012	2012	20120129	11/30/2012 9:54	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
12/28/2012	2012	20120130	12/1/2012 8:40	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
2/4/2013	2013	20130009	1/6/2013 11:43	UNINTENTIONAL RELEASE OF GAS	NATURAL (	INCORRECT OPERATION
6/7/2013	2013	20130047	5/10/2013 13:15	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
7/30/2013	2013	20130072	6/30/2013 18:18	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EQUIPMENT FAILURE
9/27/2013	2013	20130089	8/29/2013 10:29	UNINTENTIONAL RELEASE OF GAS	NATURAL (	OTHER OUTSIDE FORCE DAMAGE
11/25/2013	2013	20130107	10/23/2013 14:35	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
12/20/2013	2013	20130118	11/22/2013 12:56	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
4/10/2014	2014	20140036	3/14/2014 9:01	UNINTENTIONAL RELEASE OF GAS	NATURAL (	INCORRECT OPERATION
4/24/2014	2014	20140045	3/25/2014 15:10	UNINTENTIONAL RELEASE OF GAS	NATURAL (	INCORRECT OPERATION
8/15/2014	2014	20140087	7/18/2014 8:00	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
9/18/2014	2014	20140097	8/19/2014 8:30	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
9/23/2014	2014	20140098	8/24/2014 3:20	REASONS OTHER THAN RELEASE OF GAS		NATURAL FORCE DAMAGE
11/21/2014	2014	20140126	10/24/2014 7:28	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
11/25/2014	2014	20140129	10/15/2014 13:00	UNINTENTIONAL RELEASE OF GAS	NATURAL (	CORROSION FAILURE
12/17/2014	2014	20140142	11/19/2014 21:02	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
12/22/2014	2014	20140148	11/22/2014 16:52	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EQUIPMENT FAILURE
1/9/2015	2014	20150002	12/10/2014 9:00	REASONS OTHER THAN RELEASE OF GAS		OTHER INCIDENT CAUSE
1/23/2015	2014	20150010	12/23/2014 4:00	UNINTENTIONAL RELEASE OF GAS	NATURAL (	CORROSION FAILURE
2/6/2015	2015	20150015	1/7/2015 17:04	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EQUIPMENT FAILURE
2/27/2015	2015	20150025	1/28/2015 3:48	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EQUIPMENT FAILURE
3/30/2015	2015	20150041	2/28/2015 0:00	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
5/13/2015	2015	20150066	4/13/2015 11:13	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
5/15/2015	2015	20150068	4/17/2015 14:29	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
6/5/2015	2015	20150076	5/6/2015 23:59	UNINTENTIONAL RELEASE OF GAS	NATURAL (	MATERIAL FAILURE OF PIPE OR WELD
11/24/2015	2015	20150139	10/23/2015 11:23	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
12/14/2015	2015	20150148	11/13/2015 15:32	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
2/8/2016	2016	20160013	1/7/2016 13:11	UNINTENTIONAL RELEASE OF GAS	NATURAL (	MATERIAL FAILURE OF PIPE OR WELD
6/13/2016	2016	20160049	5/13/2016 14:45	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EQUIPMENT FAILURE
7/5/2016	2016	20160056	6/5/2016 5:16	UNINTENTIONAL RELEASE OF GAS	NATURAL (	MATERIAL FAILURE OF PIPE OR WELD
8/16/2016	2016	20160065	7/16/2016 6:59	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
9/26/2016	2016	20160078	8/27/2016 7:11	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
12/31/2016	2016	20160097	12/3/2016 14:15	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EXCAVATION DAMAGE
2/7/2017	2017	20170015	1/8/2017 13:47	UNINTENTIONAL RELEASE OF GAS	NATURAL (	EQUIPMENT FAILURE
3/29/2017	2017	20170026	2/27/2017 12:10	REASONS OTHER THAN RELEASE OF GAS		INCORRECT OPERATION
3/30/2017	2017	20170028	2/28/2017 10:59	UNINTENTIONAL RELEASE OF GAS	NATURAL (	MATERIAL FAILURE OF PIPE OR WELD
7/21/2017	2017	20170060	6/22/2017 12:12	UNINTENTIONAL RELEASE OF GAS	NATURAL (	INCORRECT OPERATION
7/31/2017	2017	20170065	7/1/2017 4:45	UNINTENTIONAL RELEASE OF GAS	NATURAL (	INCORRECT OPERATION

EXHIBIT 9

Pacific Gas and Electric Company

Date: MARCH 30, 2017

To: JOY NAVARRETE – SAN FRANCISCO PLANNING DEPARTMENT

From: PG&E GAS TRANSMISSION PIPELINE SERVICES – INTEGRITY MANAGEMENT

Subject: 3516/3526 FOLSOM ST.

Dear Joy,

Thank you for making us aware that you plan to do grading work near the PG&E gas transmission pipeline located near 3516 and 3526 Folsom St. As you are aware, it has been confirmed that an active 26" PG&E gas transmission pipeline L-109 is routed through this location. It is imperative that any proposed demolition or construction work not impair the safety of the gas lines. This not only includes any immediate safety risk to the pipeline during demolition or construction activities, but also long-term public safety with respect to this critical piece of infrastructure. PG&E requires adequate access at all times to patrol, survey, excavate, inspect, test, and otherwise maintain the pipeline(s) on a continuous basis in accordance with PG&E Utility Standard TD-4490S "Gas Pipeline Rights-of-Way Management."

Please be aware that this letter is being sent to address PG&E gas transmission facilities only. This letter is not intended to address PG&E gas distribution or PG&E electric facilities.

If any changes are made to the site plans as discussed via previous email, PG&E will need to re-evaluate before site development begins. Considering any comments/feedback we may have, an ideal time to send us any plan changes would be during the design phase of the project, to allow the possibility of modifying the design as necessary before launching into the construction phase.

1. Standby Inspection: **A PG&E Gas Transmission Standby Inspector must be present during any demolition or construction activity within 10 feet of the gas pipeline(s).** This includes all grading, trenching, gas line depth verifications (potholes), asphalt or concrete demolition/removal, removal of trees, signs, light poles, etc. This inspection can be coordinated through the Underground Service Alert (USA) service at **811 or 1-800-227-2600.** A minimum notice of 48 hours is required. This is absolutely required for your grading project.

2. Grading/Excavation: PG&E requires a minimum of existing grade or 36 inches of cover over gas lines (whichever is less), and a maximum of 7 feet cover. Current records show that the depth of cover (top of grade to top of pipe) could be as shallow as 24", however potholing would be required to confirm this. Any excavations, including grading work, above or around the gas transmission facilities must be performed while a PG&E inspector is present. This includes all laterals, subgrades, gas line depth verifications (potholes), etc. Please follow PG&E Work Procedure TD-4412P-05 "*Excavation Procedures for Damage Prevention*" when working in the vicinity of the gas transmission pipeline. Any plans to expose and support a PG&E gas transmission pipeline across an open excavation need to be approved by PG&E Pipeline Engineering in writing **PRIOR** to performing the work. **Any grading or digging within 2 feet of a gas pipeline must be dug by hand.** Water jetting to assist vacuum excavating must be limited to 125 psig.

3. Pipeline Markers: PG&E requires pipeline markers be placed along the pipeline route in order to ensure public awareness of the presence of the pipeline. Any existing markers can be temporarily relocated to accommodate construction work (with written PG&E approval), however markers must be reinstalled once construction is complete. It is unknown at this time how accurate the pipeline marker locations are at this specific site. As stated above, please coordinate an inspection through the Underground Service Alert (USA) service at **811 or 1-800-227-2600.**

4. Landscaping: Trees or deep rooted shrubs shall not be located within 10 feet of edge of pipe (pipe zone). Trees less than 12 inches in diameter with non-intrusive root structures can be placed outside of the 10 foot pipe zone. This is in accordance with PG&E Utility Standard TD-4490S "Gas Pipeline Rights-of-Way Management" Section 2. Removal of trees is acceptable, given the stumps are not removed. If stumps/roots are being removed, further evaluation will be required to ensure that removal will not interfere with the pipelines.

5. Fencing: Care must be taken to ensure the safety and accessibility of the pipelines. No parallel fencing will be allowed within 10 ft. of the pipeline, and any perpendicular fencing will require 14 foot wide access gates to be secured with PG&E corporation locks.

6. Structures: Permanent structures must be located a minimum distance of 10 ft. from edge of pipe. Additionally, for pipeline maintenance, future construction, emergency response provisions, etc., we need a total width of 45 ft. to access the location. Do not stockpile or store demolition/construction material or equipment within this distance. PG&E cannot compromise on the ability to safely access, operate and maintain our facilities, especially when considering emergency situations.

7. Construction Loading: Please refer to chart below for approved construction loading as applicable to this project. To prevent damage to the buried gas pipelines, there are weight limits that must be enforced whenever any equipment gets within 10 feet of traversing a pipeline. Due to the weight variability of tracked equipment, cranes, vibratory compactors, etc., **do not allow any construction equipment within 10 ft. of the gas pipeline(s) without approval from the PG&E gas transmission pipeline engineer.** Wheel loading calculations will need to be determined, and the pipeline may need to be potholed by hand in a few areas to confirm the depth of the existing cover. These weight limits also depend on the support provided by the pipeline's internal gas pressure. If PG&E's operating conditions require the pipeline to be depressurized, maximum wheel loads over the pipeline will need to be further limited. For compaction, please use walk-behind compaction equipment if within 2 feet of the pipeline. Crane and backhoe outriggers must be set at least 10 feet from the centerline of the gas pipeline. **Specific to this project, please ensure max PPV vibration levels are less than 2in/sec.**

   Referencing the chart below, for wheeled equipment only (excludes tracked equipment and vibratory rollers), for a depth of cover of 2ft over top of the 26" pipeline, the pipe may be subjected to a maximum half-axle wheel load of 4580 lbs. **Specific to this project, the 17,500 lb Takeuchi TB175 excavator and 8,000 lb Bobcat Excavator are approved for use.** If any equipment is planned to be operated within 10 ft. of the pipeline that exceeds the half-axel weight specified below, please contact the gas transmission pipeline engineer for approval. Half axle weight is the gross weight upon any one wheel, or wheels, supporting one end of an axle.

Depth of Cover (ft. to Top of Pipe)	Max. Half-Axle Wheel Loading (lbs.)
2	4580
3	6843
4	7775
5	7318

Feel free to contact me if there are any questions or concerns.

John Dolcini
Pipeline Engineer - Gas Transmission
Pacific Gas and Electric Company
Email: J7DP@pge.com

EXHIBIT 10

8. VIBRATION IMPACT CRITERIA

Because of the relatively rare occurrence of annoyance due to ground-borne vibration and noise, there has been only limited sponsored research of human response to building vibration and structure-borne noise. However, with the construction of new rail rapid transit systems in the past 30 years, considerable experience has been gained as to how people react to various levels of building vibration. This experience, combined with the available national and international standards,[1,2,3] represents a good foundation for predicting annoyance from ground-borne noise and vibration in residential areas as well as interference with vibration-sensitive activities.

The criteria for environmental impact from ground-borne vibration and noise are based on the maximum root-mean-square (rms) vibration levels for repeated events of the same source. The criteria presented in Table 8-1 account for variation in project types as well as the frequency of events, which differ widely among transit projects. Most experience is with the community response to ground-borne vibration from rail rapid transit systems with typical headways in the range of 3 to 10 minutes and each vibration event lasting less than 10 seconds. It is intuitive that when there will be many fewer events each day, as is typical for commuter rail projects, it should take higher vibration levels to evoke the same community response. This is accounted for in the criteria by distinguishing between projects with varying numbers of events, where *Frequent Events* are defined as more than 70 events per day, *Occasional Events* range between 30 and 70 events per day, and *Infrequent Events* are fewer than 30 events per day. Most commuter rail branch lines will fall into the infrequent events category, although the trunk lines of some commuter rail lines serving major cities are in the occasional events category.

The criteria are primarily based on experience with passenger train operations with only limited experience from freight train operations. The difference is that passenger train operations, whether rapid transit, commuter rail, or intercity passenger railroad, create vibration events that last less than about 10 seconds. A typical line-haul freight train is about 5000 feet long. At a speed of 30 mph, it will take a 5000-foot freight train approximately two minutes to pass. Even though the criteria are primarily based on experience with shorter vibration events and this manual is oriented to transit projects, there will be situations where potential impacts from freight train ground-borne vibration will need to be evaluated. The prime example is when freight train tracks must be relocated to provide space for a transit project within a railroad right-of-way. Some guidelines for applying these criteria to freight train operations are given later in this chapter.

8.1 VIBRATION IMPACT CRITERIA FOR GENERAL ASSESSMENT

8.1.1 Sensitive-Use Categories

The criteria for acceptable ground-borne vibration are expressed in terms of rms velocity levels in decibels and the criteria for acceptable ground-borne noise are expressed in terms of A-weighted sound levels. The limits are specified for the three land-use categories defined below:

- **Vibration Category 1 - High Sensitivity:** Included in Category 1 are buildings where vibration would interfere with operations within the building, including levels that may be well below those associated with human annoyance. Concert halls and other special-use facilities are covered separately in Table 8-2. Typical land uses covered by Category 1 are: vibration-sensitive research and manufacturing, hospitals with vibration-sensitive equipment, and university research operations. The degree of sensitivity to vibration will depend on the specific equipment that will be affected by the vibration. Equipment such as electron microscopes and high resolution lithographic equipment can be very sensitive to vibration, and even normal optical microscopes will sometimes be difficult to use when vibration is well below the human annoyance level. Manufacturing of computer chips is an example of a vibration-sensitive process.

  The vibration limits for Vibration Category 1 are based on acceptable vibration for moderately vibration-sensitive equipment such as optical microscopes and electron microscopes with vibration isolation systems. Defining limits for equipment that is even more sensitive requires a detailed review of the specific equipment involved. This type of review is usually performed during the Detailed Analysis associated with the final design phase and not as part of the environmental impact assessment. Mitigation of transit vibration that affects sensitive equipment typically involves modification of the equipment mounting system or relocation of the equipment rather than applying vibration control measures to the transit project.

  Note that this category does not include most computer installations or telephone switching equipment. Although the owners of this type of equipment often are very concerned about the potential of ground-borne vibration interrupting smooth operation of their equipment, it is rare for computer or other electronic equipment to be particularly sensitive to vibration. Most such equipment is designed to operate in typical building environments where the equipment may experience occasional shock from bumping and continuous background vibration caused by other equipment.

- **Vibration Category 2 - Residential:** This category covers all residential land uses and any buildings where people sleep, such as hotels and hospitals. No differentiation is made between different types of residential areas. This is primarily because ground-borne vibration and noise are experienced indoors and building occupants have practically no means to reduce their exposure. Even in a noisy urban area, the bedrooms often will be quiet in buildings that have effective noise insulation and tightly closed windows. Moreover, street traffic often abates at night when transit continues to operate. Hence, an occupant of a bedroom in a noisy urban area is likely to be just as exposed to ground-borne noise and vibration as someone in a quiet suburban area. The criteria apply to the transit-generated ground-borne vibration and noise whether the source is subway or surface running trains.

- **Vibration Category 3 - Institutional:** Vibration Category 3 includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. Although it is generally appropriate to include office buildings in this category, it is not appropriate to include all buildings that have any office space. For example, most industrial buildings have office space, but it is not intended that buildings primarily for industrial use be included in this category.

Table 8-1. Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria for General Assessment

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch /sec)			GBN Impact Levels (dB re 20 micro Pascals)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]	N/A[4]	N/A[4]	N/A[4]
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Notes:

1. "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
2. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
3. "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
5. Vibration-sensitive equipment is generally not sensitive to ground-borne noise.

EXHIBIT 11

Table 3: Project Construction Equipment Maximum Noise Levels, L_{max}			
Type of Equipment	Range of Maximum Sound Levels (dBA at 50 feet)	Suggested Maximum Sound Levels for Analysis (dBA at 50 feet)	Maximum Sound Levels (dBA) at 100 feet
Jackhammers	75 to 85	82	76
Pneumatic Tools	78 to 88	85	79
Haul Trucks	83 to 94	88	82
Hydraulic Backhoe	81 to 90	86	80
Hydraulic Excavators	81 to 90	86	80
Air Compressors	76 to 89	86	80
Trucks	81 to 87	86	80
Source: Bolt, Beranek & Newman, 1987. *Noise Control for Buildings and Manufacturing Plants.*			

Sensitive receptors are located immediately adjacent to the proposed project at 55 Gates Street, 61 Gates Street, 65 Gates Street, and 3574 Folsom Street. During the construction period for the proposed project of approximately twelve months, occupants of the nearby properties could be disturbed by construction noise. Times may occur when noise could interfere with indoor activities in nearby residences and other businesses near the project site.

As shown in Table 3, above, construction equipment would comply with the limits in the Noise Ordinance and would not exceed 80 dBA at 100 feet, with the exception of haul trucks. In the case of haul trucks, the noise impact would be less than significant, as the analysis above is based on the maximum value in the range of maximum sound level and estimated noise presented in Table 3 is at a distance 15 feet closer to the nearest actual sensitive receptor to the proposed project. Additionally, the Federal Highway Administration, in a more recent publication than that used above, estimates dump trucks to generate noise at a level closer to 70 dBA at 100 feet, a noise level 24 dBA less than the estimate utilized in the above analysis.[30] Therefore, haul trucks used during construction of the project are anticipated to meet the noise levels in the Noise Ordinance. The increase in noise in the project area during project construction would not be considered a significant impact of the proposed

[30] US Department of Transportation, Federal Highway Administration, *Construction Noise Handbook*, Table 9.1, July 2011.

project because the construction noise would be temporary, intermittent, and restricted in occurrence and level, as the contractor would be required to comply with the Noise Ordinance. Therefore, given the above, construction noise would be less than significant.

Impact NO-3: The proposed project could result in exposure of persons to, or generation of, excessive groundborne vibration or groundborne noise levels. ***(Less-Than-Significant Impact with Mitigation Incorporated)***

Project operation associated with residential uses would not generate substantial groundborne noise and vibration. Construction of the proposed project would involve site preparation and other construction activities. It would include the use of construction equipment that could result in groundborne vibration affecting properties adjacent to the project site or to PG&E Pipeline 109. No pile driving, blasting, or substantial levels of excavation or grading activities are proposed.

Given the proposed project's proximity to PG&E Pipeline 109, a construction vibration analysis was performed for the proposed project to assess any potential adverse impact on the Pipeline from vibration due to construction-related equipment and work.[31] The report evaluated vibratory impacts related to excavation of the site for the purpose of developing a proper foundation for the buildings, digging trenches for utilities to the residences, and the extension of Folsom Street for access to the residences.

The analysis assumed work on the proposed project would include:

- For the foundations, the excavation and the installation of a 12-inch to 18-inch thick concrete slab, with a potential of drilling holes for piers. If needed, compaction of the site would be done by hand, and there is potential of hand operated jack hammering being required.
- For the utility trenches, excavation would be done at distances no closer than 5 feet from Pipeline 109. For the street extension, top soil up to as much as 12 inches will be removed, and a cement concrete road surface with a thickness of 8 to 10 inches would be installed.

[31] Illingworth and Rodkin, Inc., *Construction Vibration Evaluation for 3516 and 3526 Folsom Street*, March 24, 2017.

- For both the foundations and the street extension, the soils from the sites would be transported out by a conveyor belt to Bernal Heights Boulevard.

In order to estimate the vibration level at the Pipeline, the analysis utilized the following equation:

$$PPV_{equip}=PPV_{ref}(25/D)^{n}$$

PPV_{equip}: the Peak Particle Velocity (PPV) at 25 feet measured in inches/sec
PPV_{ref}: the PPV at the distance being measured
D: the distance being measured
n: a value determined by soil conditions, ranging from 1.5 to 1[32]

The PPV_{equip} values for the equipment to be used for the proposed were collected from three sources: the Federal Transit Authority (FTA), the New Hampshire Department of Transportation, and from a study of vibration from construction activities for a project at the Haleakala National Park in Hawaii. The PPVs for each pieces of equipment proposed to be used during project construction activities are summarized in the following table:

Table 4: Peak Particle Velocities (PPVs) of Project Construction Equipment			
	Source of Data		
Equipment (project phase)	**FTA**	**New Hampshire DOT**	**Haleakala Project**
Excavator (foundation and utility trenches)		0.04 PPV	0.18 PPV
Jackhammer, if needed (foundation)	0.04 PPV		
Small Bulldozer (grading)	0.003 PPV		
Caisson drilling, if needed (piers)	0.09 PPV		

[32] *Ibid.*

For the purposes of analysis, the higher (more conservative) value of 0.18 was used for the examining the impacts of the excavator. For the n-value in the equation above, the California Department of Transportation (Caltrans) recommends a value of 1.1 for "very stiff" and "firm" soils which, according to the August 2013 soils report, characterize the top 3 to 4 feet of the project site, which is also underlain with chert bedrock.[33] Caltrans suggests an *n*-value of 1.0 for "hard, competent rock: bedrock, exposed hard rock," which characterizes the chert bedrock located beneath the soils on the project site.[34] Utilizing the equation above, a lower *n*-value is associated with a lower PPV level—that is, harder rock reduces vibration more quickly than looser rock or soils. For the purposes of the analysis, however, to obtain a conservative (worst-case) result, an *n*-value of 1.5, the maximum value, was used.

To determine the potential for an adverse impact to the PG&E Pipeline 109, the analysis compared the highest estimated PPV for each piece of equipment at its nearest proximity to the pipe during project work. The criteria for damage to a pipeline due to vibration cover a wide-range of PPV, as documented by Caltrans.[35] For example, a PPV value of 25 in/sec associated with an "explosive near [a] buried pipe" resulted in no damage, as did PPV values for "explosive[s] near [a] buried pipe" of 50-150 PPV. The analysis prepared for the proposed project utilized a conservative 12 inches/second, a value based on the West Roxbury Lateral Project in Massachusetts, as the criteria for potential damage to the pipe.[36]

The calculated maximum PPVs for each type of equipment proposed to be used during project construction activities are summarized below in Table 5.

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[33] H. Allen Gruen, *Report Geotechnical Investigation Planned Residence at 3516 Folsom Street, San Francisco, California*, August 3, 2013.

[34] Illingswoth & Rodkin Inc, Memo: *Ground Characteristics and Effect on Predicted Vibration*, April 14, 2017.

[35] California Department of Transportation, *Transportation and Construction Vibration Guidance Manual*, September 2013, page 76.

[36] The analysis notes that buried pipes can withstand higher PPV because they are constrained and do not amplify ground motion, like freestanding structures, like historic buildings, do. According to the Caltrans report cited in the analysis, PPV values as high as 150 have been shown to not harm underground pipes.

Table 5: PPV Estimates and Damage Potential of Project Construction Equipment			
Equipment (project phase)	Closest Proximity to Pipe	Highest Estimated PPV (inches/second)	Damage criteria PPV at the Pipeline (inches/second)
Excavator (foundation)	13 feet	0.48	12
Jackhammer (foundation)	13 feet	0.11	12
Drilling (piers)	12 feet	0.24	12
Small bulldozer (road construction)	1 foot	0.38	12
Excavator (utility trenches)	5 feet	2.01	12

Although the vibration assessment for the proposed project is based on damage criteria of 12 in/sec, PG&E has evaluated the proposed project and, through its regulatory authority for work in proximity to its pipeline, has set a PPV standard of 2 in/sec for this section of Pipeline 109. [37] It is noted that this standard is highly conservative in that it is a factor of 10 lower (more stringent) than the already conservative damage criteria used in the vibration assessment.

As discussed above, on page 23, the proposed project would be required to comply with PG&E regulations for construction work within 10 feet of a pipeline. These requirements include the physical presence of a PG&E inspector whenever work within 10 feet of a pipeline is performed; grading and digging standards; the placement of pipeline markers during demolition and construction; standards for construction machinery and loading near and on top of underground pipelines; and limitations on placing landscaping, structures or fencing within certain distances from

[37] PG&E Gas Transmission Pipeline Services—Integrity Management, 3516/26 Folsom Street, March 30, 2017.

the pipeline. These practices, as required by law, are in place to ensure construction activities do not substantially affect underground services, including natural gas pipelines. Furthermore, the proposed project, including street improvements, would be subject to the same PG&E plan approvals and oversite as other excavation and street improvements in San Francisco.

In accordance with CEQA, the Planning Department does not require mitigation measures for impacts that would be less than significant through compliance with applicable regulatory requirements. Further, the vibration analysis for the project indicates that the proposed project would not exceed PG&E's highly conservative 2 in/sec PPV value (which is measured as a value rounded to a whole number). However, in an abundance of caution for the purposes of this project's environmental evaluation, this Initial Study finds that project construction would have a significant vibration impact to Pipeline 109. Implementation of Mitigation Measures M-NO-3 would ensure that PPV values remain at or below PG&E's 2 in/sec PPV value. With implementation of M-NO-3, below, there would be no possibility of a significant vibration effect on PG&E's Pipeline 109.

Mitigation Measure M-NO-3, Vibration Management Plan:

The Project Sponsor shall retain the services of a qualified structural engineer to develop, and the Project Sponsor shall adopt, a vibration management and continuous monitoring plan to cover any construction equipment operations performed within 20 feet of PG&E Pipeline 109. The vibration management and monitoring plan shall be submitted to PG&E and Planning Department staff for review and approval prior to issuance of any construction permits. The vibration management plan shall include:

- **Vibration Monitoring**: Continuous vibration monitoring throughout the duration of the major structural project activities to ensure that vibration levels do not exceed the established standard.
- **Maximum PPV Vibration Levels:** Maximum PPV vibration levels for any equipment shall be less than 2 inches per second (in/sec). Should maximum PPV vibration levels exceed 2 in/sec, all construction work shall stop and PG&E shall be notified to oversee further work.
- **Standby Inspection:** A PG&E Gas Transmission Standby Inspector must be present during any demolition or construction activity within 10 feet of the gas pipeline(s). This

includes all grading, trenching, gas line depth verifications (potholes), asphalt or concrete demolition/removal, removal of trees, signs, light poles, etc. This inspection would be coordinated through the Underground Service Alert (USA) service at 811 or 1-800-227-2600. A minimum notice of 48 hours is required.

- **Grading/Excavation:** Any excavations, including grading work, above or around Pipeline 109 must be performed with a PG&E inspector present. This includes all laterals, subgrades, and gas line depth verifications (potholes). Work in the vicinity of Pipeline 109 must be completed consistent with PG&E Work Procedure TD-4412P-05 "Excavation Procedures for Damage Prevention." Any plans to expose and support Pipeline 109 across an open excavation must be approved by PG&E Pipeline Engineering in writing prior to performing the work. Any grading or digging within two (2) feet of Pipeline 109 shall be dug by hand. Water jetting to assist vacuum excavating must be limited to 125 pounds per square inch gage (psig).
- **Pipeline Markers:** Prior to the commencement of project activity, pipeline markers must be placed along the pipeline route. With written PG&E approval, any existing markers can be temporarily relocated to accommodate construction work, but must be reinstalled once construction is complete.
- **Fencing:** No parallel fencing is allowed within 10 feet of Pipeline 109 and any perpendicular fencing shall require 14 foot access gates to be secured with PG&E corporation locks.
- **Structures:** Permanent structures must be located a minimum distance of 10 feet from the edge of Pipeline 109. A total width of 45 feet shall be maintained for pipeline maintenance. No storage of construction or demolition materials is permitted within this 45 foot zone.
- **Construction Loading:** To operate or store any construction equipment within 10 feet of Pipeline 109 that exceeds the half-axle wheel load (half axle weight is the gross weight upon any one wheel, or wheels, supporting one end of an axle) in the table below, approval from a PG&E gas transmission pipeline engineer is required. Pipeline 109 may need to be potholed by hand in to confirm the depth of the existing cover. These weight limits also depend on the support provided by the Pipeline's internal gas pressure. If PG&E's operating conditions require the Pipeline to be depressurized, maximum wheel

loads over the pipeline will need to be further limited. For compaction within two feet of Pipeline 109, walk-behind compaction equipment shall be required. Crane and backhoe outriggers shall be set at least 10 feet from the centerline of Pipeline 109. Maximum PPV vibration levels for any equipment shall be less than 2 in/sec.

Depth of Cover to Top of Pipe (ft.)	Maximum Half-Axle Wheel Loading (lbs)
2	4,580
3	6,843
4	7,775
5	7,318

With implementation of **Mitigation Measure M-NO-3** significant vibration impacts to PG&E's Pipeline 109 would be reduced to a less-than-significant level.

Impact NO-4: The proposed project would not be substantially affected by existing noise levels. *(Not Applicable)*

This impact is only to be analyzed if the proposed project would exacerbate the existing noise environment. Impact NO-1 concluded the proposed project would not result in a significant noise impact. Therefore, this impact need not be analyzed. Impacts NO-2 and No-3 address construction related noise and vibration impacts, which would not affect the proposed project as the project site would not be occupied until completion of construction activities. However, the following is provided for informational purposes.

Roadway noise is the predominant source of noise in the project vicinity. The City's background noise levels map identifies the project site to be exposed to traffic noise levels between 55 and 60 dBA L_{dn}.[38] The City's land use compatibility chart shows that "satisfactory" sound levels for residential

[38] City and County of San Francisco, *General Plan, Environmental Protection Element, Map 1 (Background Noise Levels, 2009)*, 2009. This document is available for review at: http://generalplan.sfplanning.org/images/I6.environmental/ENV_Map1_Background_Noise%20Levels.pdf.

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact	Not Applicable
13. GEOLOGY AND SOILS— Would the project:					
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:					
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42.)	☐	☐	☒	☐	☐
ii) Strong seismic ground shaking?	☐	☐	☒	☐	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐	☐
iv) Landslides?	☐	☐	☒	☐	☐
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐	☐
c) Be located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☒	☐	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property?	☐	☐	☒	☐	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☐	☒
f) Change substantially the topography or any unique geologic or physical features of the site?	☐	☐	☒	☐	☐
g) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☒	☐	☐

The project site would be connected to the City's existing sewer system and would not require use of septic systems. Therefore, Topic 13.e would not be applicable to the project site.

The analysis in this section is based, in part, on the Geotechnical Investigations prepared for the proposed project.[56] The project site is underlain by three to four feet of soil overlying chert bedrock. The soil is characterized as very stiff, lean clay at one boring location, and very stiff, silty clayey sand overlying sandy lean clay at another boring location. Groundwater was not encountered at the maximum boring depth of five feet. The proposed project includes a maximum depth of excavation of ten feet for installation of the spread footing foundations for the proposed residences.

Impact GE-1: The proposed project would not result in exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, seismic groundshaking, liquefaction, lateral spreading, or landslides. *(Less-Than-Significant Impact)*

The project site is not located within an Earthquake Fault Zone as defined by the Alquist-Priolo Earthquake Fault Zoning Act and no known or potentially active fault exists on the site.[57] No active faults have been mapped on the project site by the United States Geological Survey (USGS) or the California Geological Survey (CGS).[58] In a seismically active area, such as the San Francisco Bay Area, the possibility exists for future faulting in areas where no faults previously existed. However, since faults with known surface rupture have been mapped in California, and no evidence of active faulting on the site has been found, the potential for impacts to the proposed project due to fault rupture are less than significant.

However, although the project site is not located within a seismic hazard zone, it may be subject to ground shaking in the event of an earthquake on regional fault lines like the entire San Francisco Bay

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[56] H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3516 Folsom Street, San Francisco, California, August 3, 2013. H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3526 Folsom Street, San Francisco, California, August 3, 2013.

[57] California Department of Conservation, California Geological Survey, Alquist-Priolo Fault Zones in Electronic Format, 2010. This document is available for review at www.quake.ca.gov/gmaps/ap/ap_maps.htm

[58] U.S. Geological Survey and California Geological Survey, Quaternary Fault and Fold Database for the United States, 2010. This document is available for review at www.earthquake.usgs.gov/hazards/qfaults .

I. MITIGATION MEASURES

The following mitigation measure has been identified to reduce potentially significant environmental impacts resulting from the proposed project to Less Than Significant levels.

Mitigation Measure M-NO-3, Vibration Management Plan:

The Project Sponsor shall retain the services of a qualified structural engineer to develop, and the Project Sponsor shall adopt, a vibration management and continuous monitoring plan to cover any construction equipment operations performed within 20 feet of PG&E Pipeline 109. The vibration management and monitoring plan shall be submitted to PG&E and Planning Department staff for review and approval prior to issuance of any construction permits. The vibration management plan shall include:

- **Vibration Monitoring:** Continuous vibration monitoring throughout the duration of the major structural project activities to ensure that vibration levels do not exceed the established standard.
- **Maximum PPV Vibration Levels:** Maximum PPV vibration levels for any equipment shall be less than 2 inches per second (in/sec). Should maximum PPV vibration levels exceed 2 in/sec, all construction work shall stop and PG&E shall be notified to oversee further work.
- **Standby Inspection:** A PG&E Gas Transmission Standby Inspector must be present during any demolition or construction activity within 10 feet of the gas pipeline(s). This includes all grading, trenching, gas line depth verifications (potholes), asphalt or concrete demolition/removal, removal of trees, signs, light poles, etc. This inspection would be coordinated through the Underground Service Alert (USA) service at 811 or 1-800-227-2600. A minimum notice of 48 hours is required.
- **Grading/Excavation:** Any excavations, including grading work, above or around Pipeline 109 must be performed with a PG&E inspector present. This includes all laterals, subgrades, and gas line depth verifications (potholes). Work in the vicinity of Pipeline 109 must be completed consistent with PG&E Work Procedure TD-4412P-05 "Excavation Procedures for Damage Prevention." Any plans to expose and support Pipeline 109 across an open excavation must be approved by PG&E Pipeline Engineering in writing prior to performing the work. Any grading or digging within two (2) feet of Pipeline 109

shall be dug by hand. Water jetting to assist vacuum excavating must be limited to 125 pounds per square inch gage (psig).

- **Pipeline Markers:** Prior to the commencement of project activity, pipeline markers must be placed along the pipeline route. With written PG&E approval, any existing markers can be temporarily relocated to accommodate construction work, but must be reinstalled once construction is complete.
- **Fencing:** No parallel fencing is allowed within 10 feet of Pipeline 109 and any perpendicular fencing shall require 14 foot access gates to be secured with PG&E corporation locks.
- **Structures:** Permanent structures must be located a minimum distance of 10 feet from the edge of Pipeline 109. A total width of 45 feet shall be maintained for pipeline maintenance. No storage of construction or demolition materials is permitted within this 45 foot zone.
- **Construction Loading:** To operate or store any construction equipment within 10 feet of Pipeline 109 that exceeds the half-axle wheel load (half axle weight is the gross weight upon any one wheel, or wheels, supporting one end of an axle) in the table below, approval from a PG&E gas transmission pipeline engineer is required. Pipeline 109 may need to be potholed by hand in to confirm the depth of the existing cover. These weight limits also depend on the support provided by the Pipeline's internal gas pressure. If PG&E's operating conditions require the Pipeline to be depressurized, maximum wheel loads over the pipeline will need to be further limited. For compaction within two feet of Pipeline 109, walk-behind compaction equipment shall be required. Crane and backhoe outriggers shall be set at least 10 feet from the centerline of Pipeline 109. Maximum PPV vibration levels for any equipment shall be less than 2 in/sec.

Depth of Cover to Top of Pipe (ft.)	Maximum Half-Axle Wheel Loading (lbs)
2	4,580
3	6,843
4	7,775
5	7,318

EXHIBIT 12

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MEMO

Date: March 24, 2017

To: Fabien Lannoye
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From: Paul R. Donavan, Sc.D.
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Petaluma, CA 94954

Subject: Construction Vibration Evaluation for 3516 and 3526 Folsom Street

An evaluation was completed of the potential for vibration levels from the residential building construction project at 3516 and 3526 Folsom Street of effecting a buried PG&E gas line located about 13 feet from the nearest outside perimeter of the buildings. The approximate locations of the residences are shown in Figure 1.

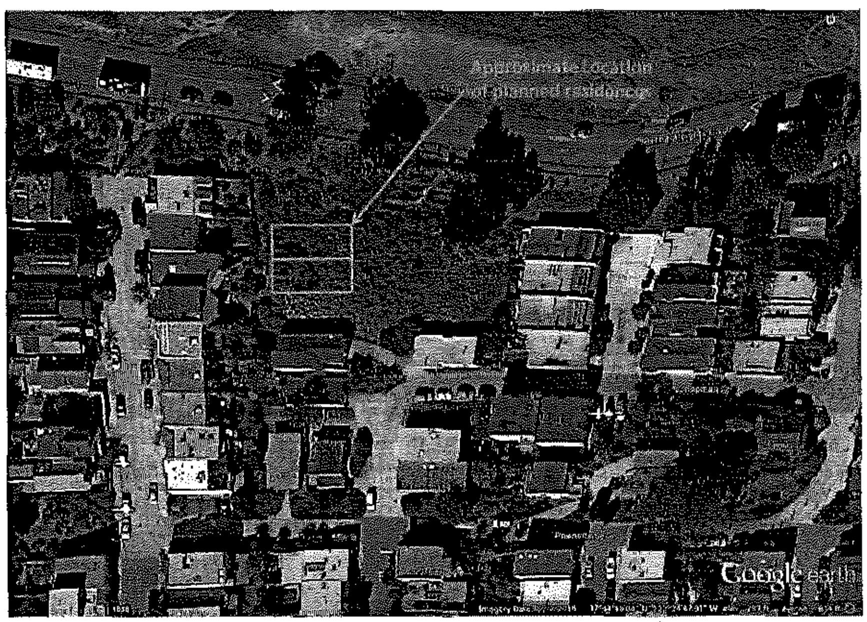

Figure 1: Aerial view of the site of the proposed residential buildings

Three aspects of this project were considered: the excavation of the sites for the purpose of developing a proper foundation for the buildings, digging trenches for utilities to the residences, and extension of Folsom Street for access to the residences. A plan view of the project is provided in Figure 2.

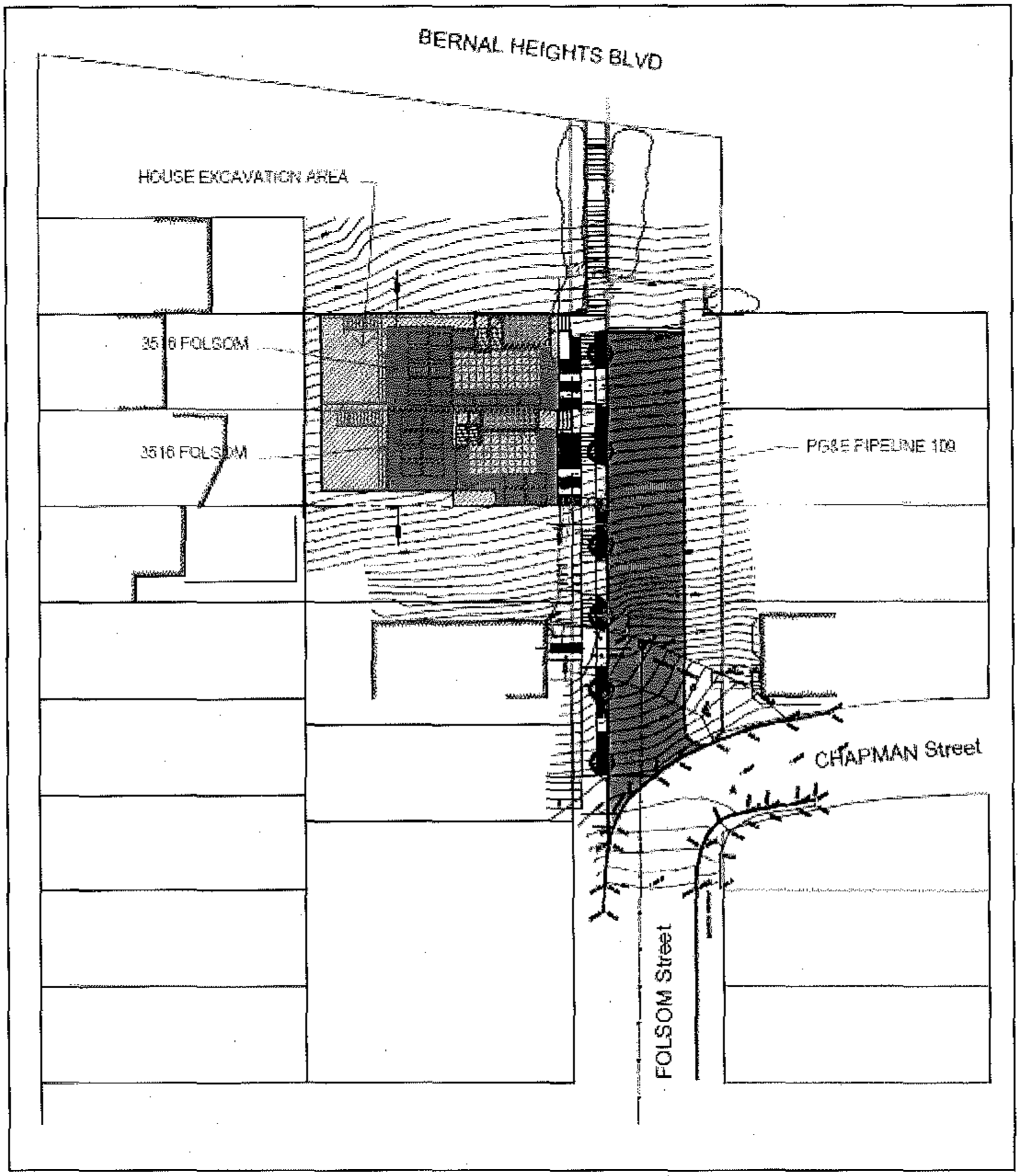

Figure 2: Plan view of the proposed Project with the location of the PG&E pipeline indicated

For the foundations, activity would involve the excavation and the installation of a 12-inch to 18-inch thick concrete slab, with a potential of drilling holes for piers. If needed, compaction of the site would be done by hand, and there is potential of hand operated jack hammering being required. For the utility trenches, excavation would be done at distances no closer than 5 feet from the gas line. For the street extension, top soil up to as much as 12 inches will be removed, and a cement concrete road surface with a thickness of 8 to 10 inches will be installed. For both the foundations and the street extension, the soils from the sites are to be transported out by a conveyor belt to Bernal Heights Boulevard.

In order to estimate the vibration level at the pipe, source vibration levels at reference distances for various types of construction equipment are available from Caltrans[1], the Federal Highway Administration (FHWA)[2], and the Federal Transit Authority (FTA)[3]. However, these resources all refer to the FTA levels which are taken as the standard reference of source levels. In cases where there are no FTA values for equipment, other source levels are obtained from the New Hampshire Department of the Transportation (NHDOT)[4]. In their 2012 report, NHDOT present levels based on their projects, as well as data from others including a Chaco Canyon Project[5] and construction activities at Haleakala National Park in Hawaii[6]. These data are typically provided in in/sec at a reference distance of 25 feet. These levels are summarized in Table 1. For equipment which has more than one value, the average was calculated and shown in the right

Table 1: Peak Particle Velocities at 25 feet for construction equipment in in/s

Type of Equipmnt	Data Source				Average
	FTA[3]	NHDOT[4]	Hawaii[6]	Chaco Canyon[5]	
Vibratory roller	0.21				
Large bulldozer	0.09				
Hoe Ram		0.28	0.12	0.04	0.15
Caisson drilling	0.09				
Loaded trucks	0.08				
Excavator		0.04	0.18		0.11
Jackhammer	0.04				
Backhoe		0.04	0.03		0.03
Small bulldozer	0.003				
Scrapper				0.02	

column of the table. For excavating the foundations and digging utility trenches, the equipment shown in Figure 3 is planned to be used. From Table 1, two PPVs have been reported in the literature covering a wide range of source level. This is not surprising as there is a large range in the size of excavators. The references do not supply details on the excavators used in generating these data. As indicated by Figure 3, the Takeuchi TB175 Excavator planned for this project is relatively small, however to be conservative in the vibration estimate, the maximum value of 0.18 in/s was used in the analysis. Since there is possibility that a hand-held jackhammer could be used in some of foundation work, the value of 0.04 in/s is used from the Federal Transit Authority Guidance[3]. For the grading work for removal of top soil for the Folsom Street extension, the small bulldozer value of 0.003 in/s was used in the estimations. If drilling for piers is required, the value of 0.09 in/s was to estimate the PPV at the gas line.

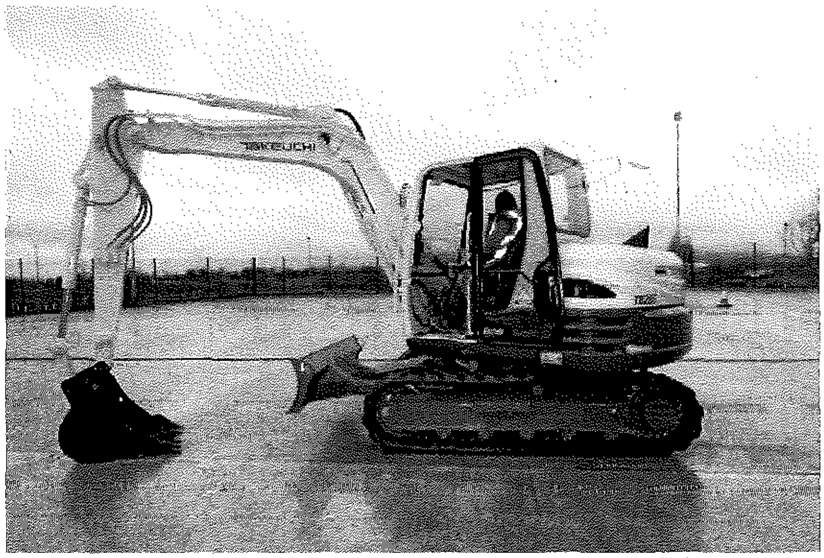

Figure 3: Photograph of a Takeuchi TB175 Excavator to be used on site

In order to estimate the vibration at specific distances, the following equation (Eqn 1) is used:

$$PPV_{equip} = PPV_{ref} (25/D)^n \tag{1}$$

where PPV_{equip} is the peak particle velocity of the construction equipment at 25 feet, PPV_{ref} is the calculated velocity at the distance D in feet, and *n* is determined by the soil conditions. There are various recommendations for the value of *n*. These range from 1.5 to 1.1[1]. From the soils report of August 2013, the soil is characterized as "very stiff" and "firm"[7]. Caltrans recommends a value for *n* of 1.1 under these conditions, and this is also the value recommended by NHDOT. However, the FTA uses a value of 1.5[3]. For distances less than the 25 feet reference distance, value of n=1.5 results in higher values of PPV so that this is also the most conservative assumption for distances of concern for the Folsom Street project. It should be noted that the above expression (Eqn 1) is primarily used to estimate vibration values at distances beyond the reference distance of 25 feet. As the distance becomes shorter than 25 feet, the vibration values increase exponentially and are increasingly sensitive to the value of *n*. As a result, the use of Eqn 1, particularly with an *n* value of 1.5, is somewhat questionable, but certainly conservative for distances less than about 10 feet. In practice, Eqn 1 has been used to estimate peak particle velocities at distances as close as 3.3 feet (1 meter)[8].

Using the highest peak particle velocity values from Table 1 discussed above and Eqn 1 with n=1.5, PPVs were estimated for the project. For an excavator, the vibration level 13 feet from the foundation construction was calculated to be 0.48 in/s. For a jackhammer, the vibration levels at 13 feet would be 0.11 in/s. If drilling of piers for the foundation is necessary, the minimum distance would also be 13 feet giving a PPV of 0.24in/s. For the street extension, the vibration velocity for the gas line will vary depending on the location of the grading operation over the width of the street. In the extreme case, this would be directly over the gas line. The gas line, according to PG&E, is about 2 to 5.6 feet below the existing cover. As the existing soil is removed, the small bulldozer (or the Takeuchi TB175 configured with a blade and no excavator) could be operating at a distance of 1 foot from the gas line. Using Eqn 1 at a distance of 1 foot, the estimated vibration levels would be 0.38 in/s. For vibration concerns, this would be expected to be an upper bound as the vibration cannot physically increase exponentially as projected by Eqn 1. For utility line excavation, the excavator would not be used closer than 5 feet from the pipe for this work. Assuming that Eqn 1 provides an upper bound on estimated PPV, this relationship gives a value of 2.01 in/s at a distance of 5 feet.

The criteria for damage due to vibration cover a wide range in PPV as documented in the Caltrans guidance[1]. These criteria are generally for building damage of varying degrees, type of structure, and whether the source is transient or continuous/frequent intermittent. In the Caltrans guidance, the extreme case is for extremely fragile historic buildings where the threshold for potential damage is a PPV of 0.08 in/s for continuous/frequent intermittent sources. For industrial buildings and bridges, a limiting criterion PPV of 2.0 in/s is suggested[9]. However, these criteria are for the response of aboveground structures, which include their unrestrained vibration that can be amplified by the incoming ground motions[9]. For buried pipe, the response is constrained; that is, the pipe cannot move freely and amplify the ground motions[1]. For these cases, higher levels of PPV can be tolerated compared to structures. PPV values from 25 to 150 in/s have been reported to cause no damage to buried pipe for transient sources[1]. A conservative PPV of criteria between 12.5 and 15 PPV has been developed based on buried pipe exposed to underground blasting. With this information, the West Roxbury Lateral Project in Massachusetts adopted of criterion of 12 in/s[10] for underground gas lines.

Using the fore mentioned described conservative assumption of equipment source levels and propagation rates, the results for this analysis for the Folsom Street project are summarized in Table 2, which identifies the specific operation and estimated PPV at the specified distance. All

Table 2: Calculated peak particle velocities for equipment and operations at the Folsom Street construction site

Equipment & Operation	Minimum Distance to Pipeline, feet	Highest Estimated PPV, in/s
Excavator - Foundation	13	0.48
Jackhammer - Foundation	13	0.11
Drilling – Foundation Piers	13	0.24
Small Bulldozer – Road Construction	1	0.38
Excavator – Utility Trenches	5	2.01

the estimated PPVs are well below the West Roxbury criteria of 12 in/s. The PPVs are essentially at or below the 2.0 in/s criterion for industrial buildings and bridges. It should also be noted that for any construction equipment operations within 10 feet of the gas pipeline, PG&E requires that Gas Transmission Standby Inspector be present during those activities. This would apply to the road construction and work on the utility trenches.

References

[1] Transportation and Construction Vibration Guidance Manual, California Department of Transportation, Report CT-HWANP-RT-13-069.25.3, September, 2013.

[2] FHWA Highway Construction Noise Handbook, Federal Highway Administration, FHWA-HEP-06-015, DOT-VNTSC-FHWA-06-02, NTIS No.PB20006-109012, Final Report, August, 2006.

[3] Transit Noise and Vibration Impact Assessment, Federal Transit Administration, DOT-T-95-16, Office of Planning, Washington, D.C., 2006.

[4] Ground Vibration Emanating from Construction Equipment Final Report, New Hampshire Department of Transportation, Report FHWA-NH-RD-12323W, Concord, New Hampshire, September 2012.

[5] Impacts of Construction Vibrations on Rock Pinnacles and Natural Bridges, General Hitchcock Highway, Tucson, AZ, Ken W. King of Geologic and Geophysical Consulting, Lakewood, CO and Matthew J. DeMarco of Central Federal Lands Highway Division, FHWA, Denver Federal Center, Denver, CO.

[6] Study of Vibrations due to Construction Activities on Haleakala, LeEllen Phelps, Mechanical Engineering Group, Document TN-0113, Revision A, ATST (Advanced Technology Solar Telescope), Appendix Q: Vibration Study, July 8, 2009.

[7] Report Geotechnical Investigation Planned Residence at 3516 Folsom Street, San Francisco, CA, prepared by H. Allen Gruen, Geotechnical Engineer, Oakland, CA, August 2013

[8] H. Amick and M. Gendreau, Construction Vibrations and Their Impact on Vibration-Sensitive Facilities, ASCE Construction Congress 6, Orlando, Florida, February, 2000. Wiss (ref)

[9] Dowding, Charles H., Construction Vibrations, Prentice-Hall, 1996.

[10] Algonquin Incremental Market Project, Analysis of the West Roxbury Crushed Stone Operations on Construction and Operation of the West Roxbury Lateral, Appendix A, prepared for Spectra Energy Partners, L.L.C. by GZA GeoEnvironmental, Inc. Norwood, MA, March 28, 2014

EXHIBIT 13

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MEMO

Date: April 14, 2017

To: Fabien Lannoye
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241 Amber Drive
San Francisco, CA 94131

From: Paul R. Donavan, Sc.D.
Illingworth & Rodkin, Inc.
1 Willowbrook Court, Suite 120
Petaluma, CA 94954

Subject: Ground Characteristics and Effect on Predicted Vibration

The March 24, 2017 Technical Memo entitled "Construction Vibration Evaluation for 3516 and 3526 Folsom Street", a value of "*n*" of 1.5 was used for estimating the propagation of peak particle velocity (PPV) in the equation:

$$PPV_{equip} = PPV_{ref}\,(25/D)^{n}$$

where D is the distance between the construction operation and receptor, in this case the PG&E gas line. It was stated that this was a conservative value. To further elaborate on that issue, please consider the following table from the Caltrans Transportation and Construction Vibration Guidance Manual:

Table 17. Measured and Suggested "n" Values Based on Soil Class

Soil Class	Description of Soil Material	Value of "n" measured by Woods and Jedele	Suggested Value of "n"
I	Weak or soft soils: loose soils, dry or partially saturated peat and muck, mud, loose beach sand, and dune sand, recently plowed ground, soft spongy forest or jungle floor, organic soils, top soil. (shovel penetrates easily)	Data not available	1.4
II	Competent soils: most sands, sandy clays, silty clays, gravel, silts, weathered rock. (can dig with shovel)	1.5	1.3
III	Hard soils: dense compacted sand, dry consolidated clay, consolidated glacial fill, some exposed rock. (cannot dig with shovel, need pick to break up)	1.1	1.1
IV	Hard, competent rock: bedrock, freshly exposed hard rock. (difficult to break with hammer)	Data not available	1.0

It will be noted that the $n=1.5$ is for soil that can be dug with a shovel. On the other hand, Soil Class IV is for harder soil which is categorized as difficult to break with a shovel. The value for n this case is 1.0. As stated in the earlier memo, the higher value of n actually estimates *lower* vibration levels. The differences in the calculated PPV for the two values of n shown below in an updated version of Table 2 of the March 24th memo:

Calculated peak particle velocities for equipment and operations at the Folsom Street construction site

Equipment & Operation	**Minimum Distance to Pipeline, feet**	**Highest Estimated PPV for n=1.5, in/s**	**Highest Estimated PPV for n=1.0, in/s**
Excavator - Foundation	13	0.48	0.35
Jackhammer - Foundation	13	0.11	0.08
Drilling – Foundation Piers	13	0.24	0.17
Small Bulldozer – Road Construction	1	0.38	0.08
Excavator – Utility Trenches	5	2.01	0.90

Contrary to what might be thought, the harder soil type actually produces lower PPV.

EXHIBIT 14

September 12, 2017

Joanna Stevenson
Blake Stevenson
1574 Church Street, Unit 1
San Francisco, CA 94131
jocyxo@gmail.com

Via U.S. Mail and Email

Re: Pre-Buyout Negotiations Disclosure Form: San Francisco Rent Ordinance §37.9E
1574 Church Street, Unit 1, San Francisco, California

Dear **Mr. and Mrs. Stevenson**,

My office represents your landlord, Christopher Do, and he has retained my services to discuss with you the option of providing you compensation to voluntarily vacate your rental unit, located at **1574 Church Street, Unit 1**, in San Francisco, California.

As you may be aware, the City of San Francisco regulates this kind of discussion between landlords and their tenants. Before landlords may negotiate a "Tenant Buyout Agreement", the landlord must first provide the tenant with certain notifications, including contact information for tenants' rights organizations, as well as substantive information about tenant rights (like the right to rescind a buyout agreement or the right not to enter one in the first place).

Those required disclosures are enclosed in this letter for your reference. The form includes each of your names – **Joanna Stevenson and Blake Stevenson** – above a field for your signature and for you to date when you received the notification from me. If you would be so kind, please execute this form and return it to my office in the enclosed, self-addressed stamped envelope. If there are any other (sub)tenants or occupants who would need to be party to such an agreement, please let me know so that I can provide the required disclosures to them as well.

Thank you in advance for your attention to this matter and for your assistance in complying with City regulations. I look forward to seeing whether everyone's expectations are aligned in reaching an agreement that I hope everyone will be happy with.

Very truly yours,

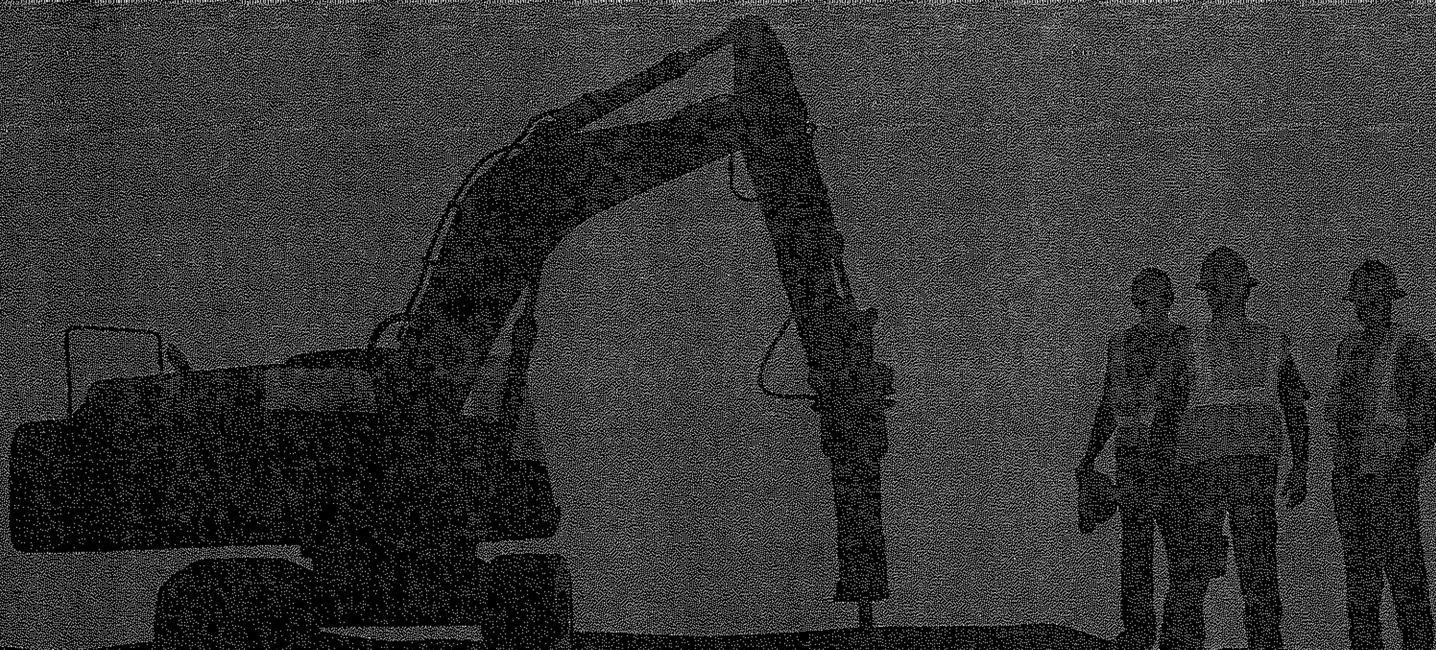
ZACKS, FREEDMAN & PATTERSON, P.C.

Justin A. Goodman

Enclosures.
Pre-Buyout Negotiations Disclosure Form: San Francisco Rent Ordinance §37.9E
w/ SASE

Transportation and Construction Vibration Guidance Manual

September 2013



California Department of Transportation
Division of Environmental Analysis
Environmental Engineering
Hazardous Waste, Air, Noise, Paleontology Office

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CALTRANS Technical Report Documentation Page

1. Report No.	2. Type of Report	3. Report Phase and Edition
CT-HWANP-RT-13-069.25.3	Guidance	Final
4. Title and Subtitle Transportation and Construction Vibration Guidance Manual		5. Report Date September 2013
6. Author(s) Jim Andrews, David Buehler, Harjodh Gill, Wesley L. Bender		7. Caltrans Project Coordinator Bruce Rymer, PE Senior Engineer
8. Performing Organization Names and Addresses California Department of Transportation Division of Environmental Analysis Environmental Engineering Hazardous Waste, Air, Noise, & Paleontology Office 1120 N Street, Mail Stop 27 Sacramento, CA 95814 http://www.dot.ca.gov/hq/env/noise/index.htm		9. Task Order No. 25 10. Contract No. : 43A0269 – ICF International
11. Sponsoring Agency Name and Address California Department of Transportation Division of Environmental Analysis Environmental Engineering Hazardous Waste, Air, Noise, & Paleontology Office Sacramento, CA 95814		12. Caltrans Functional Reviewers: *Division of Environmental Analysis*: Jim Andrews & Bruce Rymer
13. Supplementary Notes This manual does not supersede previous Caltrans publications on earthborn vibration. It is intended to supplement previous publications and to improve knowledge and information related to this issue.		14. External Reviewers James Nelson Rudy Hendriks

15. Abstract

This manual provides practical guidance to Caltrans engineers, planners, and consultants who must address vibration issues associated with the construction, operation, and maintenance of California Department of Transportation (Caltrans) projects. The guidance and procedures provided in this manual should be treated as screening tools for assessing the potential for adverse effects related to human perception and structural damage. General information on the potential effects of vibration on vibration-sensitive research and advanced technology facilities is also provided, but a discussion of detailed assessment methods in this area is beyond the scope of this manual. This document is not an official policy, standard, specification, or regulation and should not be used as such. Its content is for informational purposes only.

16. Key Words	17. Distribution Statement	18. No. of pages
earthborn and construction vibration, vibration measurement and instrumentation, air-overpressure, blasting, vibration specification, peak particle velocity, compression wave, shear wave, Rayleigh wave, material dampening coefficients, human response to vibration, pile driver vibration, vibration annoyance criteria	Available to the general public	190

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Transportation and Construction Vibration Guidance Manual

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916/653-6073

September 2013

California Department of Transportation. 2013. *Transportation and construction vibration guidance manual*. September. Sacramento, CA.

Contents

Tables

Figures

Acronyms and Abbreviations

A	acceleration
AASHTO	American Association of State Highway and Transportation Officials
Caltrans	California Department of Transportation
dB	Decibels
D_s	Square Root Scaled Distances
FFT	fast fourier transform
FTA	Federal Transit Administration
ft-lbs.	foot pounds
g	acceleration of gravity
Hz	Hertz
ICE	International Construction Equipment
in.	inches
in/sec	inches per second
in/sec^2	inches per second per second
ISO	International Standards Organization
kg	kilograms
kHz	kilo-Hertz
lbs	pounds
L_v	Vibration velocity level
mm	millimeters
mm/sec	mm/sec
mm/sec^2	mm/sec per second
MRI	magnetic resonance imaging
ms	millisecond
NCHRP	National Cooperative Highway Research Program
NIST	National Institute of Standards and Technology
OSMRE	Office of Surface Mining and Reclamation Enforcement

PETN	pentaerythritol tetranitrate
PPA	peak particle acceleration
PPV	peak particle velocity
psi	pounds per square inch
P-wave	primary waves
RI	Report of Investigations
rms	root-mean-square
R-wave	Rayleigh wave
sec.	seconds
S-wave	shear waves
USBM	U.S. Bureau of Mines
V	velocity
VdB	velocity level in decibels

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Chapter 1
Introduction And Background

This manual provides practical guidance to Caltrans engineers, planners, and consultants who must address vibration issues associated with the construction, operation, and maintenance of California Department of Transportation (Caltrans) projects.

Operation of construction equipment and construction techniques such as blasting generate ground vibration. Maintenance operations and traffic traveling on roadways can also be a source of such vibration. If its amplitudes are high enough, ground vibration has the potential to damage structures, cause cosmetic damage (e.g., crack plaster), or disrupt the operation of vibration-sensitive equipment such as electron microscopes and advanced technology production and research equipment. Ground vibration and groundborne noise can also be a source of annoyance to individuals who live or work close to vibration-generating activities. Pile driving, demolition activity, blasting, and crack-and-seat operations are the primary sources of vibration addressed by Caltrans. Traffic, including heavy trucks traveling on a highway, rarely generates vibration amplitudes high enough to cause structural or cosmetic damage. However, there have been cases in which heavy trucks traveling over potholes or other discontinuities in the pavement have caused vibration high enough to result in complaints from nearby residents. These types of issues typically can be resolved by smoothing the roadway surface.

Freight trains, mass-transit trains, and light-rail trains can also be significant sources of ground vibration and groundborne noise in the environment. Caltrans is usually not involved in the construction of rail projects. There are, however, instances in which construction or modification of a roadway requires the relocation of existing rail lines. In these cases, Caltrans must consider the effects on ground vibration associated with relocated existing tracks.

The guidance and procedures provided in this manual should be treated as screening tools for assessing the potential for adverse effects related to human perception and structural damage. General information on the potential effects of vibration on vibration-sensitive research and advanced technology facilities is also provided, but a discussion of detailed assessment methods in this area is beyond the scope of this manual. Most situations involving research and advanced technology facilities will require consultation with experts with specialized expertise in this area.

The information in this manual is meant to be informative and educational to those individuals who must address vibration from construction equipment, explosives, and facility operations. As such, the information presented herein is considered both reliable and accurate. However, because the authors have no control over the conditions under which the information might be used, any and all risk associated with the use of the information contained herein lies with the user of this manual. This document is not an official policy, standard, specification, or regulation and should not be used as such. Its content is for informational purposes only.

This manual does not supersede previous Caltrans publications on earthborne vibration. Rather, it is intended to supplement previous publications and to improve knowledge and information related to this issue. Caltrans has been involved in the evaluation of earthborne vibration since 1958 and has conducted numerous studies since that time. A Caltrans report titled *Survey of Earth-borne Vibrations due to Highway Construction and Highway Traffic* (Report CA-DOT-TL-6391-1-76-20) compiled a summary of results, findings, and conclusions of 23 studies completed in the 17-year period between 1958 and 1975. A Caltrans technical advisory titled *Transportation Related Earthborne Vibrations (Caltrans Experiences)* (Technical Advisory TAV-02-01-R9601) that was prepared in 1996 and updated in 2002 provides information from these 23 studies and other Caltrans vibration studies. This technical advisory is provided in Appendix A.

The following is an overview of the information presented in this manual. Because of the unique nature and effects of blasting, a separate chapter on that topic is presented.

- **Chapter 1, "Introduction and Background,"** summarizes the layout of this manual and provides background information on groundborne vibration.

- **Chapter 2, "Basic Physics of Ground Vibration,"** discusses the basic physics of groundborne vibration.

- **Chapter 3, "Vibration Sources,"** discusses the various sources of groundborne vibration that are of concern to Caltrans.

- **Chapter 4, "Vibration Propagation,"** discusses groundborne vibration wave types and vibration propagation models.

- **Chapter 5, "Vibration Receivers,"** discusses vibration receivers that are of concern to Caltrans: people, structures, and equipment.

- **Chapter 6, "Vibration Criteria,"** summarizes various vibration criteria that have been developed over the years.

- **Chapter 7, "Vibration Screening Assessment for Construction Equipment,"** presents a simplified procedure for assessing groundborne vibration from construction equipment.

- **Chapter 8, "Methods for Reducing Vibration,"** presents approaches to reducing the adverse effects of construction vibration.

- **Chapter 9, "General Procedures for Addressing Vibration Issues,"** discusses general procedures that can be used to avoid vibration-related problems.

- **Chapter 10, "Vibration Measurement and Instrumentation,"** discusses methods and tools used to measure and analyze vibration effects.

- **Chapter 11, "Vibration and Air-Overpressure from Blasting,"** presents information on groundborne vibration and air overpressure generated by blasting.

- **Chapter 12, "References and Additional Reading,"** lists additional sources of information.

- **Appendix A, "Technical Advisory TAV-02-01-R9601."**

- **Appendix B, "Sample Vibration Screening Procedure and Vibration Complaint Form."**

- **Appendix C, "Sample Vibration Specification."**

- **Appendix D, "Sample Blasting Vibration Specifications."**

The following individuals contributed to the preparation of this document:

- David M. Buehler, P.E., ICF International: primary author and editor

- Wesley L. Bender, Wesley L. Bender & Associates: blasting

- Harjodh Gill, PhD., Shor Acoustical Consultants: construction vibration impact assessment and reduction

- Rudy Hendriks, Caltrans: technical review
- Jim Andrews. P.E., Caltrans: technical review
- James Nelson, PhD, P.E., Wilson-Ihrig Associates: technical review
- Chris Small, ICF International: editing and document preparation

Chapter 2
Basic Physics of Ground Vibration

2.1 Simple Vibratory Motion

Dynamic excitation of an elastic system, such as the ground or a structure, results in movement of the particles that compose the elastic system. An idealized system of lumped parameters is commonly used to describe and evaluate the response of the elastic or vibratory system to excitation. The simplest lumped parameter system is called a "single-degree of freedom system with viscous damping." This system comprises a mass (to represent the weight of the system), a spring (to represent the elasticity of the system), and a dashpot (to represent damping in the system). Figure 1 is graphic representation of this idealized system.

The following equation, which excludes the effects of damping, can be used to describe the vibratory motion of a mass in this simple system:

$$D = D_{pk} \sin(2\pi f t) \qquad \textit{(Eq. 1.)}$$

Where:

D = displacement from the at-rest position at a given point in time

D_{pk} = *maximum or peak displacement amplitude from the at-rest position*

$\pi = \sim 3.1416$

f = rate of oscillation expressed in cycles per second, or Hertz (Hz)

t = time in seconds [sec.]

Figure 2 depicts the quantities that are used to describe the vibratory motion.

As the mass oscillates up and down past the at-rest position, the motion can be described as follows. When the mass is at the maximum point of displacement with the spring either compressed or extended, the velocity of the mass is zero and the acceleration of the mass is at a maximum. Conversely, as the mass passes through the point of zero displacement, the velocity is at a maximum and the acceleration is zero.

The velocity (V) of the mass can be determined by taking the time derivative of the displacement, which is equivalent to multiplying the displacement by $2\pi f$:

$$V = 2\pi f \times D \qquad (Eq.\ 2)$$

The acceleration (A) of the mass can be determined by taking the second time derivative of displacement, or the time derivative of the velocity:

$$A = 2\pi f \times V = (2\pi f)^2 \times D \qquad (Eq.\ 3)$$

Therefore, if the frequency and amplitude of displacement, velocity, or acceleration are known, the remaining amplitudes can be determined by differentiation or integration. For example, if the frequency and amplitude of velocity are known, the displacement amplitudes can be determined by integration (dividing by $2\pi f$) and the acceleration amplitude can be determined by differentiation (multiplying by $2\pi f$).

2.2 Amplitude Descriptors

In describing vibration in the ground and in structures, the motion of a particle (i.e., a point in or on the ground or structure) is used. The concepts of particle displacement, velocity, and acceleration are used to describe how the ground or structure responds to excitation. Although displacement is generally easier to understand than velocity or acceleration, it is rarely used to describe ground and structureborne vibration because most transducers used to measure vibration directly measure velocity or acceleration, not displacement. Accordingly, vibratory motion is commonly described by identifying the peak particle velocity (PPV) or peak particle acceleration (PPA). This is the zero-to-peak amplitude indicated in Figure 2.

PPV is generally accepted as the most appropriate descriptor for evaluating the potential for building damage. For human response, however, an average vibration amplitude is more appropriate because it takes time for the human body to respond to the excitation (the human body responds to an average vibration amplitude, not a peak amplitude). Because the average particle velocity over time is zero, the root-mean-square (rms) amplitude is typically used to assess human response. The

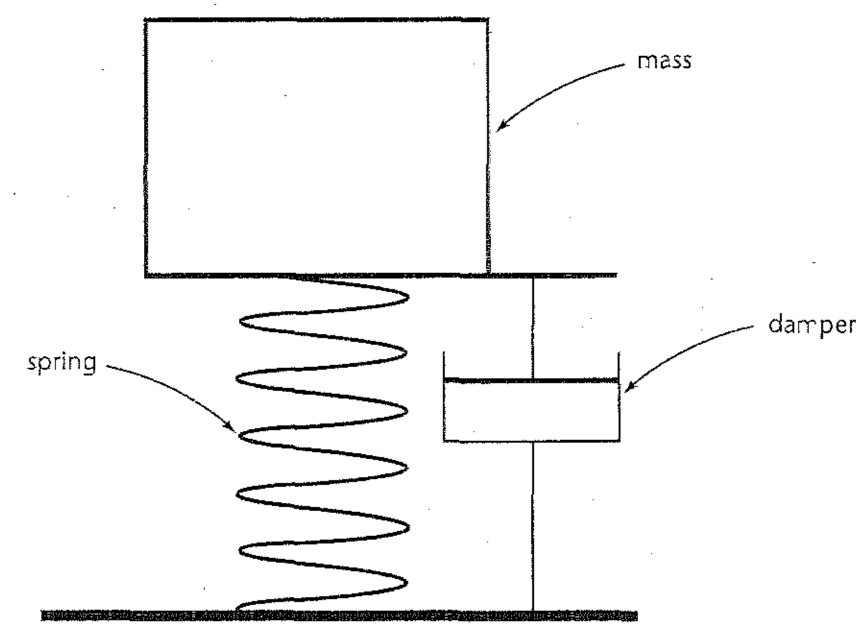

Figure 1
Simple Lumped-Parameter Vibratory System

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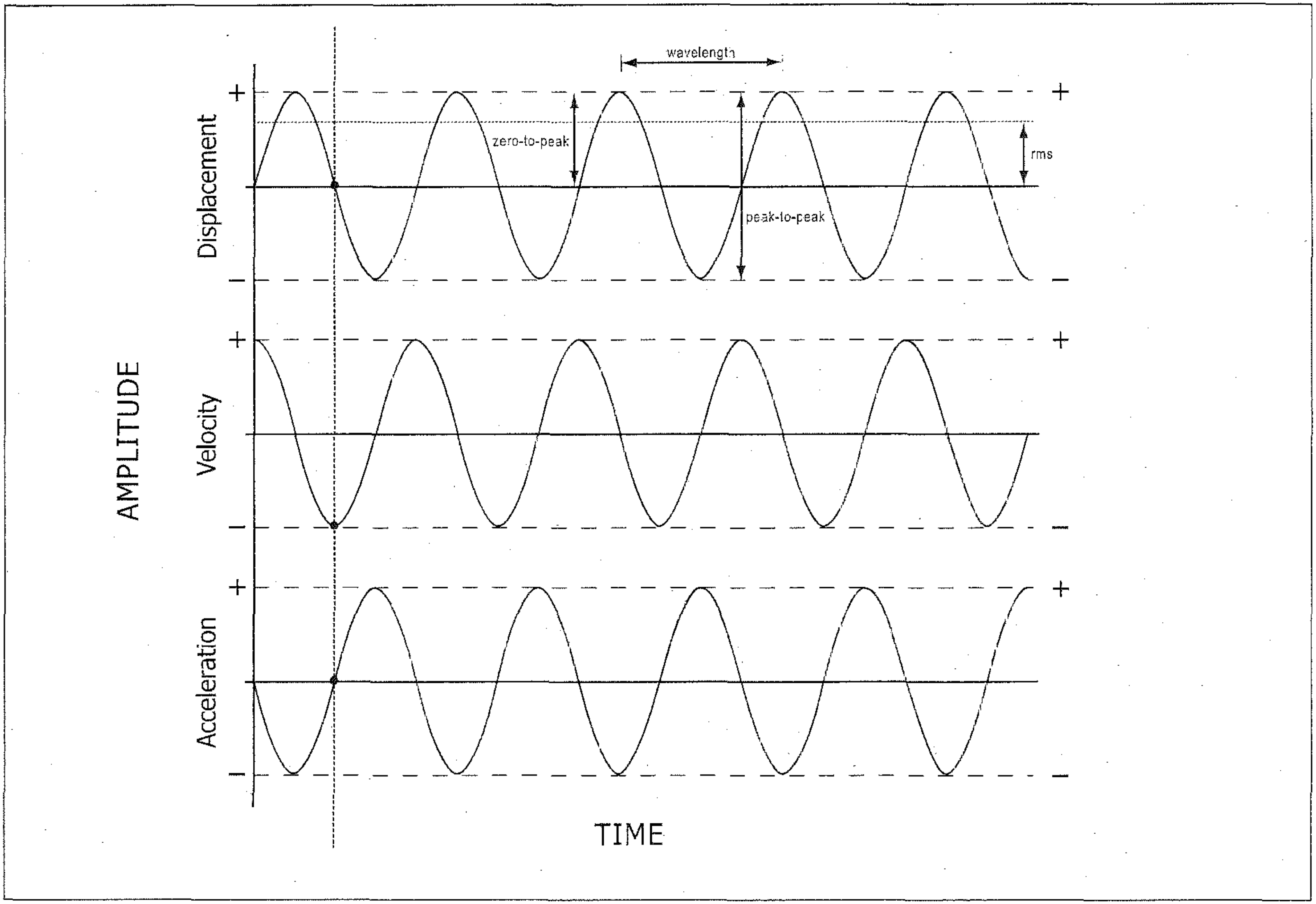

Figure 2
Quantities Used to Describe Vibratory Motion

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rms value is the average of the amplitude squared over time, typically a 1-sec. period (Federal Transit Administration 2006). The rms value is always positive and always less than PPV; for a single frequency condition, the rms value is about 70% of the PPV. The rms amplitude is indicated in Figure 2. The crest factor is the ratio of the peak amplitude to the rms amplitude. For a sine wave, the crest factor is 1.414. For random ground vibration such as vibration from trains, the crest factor is 4. For vibration from pile driving and other impact sources, the crest factor cannot be readily defined because it depends on the averaging time of the rms measurement.

Displacement is typically measured in inches (in.) or millimeters (mm). Velocity is measured in inches per second (in/sec) or millimeters per second (mm/sec). Acceleration is measured in in/sec per second (in/sec^2), mm/sec per second (mm/sec^2), or relative to the acceleration of gravity (g) (32.2 feet [ft.]/sec^2 or 9.8 meters [m]/sec^2).

Decibels (dB) are also commonly used to compress the range of numbers required to describe vibration. Vibration velocity level (L_v) in dB is defined as follows (Federal Transit Administration 1995).

$$L_v = 20 \times \log_{10}(v/v_{ref}) \qquad (Eq.\ 4)$$

Where:

L_v = *velocity level in decibels (VdB)*

v = *rms velocity amplitude*

v_{ref} = *reference velocity amplitude*

In the United States, v_{ref} is usually 1×10^{-6} in/sec (1 µ-in/sec). For example, an rms value of 0.0018 in/sec is equal to a vibration velocity level of 65 VdB (re: 1 µ-in/sec). In this manual, all vibration velocity dB values are expressed relative to 1 u-in/sec rms. Vibration in terms of PPV is referred to as vibration velocity amplitude, whereas vibrations in terms of VdB is referred to as vibration velocity level.

When discussing vibration amplitude, the direction of the particle motion must be considered. Vibration amplitude can be described in terms a vertical component; a horizontal longitudinal component; a horizontal transverse component; and the resultant, which is the vector sum of the horizontal and vertical components. Caltrans most often uses a vertical PPV descriptor because vibration amplitude along the ground surface is usually, but not always, greatest in the vertical direction (Hendriks 2002). More importantly, the vertical component is usually representative of the vibration in all three orthogonal directions and is most easily measured.

In addition to the three translational axes discussed above, particle motion can also be rotational or angular along three rotational axes. Rotational particle motion is generally not a concern with regard to human or structure response. However, certain semiconductor tools, radar antennas, and telescopes are sensitive to rotational vibration. A detailed discussion of rotational particle motion is beyond the scope of this manual.

Chapter 3
Vibration Sources

The duration and amplitude of vibration generated by construction and maintenance equipment varies widely depending on the type of equipment and the purpose for which it is being used. The vibration from blasting has a high amplitude and short duration, whereas vibration from grading is lower in amplitude but longer in duration. In assessing vibration from construction and maintenance equipment, it is useful to categorize the equipment by the nature of the vibration generated. Various equipment categories according to type of vibration and/or activities in each category are discussed below.

Equipment or activities typical of continuous vibration include:

- excavation equipment,
- static compaction equipment,
- tracked vehicles,
- traffic on a highway,
- vibratory pile drivers,
- pile-extraction equipment, and
- vibratory compaction equipment.

Equipment or activities typical of single-impact (transient) or low-rate repeated impact vibration include:

- impact pile drivers,
- blasting,
- drop balls,
- "pogo stick" compactors, and

- crack-and-seat equipment.

Equipment typical of high-rate repeated impact vibration includes jackhammers and pavement breakers.

Because vehicles traveling on highway are supported on flexible suspension systems and pneumatic tires, these vehicles are not an efficient source of ground vibration. They can, however, impart vibration into the ground when they roll over pavement that is not smooth. Continuous traffic traveling on a smooth highway creates a fairly continuous but relatively low level of vibration. Where discontinuities exist in the pavement, heavy truck passages can be the primary source of localized, intermittent vibration peaks. These peaks typically last no more than a few seconds and often for only a fraction of a second. Because vibration drops off rapidly with distance, there is rarely a cumulative increase in ground vibration from the presence of multiple trucks. In general, more trucks result in more vibration peaks, though not necessarily higher peaks. Automobile traffic normally generates vibration amplitudes that are one-fifth to one-tenth the amplitude of truck vibration amplitudes. Accordingly, ground vibration generated by automobile traffic is usually overshadowed by vibration from heavy trucks.

Freight trains, commuter rail trains, mass-transit trains, and light-rail trains can also be significant sources of ground vibration in the environment. Although Caltrans is usually not involved in the construction of rail projects, there are instances in which construction or modification of a roadway requires the relocation or existing rail lines. In these cases, Caltrans must consider the effects on ground vibration associated with relocated existing tracks. Factors that affect the amount of vibration generated by a train include:

- stiffness of the vehicle suspension systems,
- unsprung mass of the wheel sets and trucks,
- roundness of the wheels,
- roughness of the rails and wheels,
- rail support system,
- mass and stiffness of the guideway structure, and
- stiffness and layering of soils supporting the rails.

For a detailed discussion of vibration effects from trains, refer to Federal Transit Administration 2006, Nelson 1987, and U.S. Department of Transportation 1982.

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Chapter 4
Vibration Propagation

4.1 Vibration Wave Types

When the ground is subject to vibratory excitation from a vibratory source, a disturbance propagates away from the vibration source. The ground vibration waves created are similar to those that propagate in water when a stone is dropped into the water. To assess ground vibration propagation over distance, the ground is modeled as an infinite elastic halfspace. The body of this type of medium can sustain two types of waves: "compression" or "primary" waves (P-waves), and "secondary" or "shear" waves (S-waves). These waves are called "body waves." The particle motion associated with a P-wave is a push-pull motion parallel to the direction of the wave front, whereas particle motion associated with an S-wave is a transverse displacement normal to the direction of the wave front.

In 1885, Lord Rayleigh discovered a third type of wave that can propagate in a halfspace. The motion of this wave, called a Rayleigh wave (R-wave), is confined to a zone near the surface or boundary of the halfspace. The R-wave consists of horizontal and vertical components that attenuate rapidly with depth (Richart 1970). Figure 3 depicts the deformation characteristics of P-, S-, and R-waves.

P-, S-, and R-waves travel at different speeds. The P-wave is the fastest, followed by the S-wave, then the R-wave. For a single short-duration disturbance, the characteristic wave system is shown in Figure 4 (Richart 1970). About 67% of energy is transmitted in the R-wave, 26% in the S-wave, and 7% in the P-wave (Richart 1970). As shown in Figure 5, the P-wave arrives first, followed by the S-wave, then the R-wave, with most of the energy in the R-wave. Along the surface of the ground, the P- and S-waves decay more rapidly than the R-wave. Therefore, the R-wave is the most significant disturbance along the surface of the ground, and it may be the only clearly distinguishable wave at large distances from the source (Richart 1970). However, at higher frequencies the R-wave may not be identifiable because inhomogeneities and layering complicate the propagation of these waves.

4.2 Vibration Propagation Models

When the ground is subject to vibratory excitation, body waves propagate outward radially from the source along a hemispherical wave front, while the R-wave propagates outward radially along a cylindrical wave front. All of these waves encounter an increasingly large volume of material as they travel outward, and the energy density in each wave decreases with distance from the source. This decrease in energy density and the associated decrease in displacement amplitude is called spreading loss. The amplitudes of body waves decrease in direct proportion to the distance from the source, except along the surface, where their amplitudes decrease in direct proportion to square of the distance to the source. The amplitude of R-waves decreases in direct proportion to the square root of the distance from the source.

The general equation for modeling spreading loss (often called "geometric attenuation") is as follows:

$$v_b = v_a\ (r_a/r_b)^{\gamma} \qquad \textit{(Eq. 5)}$$

Where:

v_a = *vibration amplitude of the source at distance* r_a

v_b = *vibration amplitude at distance* r_b

γ = *geometric attenuation coefficient*

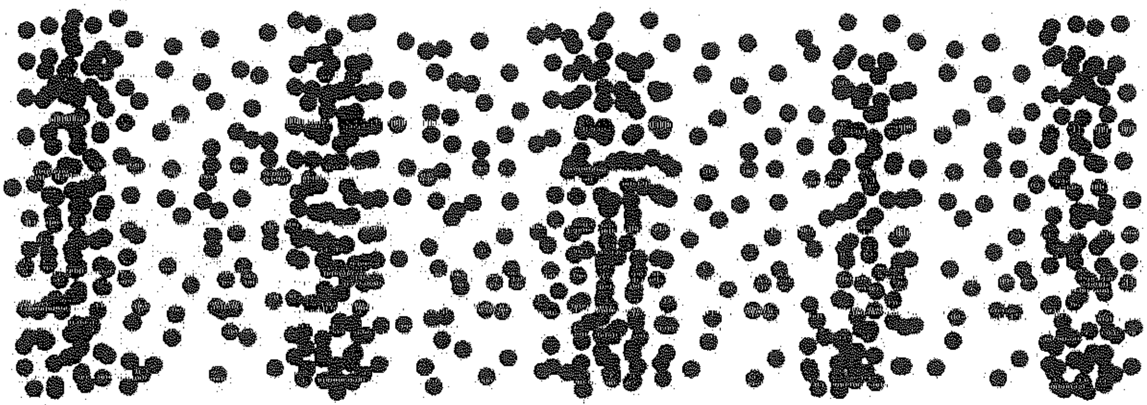
As implied above, the geometric attenuation exponent depends on the wave type and propagation path. Table 1 summarizes the geometric attenuation coefficient by wave type and propagation path.

Table 1. Geometric Attenuation Coefficients

Source	**Wave Type**	**Measurement Point**	**γ**
Point on surface	R	Surface	0.5
Point on surface	Body (P or S)	Surface	2
Point at depth	Body (P or S)	Surface	1
Point at depth	Body (P or S)	Depth	1

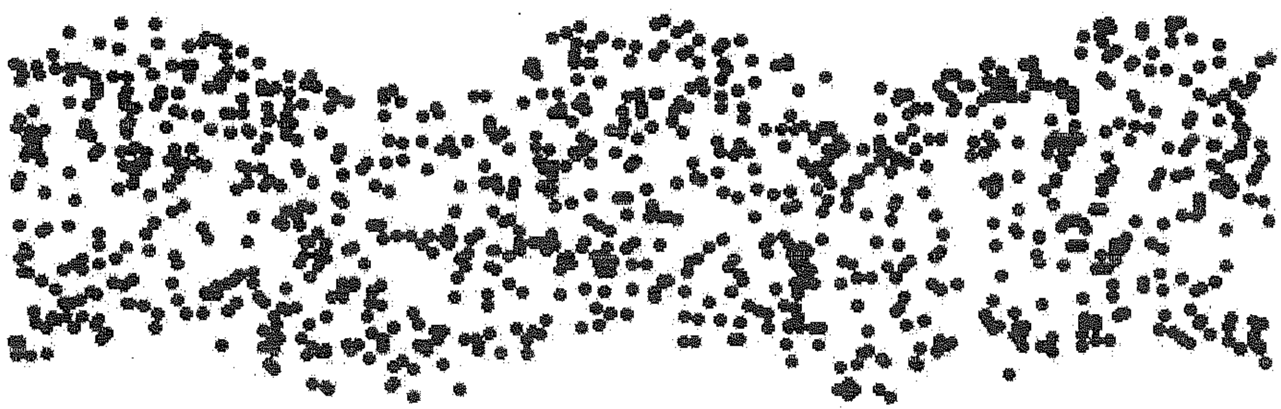
Source: Amick 2000.

Given that two-thirds of the total input energy is transmitted away from a vertically oscillating source by the R-wave and that the R-wave decays much more slowly with distance than body waves, the R-wave is of primary concern for foundations on or near the ground surface (Richart 1970). Most construction settings involve surface or near-surface sources



Compression or Primary Wave (P-Wave)

direction of wave propagation



Shear or Secondary Wave (S-Wave)

Figure 3
Body Wave Types

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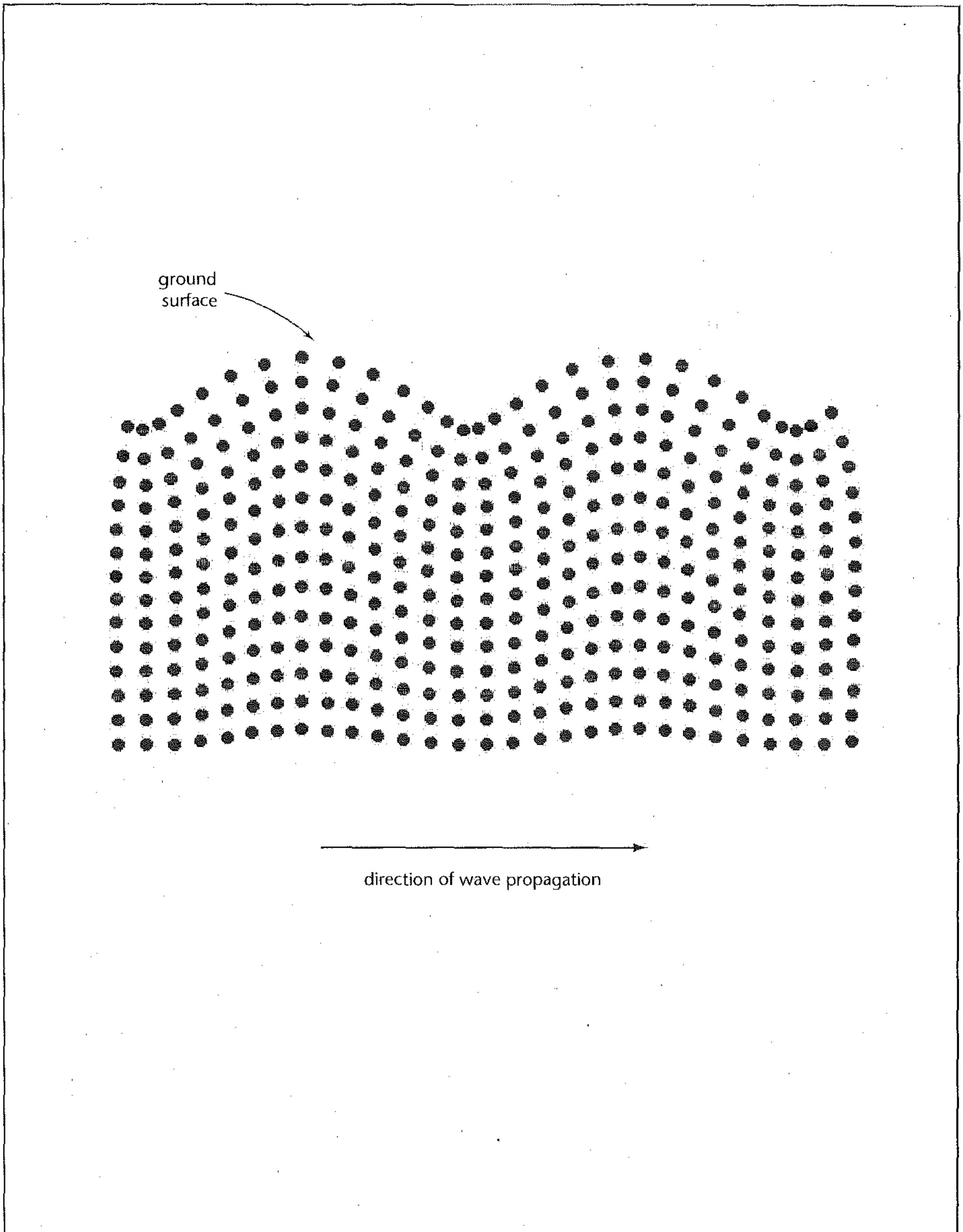

Figure 4
Rayleigh Surface Wave

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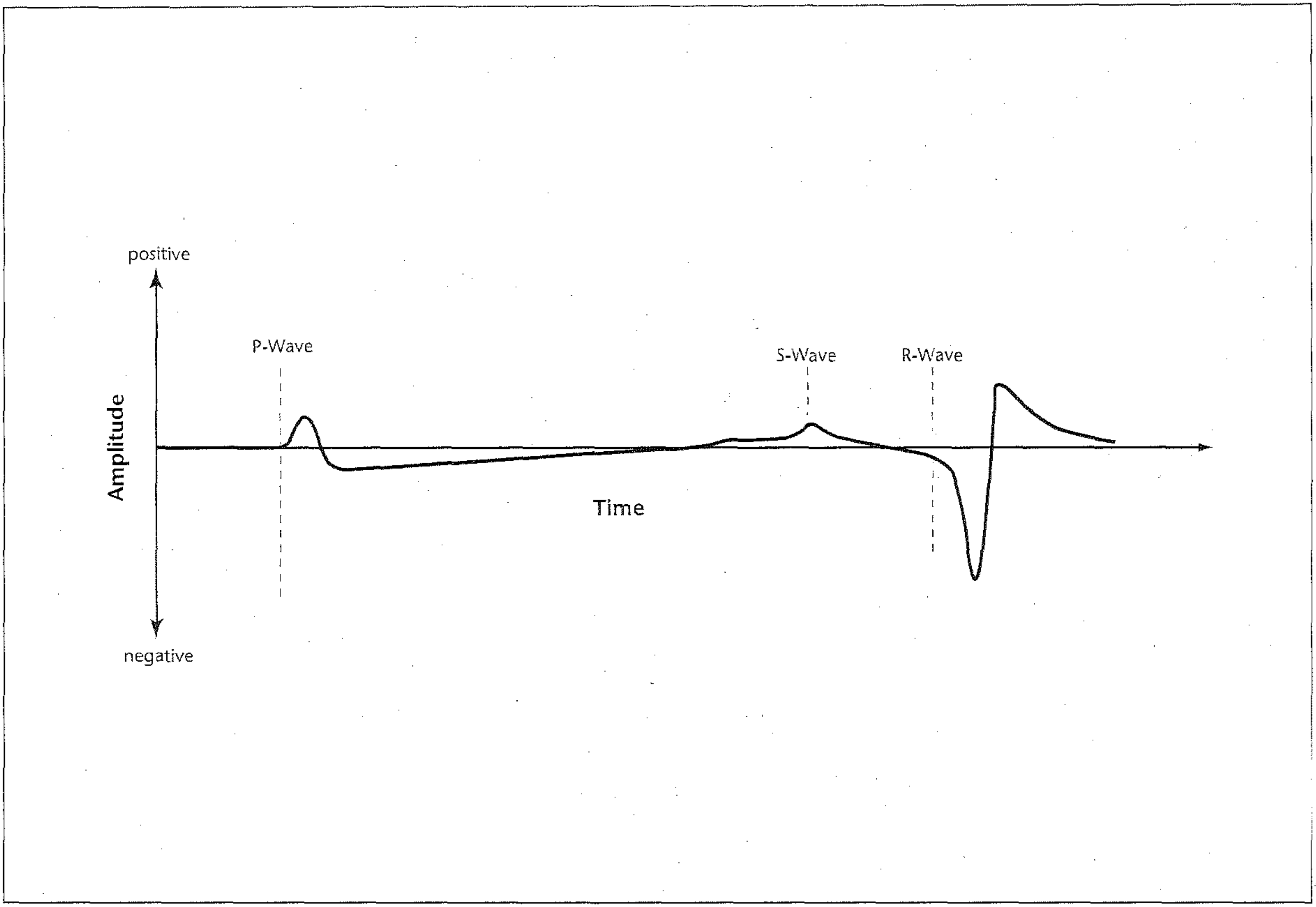

Figure 5
Wave System from a Surface Point Source

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and receivers, making the R-wave the primary wave of concern. Even when the actual vibration source is below the surface, as with pile driving, R-waves are formed within a few meters of the point on the surface directly above the source (Dowding 1996). Accordingly, propagation of vibration from construction sources, including pile driving, is typically modeled in terms of R-waves (i.e., $\gamma = 0.5$). For a buried source, the R-wave emerges at a distance of about five times the depth from the source.

Because soil is not perfectly elastic, another attenuation factor influences attenuation of R-waves. In real earth materials, energy is lost by material damping (Richart 1970). Material damping is generally thought to be attributable to energy loss due to internal sliding of soil particles. Fluid motion in pores may also produce attenuation. Assuming R-waves are of primary consideration, the effect of material damping can be added to Eq. 5 as follows (Richart 1970):

$$v_b = v_a \, (r_a/r_b)^{0.5} \, e^{\,a(ra - rb)} \qquad \textit{(Eq. 6)}$$

Where:

α = *material damping coefficient*

Many factors affect material damping in soil, including soil type, moisture content, temperature, and the frequency of the vibration sources. Clays tend to exhibit higher damping than sandy soils (Wiss 1967). Wet sand attenuates less than dry sand because the combination of pore water and sand particles in wet sand does not subject compressional waves to as much attenuation by friction damping as does dry sand. Propagation of R-waves is moderately affected by the presence or absence of water (Richart 1970). Frozen soil attenuates less than thawed soil (Barkan 1962). Table 2 summarizes material damping coefficients for various soil types.

Table 2. Summary of Material-Damping Coefficients (Applies to Both P- and S-Waves)

Investigator	Soil Type	α feet^{-1}	α meter^{-1}
Forssblad	Silty gravelly sand	0.04	0.13
Richart	4 in. concrete slab over compact granular fill	0.006	0.02
Woods	Silty fine sand	0.079	0.26
Barkan	Saturated fine grain sand	0.003	0.010
	Saturated fine grain sand in frozen state	0.018	0.06
	Saturated sand with laminae of peat and organic silt	0.012	0.04
	Clayey sand, clay with some sand, and silt above water level	0.012	0.04
	Marly chalk	0.03	0.1
	Loess and loessial soil	0.03	0.1
	Saturated clay with sand and silt	0.0–0.037	0.0–0.12
Dalmatov	Sand and silt	0.079–0.11	0.026–0.36
Clough, Chameau	Sand fill over bay mud	0.015–0.061	0.05–0.2
	Dune sand	0.076–0.2	0.025–0.65
Peng	Soft Bangkok clay	0.079–0.13	0.026–0.44
Hendriks	Sand-silt, clayey silt, silty sand	0.006	0.021

Sources: Amick 2000, Hendriks 2002 (for Hendricks only).

A more simplified model has been suggested by Wiss (1981), who obtained a best fit of field data with the following equation:

$$V = kD^{-n} \qquad \textit{(Eq. 7)}$$

Where:

V = PPV of the seismic wave

k = value of velocity at one unit of distance

D = distance from the vibration source

n = slope or attenuation rate

The "n" value in this case is not equivalent to the material damping coefficient, but rather is a composite value or pseudo-attenuation coefficient that accounts for both geometric and material damping. Woods and Jedele (1985) developed values for "n" from field construction data. These values were related to generic soil types as indicated in Table 3.

Table 3. "n" Values Based on Soil Classes

Soil Class	Soil Type	"n" Value for Eq. 7
Class I	*Weak or soft soils:* lossy soils, dry or partially saturated peat and muck, mud, loose beach sand, dune sand, recently plowed ground, soft spongy forest or jungle floor, organic soils, topsoil (shovel penetrates easily)	None identified
Class II	Competent soils: *most sands, sandy clays, silty clays, gravel, silts, weathered rock (can dig with a shovel)*	1.5
Class III	*Hard soils:* dense compacted sand, dry consolidated clay, consolidated glacial till, some exposed rock (cannot dig with a shovel, need a pick to break up)	1.1
Class IV	*Hard, competent rock:* bedrock, freshly exposed hard rock (difficult to break with a hammer)	None identified

Source: Wood 1997.

There is a relationship between vibration amplitude and the energy of the driving force (Hendriks 2002). In general, if the energy of the driving force changes from E_1 to E_2, the vibration amplitude changes from V_1 to V_2 according to the following equation:

$$V_2 = V_1(E_2/E_1)^{0.5} \qquad (Eq.\ 8)$$

In general, if the vibration amplitude of a source at a given distance is known, Eq. 6 or Eq. 7 can be used to estimate the resulting amplitude at various distances. This methodology, which does not account for the frequency dependence of the material-damping coefficient, provides a convenient and reasonable means of assessing vibration impact on structures and people. This method does not, however, have enough detail to be particularly useful for impact assessment for vibration-sensitive research or advanced technology facilities (Amick 2000). There is a significant body of knowledge that relates human response and building damage to the peak velocity amplitude measured in the time domain. Essentially, this is the function of Eq. 6 and Eq. 7. However, most assessment of the impact of vibration on research and advanced technology facilities is based on measurement and analysis in the frequency domain using frequency spectra (typically one-third octave spectra). The assessment of frequency-dependent vibration propagation is beyond the scope of this guidance manual.

For the purposes of assessing vibration effects on people and structures, use of a frequency- independent material-damping coefficient is supported by the fact that damage levels in terms of velocity in the frequency range of 1–80 Hz tend to be independent of frequency. This is also true for complaint levels in a frequency range of 8–80 Hz. Typical vibration from transportation and construction sources typically falls in the range of 10–30 Hz and usually centers around 15 Hz (Hendriks 2002). Within the narrow range of frequencies associated with most sources, frequency independence is a reasonable assumption.

Chapter 7 discusses a suggested method for applying propagation models to the assessment of groundborne vibration from construction equipment. Chapter 8 discusses a method relating to blasting.

Chapter 5
Vibration Receivers

There are three primary types of receivers that can be adversely affected by ground vibration: people, structures, and equipment.

Ground vibration can be annoying to people. The primary effect of perceptible vibration is often a concern. However, secondary effects, such as the rattling of a china cabinet, can also occur, even when vibration levels are well below perception. Any effect (primary perceptible vibration, secondary effects, or a combination of the two) can lead to annoyance. The degree to which a person is annoyed depends on the activity in which they are participating at the time of the disturbance. For example, someone sleeping or reading will be more sensitive than someone who is running on a treadmill. Reoccurring primary and secondary vibration effects often lead people to believe that the vibration is damaging their home, although vibration levels are well below minimum thresholds for damage potential.

Vibration generated by construction activity has the potential to damage structures. This damage could be structural damage, such as cracking of floor slabs, foundations, columns, beams, or wells, or cosmetic architectural damage, such as cracked plaster, stucco, or tile.

Ground vibration also has the potential to disrupt the operation of vibration-sensitive research and advanced technology equipment. This equipment can include optical microscopes, cell probing devices, magnetic resonance imaging (MRI) machines, scanning electron microscopes, photolithography equipment, micro-lathes, and precision milling equipment. The degree to which this equipment is disturbed depends on the type of equipment, how it used, and its support structure. For example, equipment supported on suspended floors may be more susceptible to disturbance than equipment supported by an on-grade slab.

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Chapter 6
Vibration Criteria

Over the years, numerous vibration criteria and standards have been suggested by researchers, organizations, and governmental agencies. There are no Caltrans or Federal Highway Administration standards for vibration, and it is not the purpose of this manual to set standards. Rather, the following discussion provides a summary of vibration criteria that have been reported by various researchers, organizations, and governmental agencies. The information is used in this chapter to develop a synthesis of these criteria that can be used to evaluate the potential for damage and annoyance from vibration-generating activities. In addition to the criteria discussed in this chapter, additional criteria that apply specifically to blasting are provided in Chapter 11.

6.1 People

Numerous studies have been conducted to characterize the human response to vibration. Table 4 summarizes the results of an early study (Reiher 1931) on human response to steady-state (continuous) vibration. Human response to vibration generated by blasting is discussed in Chapter 8.

Table 4. Human Response to Steady State Vibration

PPV (in/sec)	Human Response
3.6 (at 2 Hz)–0.4 (at 20 Hz)	Very disturbing
0.7 (at 2 Hz)–0.17 (at 20 Hz)	Disturbing
0.10	Strongly perceptible
0.035	Distinctly perceptible
0.012	Slightly perceptible

Table 5 summarizes the results of another study (Whiffen 1971) that relates human response to vibration from traffic (continuous vibration).

Table 5. Human Response to Continuous Vibration from Traffic

PPV (in/sec)	Human Response
0.4–0.6	Unpleasant
0.2	Annoying
0.1	Begins to annoy
0.08	Readily perceptible
0.006–0.019	Threshold of perception

Table 6 summarizes the results of another study (Wiss 1974) that relates human response to transient vibration.

Table 6. Human Response to Transient Vibration

PPV (in/sec)	Human Response
2.0	Severe
0.9	Strongly perceptible
0.24	Distinctly perceptible
0.035	Barely perceptible

The results in Tables 4–6 suggest that the thresholds for perception and annoyance are higher for transient vibration than for continuous vibration.

In 1981, the International Standards Organization (ISO) published *Guide to the Evaluation of Human Exposure to Vibration and Shock in Buildings (1 Hz to 80 Hz)* (ISO 2631). This document, based on the work of many researchers, suggested that humans are sensitive to particle velocity in the range of 8–80 Hz. This means that the same velocity at different discrete frequencies will elicit the same response, such as detection or discomfort. Below 8 Hz, the body is less sensitive to vibration, and therefore responds more uniformly to acceleration (i.e., higher velocities are needed to elicit the same response). Table 7 summarizes the vibration criteria in ISO 2631 for vibration sources with predominant frequencies in the range of 8–80 Hz. It is recommended in ISO 2631 that one-third octave band filtering be used when the vibration source has many closely spaced frequencies or contains broadband energy.

Table 7. ISO 2631 Vibration Criteria

Building Use	Vibration Velocity Level (VdB)	Vibration Velocity rms Amplitude (in/sec)
Workshop	90	0.032
Office	84	0.016
Residence	78 day/75 night	0.008
Hospital operating room	72	0.004

Also, FTA (2006) has developed vibration criteria based on building use. These criteria, shown in Table 8, are based on overall rms vibration levels expressed in VdB.

Table 8. Federal Transit Administration Vibration Impact Criteria

Land Use Category	Vibration Impact Level for Frequent Events (VdB)	Vibration Impact Level for Infrequent Events (VdB)
Category 1: Buildings where low ambient vibration is essential for interior operations	65	65
Category 2: Residences and buildings where people normally sleep	72	80
Category 3: Institutional land uses with primarily daytime use	75	83

Note: "Frequent events" is defined as more than 70 events per day. "Infrequent events" is defined as fewer than 70 events per day.

6.2 Structures

The effects of vibration on structures has also been the subject of extensive research. Much of this work originated in the mining industry, where vibration from blasting is a critical issue. The following is a discussion of damage thresholds that have been developed over the years. Mining industry standards relating to structure damage thresholds are presented in Chapter 7.

A study by Chae (1978) classifies buildings in one of four categories based on age and condition. Table 9 summarizes maximum blast vibration amplitudes based on building type. (The study recommends that the categories be lowered by one if the structure is subject to repeated blasting.)

Table 9. Chae Building Vibration Criteria

Class	PPV (Single Blast) (in/sec)	PPV (Repeated Blast) (in/sec)
Structures of substantial construction	4	2
Relatively new residential structures in sound condition	2	1
Relatively old residential structures in poor condition	1	0.5
Relatively old residential structures in very poor condition	0.5	—

The Swiss Association of Standardization has developed a series of vibration damage criteria that differentiates between single-event sources (blasting) and continuous sources (machines and traffic) (Wiss 1981). The criteria are also differentiated by frequency. Assuming that the frequency range of interest for construction and traffic sources is 10–30 Hz, Table 10 shows criteria for 10–30 Hz.

Table 10. Swiss Association of Standardization Vibration Damage Criteria

Building Class	Continuous Source PPV (in/sec)	Single-Event Source PPV (in/sec)
Class I: buildings in steel or reinforced concrete, such as factories, retaining walls, bridges, steel towers, open channels, underground chambers and tunnels with and without concrete alignment	0.5	1.2
Class II: buildings with foundation walls and floors in concrete, walls in concrete or masonry, stone masonry retaining walls, underground chambers and tunnels with masonry alignments, conduits in loose material	0.3	0.7
Class III: buildings as mentioned above but with wooden ceilings and walls in masonry	0.2	0.5
Class IV: construction very sensitive to vibration; objects of historic interest	0.12	0.3

Konan (1985) reviewed numerous vibration criteria relating to historic and sensitive buildings, and developed a recommended set of vibration criteria for transient (single-event) and steady-state (continuous) sources. Konan recommended that criteria for continuous vibration be about half the amplitude of criteria for transient sources. Table 11 summarizes the recommended criteria.

Table 11. Konan Vibration Criteria for Historic and Sensitive Buildings

Frequency Range (Hz)	Transient Vibration PPV (in/sec)	Steady-State Vibration PPV (in/sec)
1–10	0.25	0.12
10–40	0.25–0.5	0.12–0.25
40–100	0.5	0.25

Whiffen (1971) presents additional criteria for continuous vibration. These criteria are summarized in Table 12.

Table 12. Whiffen Vibration Criteria for Continuous Vibration

PPV (in/sec)	Effect on Buildings
0.4–0.6	Architectural damage and possible minor structural damage
0.2	Threshold at which there is a risk of architectural damage to normal dwelling houses (houses with plastered walls and ceilings)
0.1	Virtually no risk of architectural damage to normal buildings
0.08	Recommended upper limit of vibration to which ruins and ancient monuments should be subjected
0.006–0.019	Vibration unlikely to cause damage of any type

Siskind et al. (1980) applied probabilistic methods to vibration damage thresholds for blasting. Three damage thresholds have been identified and are described in Table 13 in terms of PPV for probabilities of 5, 10, 50, and 90%.

Table 13. Siskind Vibration Damage Thresholds

	PPV (in/sec)			
Damage Type	**5% Probability**	**10% Probability**	**50% Probability**	**90% Probability**
Threshold damage: loosening of paint, small plaster cracks at joints between construction elements	0.5	0.7	2.5	9.0
Minor damage: loosening and falling of plaster, cracks in masonry around openings near partitions, hairline to 3-mm (0–1/8-in.) cracks, fall of loose mortar	1.8	2.2	5.0	16.0
Major damage: cracks of several mm in walls, rupture of opening vaults, structural weakening, fall of masonry, load support ability affected	2.5	3.0	6.0	17.0

Dowding (1996) suggests maximum allowable PPV for various structure types and conditions. Table 14 summarizes these values.

Table 14. Dowding Building Structure Vibration Criteria

Structure and Condition	Limiting PPV (in/sec)
Historic and some old buildings	0.5
Residential structures	0.5
New residential structures	1.0
Industrial buildings	2.0
Bridges	2.0

The American Association of State Highway and Transportation Officials (AASHTO) (1990) identifies maximum vibration levels for preventing damage to structures from intermittent construction or maintenance activities. Table 15 summarizes the AASHTO maximum levels.

Table 15. AASHTO Maximum Vibration Levels for Preventing Damage

Type of Situation	Limiting Velocity (in/sec)
Historic sites or other critical locations	0.1
Residential buildings, plastered walls	0.2–0.3
Residential buildings in good repair with gypsum board walls	0.4–0.5
Engineered structures, without plaster	1.0–1.5

The National Cooperative Highway Research Program (NCHRP) published a report in September 2012 entitled "Current Practices to

Address Construction Vibration and Potential Effects to Historic Buildings Adjacent to Transportation Projects." This report summarizes a detailed literature search on the topic of construction vibration effects on historic building along with information from a survey of state departments of transportation on the topic. The report also provides a suggested guideline approach to assessing these effects. The report can be found at the following NCHRP website:

http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25(72)_FR.pdf

6.3 Equipment

The operation of equipment for research, microelectronics manufacturing, medical diagnostics, and similar activities can be adversely affected by vibration. For the purposes of designing facilities to house this equipment, vibration criteria that are generic (i.e., applicable to classes of equipment or activity) rather than specific have been developed (Amick et al. 2005). These criteria are expressed in terms of one-third octave band velocity spectra and are summarized in Table 16.

Table 16. Vibration Criteria for Sensitive Equipment

Criterion Curve (see Figure 1)	Max Level[1] (microinches/sec) (dB)	Detail Size[2] (microns)	Description of Use
Workshop (ISO)	32,000	NA	Distinctly perceptible vibration. Appropriate to workshops and nonsensitive areas.
Office (ISO)	16,000	NA	Perceptible vibration. Appropriate to offices and nonsensitive areas.
Residential Day (ISO)	8,000	75	Barely perceptible vibration. Appropriate to sleep areas in most instances. Usually adequate for computer equipment, semiconductor probe test equipment, and microscopes less than 40x.
Op. Theatre (ISO)	4,000	25	Vibration not perceptible. Suitable in most instances for surgical suites, microscopes to 100x and for other equipment of low sensitivity.
VC-A	2,000	8	Adequate in most instances for optical microscopes to 400x, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	1,000	3	Appropriate for inspection and lithography equipment (including steppers) to 3 µ line widths.
VC-C	500	1-3	Appropriate standard for optical microscopes to 1,000x, lithography and inspection equipment (including moderately sensitive electron microscopes) to 1 µ detail size, TFT-LCD stepper/scanner processes.
VC-D	250	0.1-0.3	Suitable in most instances for the most demanding equipment including many electron microscopes (SEMs and TEMs) and E-Beam systems.
VC-E	125	<0.1	A challenging criterion to achieve. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems, E-beam lithography systems working at nanometer scales, and other systems requiring extraordinary dynamic stability.
VC-F	62.5	N/A	Appropriate for extremely quiet research spaces; generally difficult to achieve in most instances, especially cleanrooms. Not recommended for use as a design criterion, only for evaluation.
VC-G	31.3	N/A	Appropriate for extremely quiet research spaces; generally difficult to achieve in most instances, especially cleanrooms. Not recommended for use as a design criterion, only for evaluation.

[1] As measured in one-third octave bands of frequency over the frequency range 8 to 80 Hz (VC-A and VC-B) or 1 to 80 Hz (VC-C through VC-G).

[2] The detail size refers to the line width in the case of microelectronics fabrication, the particle (cell) size in the case of medical and pharmaceutical research, etc. It is not relevant to imaging associated with probe technologies, AFMs, and nanotechnology.

The information given in this table is for guidance only. In most instances, it is recommended that the advice of someone knowledgeable about the applications and vibration requirements of the equipment and process be sought.
Source: Amick et al. 2005.

Chapter 7
Vibration Prediction and Screening Assessment for Construction Equipment

To assess the potential for vibration to annoy people and damage structures, a reasonable means must be available for estimating or predicting the PPV from various sources at various distances. This section describes a simple method for predicting vibration amplitudes from construction equipment, in terms of PPV, for a variety of vibration sources and soil types. A method for evaluating vibration from blasting is provided in Chapter 8. The evaluation of potential vibration impacts on research and advanced technology production equipment is beyond the scope of this manual. Individuals with specialized expertise in the evaluation of these impacts should be contacted in cases where research and advanced technology equipment could be affected.

This assessment of effects relates to the direct effects of vibration on people and structures. For pile driving, there are few cases of direct damage to structures located farther from a pile than the length of that pile. Settlement of soil as the result of pile driving, however, has potential to damage surface and buried structures at greater distances. Assessment of effects related to vibration-related soil settlement is beyond the scope of this manual. Individuals with specialized expertise in vibration-related soil settlement should be consulted in cases where construction-induced vibration could result in soil settlement or liquefaction.

The method presented in this chapter uses reference vibration source amplitudes and the simplified Wiss propagation model (Eq. 7) described in Chapter 4. The following discussion is separated into the following equipment categories: pile drivers, hydraulic breakers, and other construction equipment. Vibration amplitudes estimated using the method presented in this chapter are expected to be *typical worst-case values* and should be viewed as guidelines only. Actual values from equipment used by a contractor may result in vibration amplitudes that exceed or are lower than the estimated values.

7.1 Pile Driving Equipment

A wide variety of impact and vibratory pile driving hammers is used for driving or extracting various types of piles. Commonly used types of pile drivers are described below.

- **Drop hammer:** The simplest form of pile driving hammer is a falling weight called a gravity or drop hammer. In this case, a weight is raised to the desired height by an attached crane hoist line and dropped directly or indirectly onto the pile. The weight can be enclosed in a steel cylinder.

- **Pneumatic hammer:** A pneumatic impact hammer, also called a compressed-air hammer, is essentially a drop hammer in which a ram/piston in a cylinder is propelled upward by compressed air. The ram strikes the pile cap at the end of a downward stroke, which may be in a free fall under gravity (single-acting) or assisted in downward stroke by pressurized air over the piston head to accelerate the ram (double-acting).

- **Diesel hammer:** Diesel impact hammers are similar to pneumatic hammers. However, whereas pneumatic hammers are one-cylinder drivers that require compressed air from an external source, diesel hammers carry their own fuel, from which they generate their power internally. The falling ram compresses the air in the cylinder, and the impact atomizes a pool of diesel fuel at the end of the cylinder. The atomized fuel ignites with the compressed air and propels the ram upward, ready for the next downward stroke. The burnt gases are scavenged from the cylinder on the upward stroke of the ram. Some diesel hammers are provided with an adjustable fuel pump that serves to regulate the jumping height, and thereby the impact energy.

- **Hydraulic hammer:** Hydraulic impact hammers are a relatively new type of hammer. They are similar to the pneumatic impact hammers, except that the ram is lifted hydraulically, using an external hydraulic source, and then is left to fall freely or is accelerated downward by pressurized gas above the piston.

- **Vibratory pile driver:** Vibratory pile drivers advance the pile by vibrating it into the ground. They are especially effective for soils that are vibratorily mobile, such as sands and silts. Vibration is created in the gear case by rotating eccentric weights powered by hydraulic motors, and sometimes by electric motors. Only vertical vibration is created in the gear case. Horizontal vibration is canceled by the paired eccentrics, which are interconnected with gears to maintain synchronization. The vibration created in the gear case is transmitted into the pile being driven or extracted by means of a hydraulic clamp attached to the bottom of the gear case. The complete vibrator assembly is held by crane. To prevent the vibration created in the gear case from affecting the crane line, a vibration suppresser assembly is attached to the top of the gear case.

The rated energies of most pile drivers are in the range of about 20,000–300,000 foot-pounds (ft-lbs.) (Woods 1997). One very large driver, the Vulcan 6300, has a rated energy of 1,800,000 ft-lbs. Smaller drivers have rated energies as low as 300 ft-lbs. (Woods 1997.)

7.1.1 Vibration Amplitudes Produced by Impact Pile Drivers

An extensive review of the available literature (Martin 1980; Wood and Theissen 1982; Wiss 1967, 1974, 1981; Dowding 1996; Federal Transit Administration 1995; Woods 1997; Schexnayder and Ernzen 1999) and information provided by the manufacturers (Preston 2002; Morris 1991, 1996, 1997) indicates that the PPV from impact pile drivers can be estimated by the following equation:

$$PPV_{Impact\ Pile\ Driver} = PPV_{Ref}\,(25/D)^{n} \times (E_{equip}/E_{Ref})^{0.5} \quad (in/sec) \quad (Eq.\ 9)$$

Where:

PPV_{Ref} = 0.65 in/sec for a reference pile driver at 25 ft.

D = distance from pile driver to the receiver in ft.

n = 1.1 is a value related to the vibration attenuation rate through ground

E_{Ref} = 36,000 ft-lb (rated energy of reference pile driver)

E_{equip} = rated energy of impact pile driver in ft-lbs.

The above equation is based on extensive review of the actual data points at various distances, measured for a wide range of impact pile drivers. The data were measured at the ground surface outside or within various types of buildings.

Literature indicates that the value of "n" in the above equation is generally 1 to 1.5. The suggested value for n is 1.1. The use of values greater than

1.1 would likely result in overestimation of amplitudes at distances closer than 25 ft and would be slightly conservative at distances beyond 25 ft.

If vibration impacts, based on the above approach, are expected to exceed the vibration assessment criteria, vibration estimates may be refined further by using values of "n" that are based on soil type classification, ranging from Class I–IV soils as outlined in the National Cooperative Highway Research Program (NCHRP) Synthesis 253 (Woods 1997), and based on data developed by Woods and Jedele (1985). This step would require detailed information on soil conditions at the site. Table 17 describes soil materials, soil classes, values of "n" determined by Woods and Jedele (1985), and suggested values for "n" for the purposes of estimating vibration amplitude.

Table 17. Measured and Suggested "n" Values Based on Soil Class

Soil Class	Description of Soil Material	Value of "n" measured by Woods and Jedele	Suggested Value of "n"
I	Weak or soft soils: loose soils, dry or partially saturated peat and muck, mud, loose beach sand, and dune sand, recently plowed ground, soft spongy forest or jungle floor, organic soils, top soil. (shovel penetrates easily)	Data not available	1.4
II	Competent soils: most sands, sandy clays, silty clays, gravel, silts, weathered rock. (can dig with shovel)	1.5	1.3
III	Hard soils: dense compacted sand, dry consolidated clay, consolidated glacial till, some exposed rock. (cannot dig with shovel, need pick to break up)	1.1	1.1
IV	Hard, competent rock: bedrock, freshly exposed hard rock. (difficult to break with hammer)	Data not available	1.0

As indicated by Wood and Theissen (1982), the use of published attenuation relationships, based primarily on Wiss (1967) and Attewell and Farmer (1973), relating hammer energies, scaled distances, and PPVs to predict vibration levels in moderately large commercial buildings or in buried structures would probably result in overly conservative estimates. Wiss (1967, 1974, 1981) does not report data points for complete evaluation, but rather presents only generalized curves.

Research by Wood and Theissen (1982) and an evaluation of the available literature indicate that predictions based on Wiss and Attewell and Farmer are likely to be overly conservative. Therefore, it is prudent to be cautious about the upper range of values presented in FTA's *Transit Noise and Vibration Impact Assessment* guidance manual (Federal Transit Administration 2006) and the NCHRP Synthesis 218 (Schexnayder and Ernzen 1999) for the impact pile drivers, because these higher values appear to be based on Wiss's curves. The typical values for impact pile drivers, reported in these publications, appear to be based on the actual measured data reported by Martin (1980) and form the basis for Eq. 9 above.

7.1.2 Vibration Amplitudes Produced by Vibratory Pile Drivers

Information regarding vibration amplitudes produced by vibratory pile drivers is scarce in published literature. However, Wood (1982) presents some data for vibratory pile drivers. International Construction Equipment (ICE) has also provided some data for the vibratory pile drivers (Morris 1991, 1996, 1997). ICE conducted tests in 1991 with three different vibratory pile drivers and measured vibration levels at several distances between 3 and 100 ft. Wiss (1967, 1974, 1981) also presents some data curves for vibratory pile drivers. A lack of actual data points and inconsistency in the curves presented in different publications suggests that some caution be applied in evaluating the data.

Based on review of the available literature (Wood and Theissen 1982; Wiss 1967, 1974, 1981) and information provided by ICE (Morris 1991, 1996, 1997), vibration amplitudes produced by vibratory pile drivers can be estimated by the following equation:

$$PPV_{Vibratory\ Pile\ Driver} = PPV_{Ref}\,(25/D)^n \quad (in/sec) \qquad (Eq.\ 10)$$

Where:

PPV_{Ref} = *0.65 in/sec for a reference pile driver at 25 ft*

D = *distance from pile driver to the receiver in ft.*

n = *1.1 (the value related to the attenuation rate through ground)*

The suggested value for "n" is 1.1, the same value used for impact pile drivers. If desired and if soil information is available, the value of "n" may be changed to reflect soil type classification, as shown in Table 17.

Vibratory pile drivers generate the maximum vibration levels during the start-up and shut-down phases of the operation because of the various resonances that occur during vibratory pile driving (Woods 1997). Maximum vibration occurs when the vibratory pile driver is operating at the resonance frequency of the soil-pile-driver system. The frequency depends on properties of the soil strata being penetrated by the pile.

As indicated in the NCHRP Synthesis 253 (Woods 1997), vibration from vibratory pile drivers is related to the centrifugal force, which is proportional to the mass of the rotating eccentric elements, the radius of eccentricity of rotating elements, and the frequency of the rotating elements. Because of the scarcity of available data, the effect of centrifugal force on vibration from vibratory pile drivers could not be evaluated. In the absence of any reliable data, it is recommended that vibration from vibratory pile drivers be estimated by using Eq. 10 above.

Eq. 10 can be used to estimate the vibration amplitude during the resonant start-up and shut-down phases of the pile driving operation. Although there are no actual data that show the relative magnitude of vibration during the primary driving phase, away from the resonance effects, it is estimated that it could be 50% or less of the maximum levels that may occur during the start-up and shut-down phases. The maximum levels during the start-up and shut-down phases are the important values that should be evaluated when assessing potential impacts. Vibration generated during these start-up and shut-down phases is often very perceptible and is the source of most complaints from vibratory pile driving activity.

The FTA's *Transit Noise and Vibration Impact Assessment* (Federal Transit Administration 2006) and NCHRP Synthesis 218 (Schexnayder and Ernzen 1999) state that continuous operation at a fixed frequency may be more noticeable to nearby residents, even at lower vibration levels. In addition, the steady-state excitation of the ground may increase the response at the resonance frequency of building components. Response may be unacceptable in cases of fragile historical buildings or vibration-sensitive manufacturing processes. Impact pile drivers, conversely, produce high vibration levels for a short duration (0.2 second) any may have sufficient time between impacts to allow any resonant response to decay.

Wood and Theissen (1982) state that vibration levels from vibratory pile drivers may be at least as severe as those from impact pile drivers, and that the potential for damage from vibratory pile drivers may be greater than that from impact hammers because of sustained vibration levels. Vibration data provided by ICE (Morris 1991, 1996, 1997) support the fact that vibratory pile drivers generate vibration levels that are somewhat similar to those produced by impact pile drivers. The use of resonance-free vibratory pile drivers may be an exception to this inference (see "Vibration Mitigation Measures for Pile Drivers" section below).

7.1.3 Vibration Amplitudes Produced by Hydraulic Breakers

Review of available literature indicates that there is no information available about measured vibration amplitudes from hydraulic breakers used in pavement and concrete demolition projects. Hydraulic breakers (also called hoe-rams, hydraulic hammers, or mounted impact hammers) are generally rated by the amount of energy being delivered, typically in the range of 70–15,000 ft-lbs. Because the breakers are rated in a similar manner to impact pile drivers, it is reasonable to assume that the approach presented in Eq. 9 can be used for estimating vibration amplitude from hydraulic breakers. Because hydraulic breakers generally have much lower energy ratings than impact pile drivers, Eq. 9 should be adjusted for typical reference energy of only 5,000 ft-lbs. for hydraulic breakers.

Based on the above discussion, vibration produced by hydraulic breakers can be estimated by the following formula:

$$PPV_{Hydraulic\ Breaker} = PPV_{Ref}\,(25/D)^n \times (E_{equip}/E_{Ref})^{0.5} \quad (in/sec) \quad (Eq.\ 11)$$

Where:

PPV_{Ref} = 0.24 in/sec for a reference hydraulic breaker at 25 ft.

D = distance from hydraulic breaker to the receiver in ft.

n = 1.1 (the value related to the attenuation rate through ground)

E_{Ref} = 5,000 ft-lbs. (rated energy of reference hydraulic breaker)

E_{equip} = rated energy of hydraulic breaker in ft-lbs.

The suggested value for "n" is 1.1. Because vibration from the hydraulic breakers originates primarily near the ground surface, a value of "n" based on soil classification may not necessarily be applicable; however, a higher value of "n" based on site-specific soil conditions could be used for a less-conservative estimation of vibration amplitude.

7.2 Vibration Produced by Other Construction Equipment

Review of available literature indicates that there is limited information available on vibration source levels from general construction equipment. The most comprehensive list of vibration source amplitudes is provided in the document entitled *Transit Noise and Vibration Impact Assessment* (Federal Transit Administration 2006). This document lists vibration source amplitudes at 25 ft. for various types of construction equipment. Table 18 summarizes these and other source levels.

Caltrans has conducted several studies related to ground vibration produced by crack-and-seat operations. A study conducted by Caltrans (2000) measured and evaluated ground vibration generated by crack-and-seat operations along State Route 101 near Santa Maria. A Walker Megabreaker Model 8-13000 was used. This machine drops an 8-ft-wide by 10-ft-tall steel plate weighing 13,000 lbs. approximately 4 ft. Operation of this machine produced the following results:

- At 12 m, PPV = 1.25 in/sec.
- At 27 m, PPV = 0.422 in/sec, 0.62 in/sec, and 0.412 in/sec.
- At 34 m, PPV = 0.290 in/sec.
- At 63 m, PPV = 0.083.

Another study (Ames et al. 1976) conducted in 1972 produced the following results:

- At 10 ft., PPV = 2.99 in/sec.
- At 38 ft., PPV = 0.275 in/sec.

The Santa Maria data has been used to develop a reference vibration amplitude for crack-and-seat operation. Using the measurement at 12 m as the reference distance, the data corresponds to Eq. 12 with N = 1.5. The reference amplitude at 25 ft. extrapolated from this is 2.4 in/sec and is shown in Table 18.

Table 18. Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV at 25 ft. (in/sec)
Vibratory roller	0.210
Large bulldozer	0.089
Caisson drilling	0.089
Loaded trucks	0.076
Jackhammer	0.035
Small bulldozer	0.003
Crack-and-seat operations	2.4

Sources: Federal Transit Administration 1995 (except Hanson 2001 for vibratory rollers) and Caltrans 2000 for crack-and seat-operations.

Using these source levels, vibration from this equipment can be estimated by the following formula:

$$PPV_{Equipment} = PPV_{Ref}\,(25/D)^{n} \quad (in/sec) \qquad (Eq.\ 12)$$

Where:

PPV_{Ref} = *reference PPV at 25 ft.*

D = *distance from equipment to the receiver in ft.*

$n = 1.1$ *(the value related to the attenuation rate through ground)*

The suggested value for "n" is 1.1. Because vibration from this equipment originates primarily near the ground surface, modifying the value of "n" based on soil classification may not necessarily be applicable; however, a higher value of "n" based on site-specific soil conditions could be used for a less-conservative estimation of vibration amplitude. FTA recommends a value of "n" of 1.5 for vibration assessment. Using a value of 1.5 is less conservative than using a value of 1.4 or less (as indicated in Table 17) because it assumes that vibration will attenuate at a greater rate.

7.3 Evaluating Potential Vibration Impacts

As shown in Chapter 6, there is limited consistency between the categorization of effects and damage thresholds; however, it is apparent that damage thresholds for continuous sources are less than those for single-event or transient sources. It is also apparent that the vibration from traffic is continuous and that vibration from a single blasting event is a single transient event; however, many types of construction activities fall between a single event and a continuous source. An impact pile driver, for example, continuously generates single transient events. As a practical matter and based on the nature of available criteria, the criteria can only be reasonably separated into two categories: continuous and transient.

To assess the damage potential from ground vibration induced by construction equipment, a synthesis of various vibration criteria presented in Chapter 6 has been developed. This synthesis of criteria essentially assumes that the threshold for continuous sources is about half of the threshold for transient sources. A vibration amplitude predicted using Eqs. 9–12 can be compared the criteria in Tables 19 and 20 to evaluate the potential for damage.

Table 19. Guideline Vibration Damage Potential Threshold Criteria

	Maximum PPV (in/sec)	
Structure and Condition	**Transient Sources**	**Continuous/Frequent Intermittent Sources**
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

A similar synthesis of criteria relating to human perception has also been developed and is summarized in Table 19. A vibration amplitude predicted with Eqs. 1–4 can be compared to the criteria in Table 20 for a simple evaluation of the potential for annoyance and adverse impact. Some individuals may be annoyed at barely perceptible levels of vibration, depending on the activities in which they are participating.

Table 20. Guideline Vibration Annoyance Potential Criteria

	Maximum PPV (in/sec)	
Human Response	**Transient Sources**	**Continuous/Frequent Intermittent Sources**
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

7.3.1 Example Calculations

Example 1: An 80,000 ft-lb. pile driver will be operated at 100 ft. from a new office building and 100 ft. from a historic building known to be fragile. Evaluate the potential for damage to the buildings and annoyance to the building occupants. No information on the soil conditions is known.

Use Eq. 10 to estimate the PPV from the pile driving at 100 ft. In the absence of soil information, use N = 1.1.

$$PPV = 0.65\ (25/100)^{1.1}\ X\ (80{,}000/36{,}000)^{0.5} = 0.21\ in/sec$$

Table 19 suggests that an appropriate damage potential threshold for new commercial buildings is 0.5 in/sec when the source is continuous. The predicted vibration amplitude of 0.21 in/sec is well below this value, indicating low potential for structural damage to the building.

Table 19 suggests that an appropriate damage potential threshold for a fragile building is 0.1 in/sec when the source is continuous. The predicted vibration amplitude of 0.21 in/sec exceeds this value, indicating potential for structural damage to the building.

Table 20 suggests that a transient vibration amplitude 0.21 in/sec would be strongly perceptible, indicating that pile driving could lead to annoyance of building occupants.

Example 2: A vibratory roller will be operated 50 ft. from residences constructed in the 1940s. A detailed soil study is available indicating that the soil is hard competent rock. Evaluate the potential for damage to the buildings and annoyance to the building occupants.

Use Eq. 12 and data from Table 18 to estimate the vibration amplitude. Hard competent rock is in Soil Class IV. Therefore, N = 1.0 should be used.

$$PPV = 0.210\ (25/50)^{1} = 0.11\ in/sec$$

Table 19 suggests that an appropriate damage potential threshold for older residential structures is 0.3 in/sec when the source is continuous. The predicted vibration amplitude of 0.11 in/sec does not exceed this value, indicating low potential for structural damage to the building.

Table 20 suggests that a continuous vibration amplitude 0.11 in/sec would be strongly to severely perceptible, indicating that operation of the roller could lead to a high level of annoyance of residences.

Example 3: Crack-and-seat operations will be conducted on a freeway located 75 ft. from newly constructed residences and residences constructed in the 1940s. Soil conditions are known to be dense, compacted sand. Evaluate the potential for damage to the residences and annoyance to the building occupants.

Use Eq. 12 to estimate the PPV from the pile driving at 120 ft.. Dense, compacted sand is in Soil Class IV. Therefore, N = 1.1 should be used.

$$PPV = 2.4\ (25/120)^{1.1} = 0.43\ in/sec$$

Table 19 suggests that an appropriate damage potential threshold for older residential structures is 0.3 in/sec when the source is continuous. The threshold for new residential construction is 0.5 in/sec. The predicted vibration amplitude of 0.43 in/sec is below the 0.5 in/sec threshold for new residential construction but above the threshold of 0.3 for older construction, indicating low potential for structural damage to the newer residences but potential for damage to the older structures.

Table 20 suggests that a transient vibration amplitude 0.43 in/sec would be severely perceptible, indicating that pile driving could lead to annoyance of residents.

Chapter 8
Methods for Reducing Vibration

This chapter discusses methods for reducing ground vibration. For the most part, the methods involve reducing vibration at the source. Wave barriers treat the transmission path between the source and the receiver. Once ground vibration is transmitted to a receiver, there are few, if any, means for reducing the vibration.

8.1 Wave Barriers

The following discussion is a summary of the discussion of wave barriers provided in NCHRP Synthesis 253 (Woods 1997). Richart (1970) also provides useful information on this subject.

The purpose of a barrier is to reflect or absorb wave energy, thereby reducing the propagation of energy between a source and a receiver. A wave barrier is typically a trench or a thin wall made of sheet piles or similar structural members. The depth and width of a wave barrier must be proportioned to the wavelength of the wave intended for screening. The wavelength of a seismic wave is a function of propagation velocity and frequency. Pile driving typically generates ground vibration with frequencies in the range of 4–30 Hz. With common wave velocities in the range of 61–610 m/s, typical wavelengths can be in the range of 3–152 m.

Studies indicate that the depth of a wave barrier must be at least two-thirds of the seismic wavelength to be screened and that the length of the barrier must be at least one wavelength to screen even a small area. In one case, a trench wave barrier that was 1.19 wavelengths deep by 1.79 wavelengths long resulted in an 88% reduction in amplitude in two small areas behind the trench. Wave barriers must be very deep and long to be effective, and they are not cost effective for temporary applications such as pile driving vibration mitigation.

8.2 Vibration Reduction for Impact Pile Drivers

Impact pile driving can be the most significant source of vibration at construction sites. The principal means of reducing vibration from impact pile driving are listed below. Some of these methods may not be appropriate in specific situations, but where they are practical, they can often be used to reduce vibration to an acceptable level.

- **Jetting:** Jetting is a pile driving aid in which a mixture of air and water is pumped through high-pressure nozzles to erode the soil adjacent to the pile to facilitate placement of the pile. Jetting can be used to bypass shallow, hard layers of soil that would generate high levels of vibration at or near the surface if an impact pile driver was used.

- **Predrilling:** Predrilling a hole for a pile can be used to place the pile at or near its ultimate depth, thereby eliminating most or all impact driving.

- **Using cast-in-place or auger cast piles:** Using cast-in-place or auger cast piles eliminates impact driving and limits vibration generation to the small amount generated by drilling, which is negligible.

- **Using nondisplacement piles:** Use of nondisplacement piles such as H piles may reduce vibration from impact pile driving because this type of pile achieves its capacity from end bearing rather than from large friction transfer along the pile shaft.

- **Using pile cushioning:** With pile cushioning, a resilient material is placed between the driving hammer and the pile to increase the period of time over which the energy from the driver is imparted to the pile. Keeping fresh, resilient cushions in the system can reduce the vibration generated by as much as a factor of 2 (Woods 1997).

- **Scheduling for specific times to minimize disturbance at nearby vibration-sensitive sites:** Adverse effects can be avoided if pile driving is not scheduled for times at which vibration could disturb equipment or people. For example, if pile driving near a residential area can be scheduled during business hours on weekdays, many people will be at work and will therefore not be affected.

- **Using alternative nonimpact drivers:** Several types of proprietary pile driving systems have been designed specifically to reduce impact-induced vibration by using torque and down-pressure or hydraulic static loading. These methods would be expected to significantly reduce adverse vibration effects from pile placement. The applicability of these methods depends in part on the type of soil. The following information is provided for informational purposes only. This discussion is not intended to favor any commercial product; inclusion of information on these products does not constitute endorsement or approval by Caltrans.

- The first nondynamic system is the Fundex Tubex piling system, manufactured by Fundex in the Netherlands and marketed by American Piledriving in California. Tubex piles are installed with minimal vibration by using torque and down-pressure to produce true soil displacement piles. A patented cast-steel boring drill tip is welded to the pipe casing; then, the Tubex machine installs the pile by gripping the outside of the pipe casing with hydraulic clamps and, in essence, screwing the pile into the ground. Grout injection ports are located at the base of the tip, which allows for the injection of water as a drilling medium and for the injection of grout to produce a soil-cement mixture around the steel casing. Once the steel shell is installed and grouted, concrete and reinforcing are conventionally placed inside the pipe as structurally required by design, or the pile is left unfilled as a simple pipe pile.

  Based on vibration tests performed in 2001 by American Piledriving, the vibration amplitude generated by the Tubex system is expected to be about 0.05 in/sec at 25 ft. This amplitude is significantly lower than vibration generated by conventional impact or vibratory pile drivers. Tubex piles were evaluated by Caltrans in a test project conducted near Interstate 280 in the San Francisco Bay Area. The ultimate capacity of the Tubex pile in terms of tension and compression exceeded all other pile types evaluated.

- The second nondynamic system is the Still Worker (Liddy 2002), a static load piling system, marketed by the Ken-Jet Corporation in New Jersey. This system hydraulically installs and retrieves H-piles, pipe, and sheet piles, generating significantly less vibration than is generally associated with conventional impact and vibratory pile drivers. The system uses hydraulics to push in piles in a smooth, fluid motion that virtually eliminates vibration commonly associated with the installation of piling. Although there are no available vibration data for the system, it appears to substantially reduce vibration from pile driving. A product developed by Giken Engineering Group called the "Silent Piler" operates in a similar fashion.

- Using a vibratory pile driver instead of an impact pile driver can reduce some vibration problems, but vibration amplitudes are similar to those of an impact pile driver because a resonance can occur as the vibratory pile driver starts up and shuts down. One alternative to conventional vibratory pile drivers is a resonance-free vibrator, or variable eccentric moment vibrator. ICE manufactures two such models. These vibrators do not vibrate during start up and shut down, thereby avoiding the excessive vibrations that are commonly associated with traditional vibratory units. By changing the static moment, these vibrators can vary the frequency of operation and the force amplitude. Before the vibrator is started, two parallel rows of eccentric weights are shifted out of phase, resulting in no vibration during start up. By changing the relative orientation of the two rows of parallel eccentric masses, the static moment is changed. After the vibrator reaches full speed, the eccentric masses are shifted into phase, resulting in maximum eccentric moment and maximum amplitude to drive the pile efficiently. Before shut down, the two rows of eccentric weights are again shifted out of phase, resulting in no vibration during shut down.

8.3 Vibration Reduction for Hydraulic Breakers

If vibration levels from hydraulic breakers are expected to exceed applicable vibration limits, the following vibration-reducing measures can be considered. Some of these methods may not be appropriate in particular situations, but they can often be used to reduce vibration levels to an acceptable limit where they are practical.

- A hydraulic crusher (also called smasher, densifier, processor, or pulverizer) can be used to break up the material. A hydraulic crusher is an attachment that is generally mounted on the end of a backhoe, excavator, or skid-steer. It has large jaws that open and close. When closed, the attachment can cut through and crush concrete and any rebar used in the concrete. The attachment can be used for demolition of concrete dividers, such as those used between roadways, and at locations where the concrete can be placed between the jaws. For demolition of a sidewalk or pavement, digging or breaking up of the surface may be required to allow the concrete to be placed between the jaws.

- Saws or rotary rock-cutting heads can be used to cut bridge decks or concrete slabs into small sections that can be loaded onto trucks for disposal.

- Hydraulic splitters can be used to break up concrete. These devices apply lateral force against the inside of holes drilled into the concrete.

- Chemicals can be used to split concrete.

- Pavement and concrete demolition can be scheduled for certain times to minimize the disturbance at the nearby vibration-sensitive sites.

8.4 Vibration Reduction Measures for Other Construction Equipment

In most cases, vibration induced by typical construction equipment does not result in adverse effects on people or structures. Noise from the equipment typically overshadows any meaningful ground vibration effects on people. Some equipment, however, including vibratory rollers and crack-and-seat equipment, can create high vibration levels.

Because of the nature of these types of devices, the options for reducing vibration are limited. Maximizing the distance between the source and receiver might be possible, but there is usually little or no flexibility in this regard. Conducting work when most people are not in the area (e.g., at work) or when sensitive equipment is not operating can avoid or minimize adverse impacts with this type of equipment, but pavement crack-and-seat operations often must be conducted at night to avoid disrupting traffic. As such, little can be done to avoid adverse impacts on people. In some circumstances, temporary relocation of residents during these operations may be appropriate; this is often done by offering hotel vouchers to potentially affected residents.

In the absence of measures than can physically reduce induced ground vibration, informing the public about the project and the potential effects of construction activities is, in many cases, the best way to avoid adverse reactions from the public. The suggested process for engaging the public is discussed in Chapter 9.

8.5 Vibration Reduction for Vehicle Operations

Vehicles traveling on a smooth roadway are rarely, if ever, the source of perceptible ground vibration. However, discontinuities in roadway pavement often develop as the result of settling of pavement sections, cracking, and faulting. When this occurs, vehicles passing over the pavement discontinuities impart energy into the ground, generating vibration. In most cases, only heavy trucks, not automobiles, are the source of perceptible vibration. Trucks traveling over pavement discontinuities also often rattle and make noise, which tends to make the event more noticeable when the ground vibration generated may only be barely noticeable.

Because vibration from vehicle operations is almost always the result of pavement discontinuities, the solution is to smooth the pavement to eliminate the discontinuities. This step will eliminate perceptible vibration from vehicle operations in virtually all cases.

8.6 Vibration Reduction for Train Operations

Methods for reducing ground vibration generated by rail operations are described in FTA 2006. These methods include:

- maintaining wheel and rail smoothness;
- locating special trackwork for turnouts and crossovers away from vibration-sensitive areas;
- specifying vehicles with low unsprung weight, soft primary suspension, minimum metal-to-metal contact between moving parts of the truck, and smooth wheels; and
- use of special track-support systems such as:
  - resilient fasteners,
  - ballast mats,
  - resiliently supported ties,
  - floating slabs, and
  - speed reduction.

Special track support systems require engineering to ensure optimal effectiveness in reducing vibration.

Chapter 9
General Procedures for Addressing Vibration Issues

Concerns about vibration generally arise because of complaints about existing operations or construction and maintenance activities. (Construction and maintenance activities are collectively referred to here as "construction activities.") Concerns can also arise in response to planned activities, such as the construction and operation of a new facility or the modification of an existing facility. This chapter discusses the recommended procedures for addressing vibration concerns about both existing and planned activities and operations.

9.1 Vibration Concerns about Existing Activities and Operations

Pile driving and crack-and-seat operations near homes or businesses are the primary subjects of vibration complaints. Vibration complaints can also be generated in response to traffic operations if pavement is in poor condition. Increases in traffic, heavy truck, or bus operations resulting from opening of new transportation facilities or the redirection of traffic can also trigger complaints. Although complaints can come from any type of receiver, most are from occupants of residences and from businesses that have vibration-sensitive equipment or operations. Complaints about vibration require a response from Caltrans.

The first step in investigating complaints is to interview the individuals making the complaints (i.e., the complainants) and to assess the severity of the vibration concern. A list of questions, a screening procedure to determine the severity of the concern, and a vibration complaint form are provided in Appendix B for this purpose. In assessing the severity of a vibration concern, the most important issues are:

- The type and location of the vibration source(s)

- The complainant's concerns (e.g., annoyance, damage, disruption of operations)
- The location that is most sensitive, or where vibration is most noticeable

The screening procedure may indicate that vibration monitoring should be conducted. Vibration monitoring of existing operations or construction activity can range from simple, single-location measurements to more complex, simultaneous, multi-instrument measurements. The simple approach consists of taking measurements at the most sensitive location or the location perceived by the complainant to have the worst level of vibration. Sufficient data should be collected for each location of interest. For highway traffic vibrations, 10 heavy-truck pass-bys (preferably worst-case combinations of several trucks) for each location should be measured. For pile driving or crack-and-seat operations, several minutes of equipment operation should be monitored at each location of interest. The measurement results can then be compared to the applicable vibration criteria.

If the simple measurement indicates that vibration approaches or exceeds applicable criteria, a more detailed study should be conducted. This study involves placing a sensor close to the source as a reference and one or more sensors at the critical locations. The reference sensor remains fixed in one location near the source, whereas the response sensors may be moved to different locations. The simultaneous measurements can then be used to positively identify the vibration source, the drop-off rate, and the response (i.e., vibration level) at the locations of interest. This information can be used to identify unusual conditions that may be contributing to the high vibration condition and to identify a course of action to reduce the impact.

9.2 Vibration Concerns about Planned Activities and Operations

Avoiding adverse vibration effects regarding planned construction activities and facility operations involves using physical methods to reduce the actual vibration and good public relations to ensure that the public is well informed about the work and its potential effects. In general, literature on the subject shows that only blasting, pile driving, and pavement breaking have documented examples of potential damage to buildings (American Association of State Highway and Transportation Officials [AASHTO] 1990). For pile driving and pavement breaking, the potential for damage from vibration is at locations in relatively close proximity to the activity. However, because the threshold of perception for vibration is much lower than the threshold for damage, claims of damage often arise because of perceptible vibration and not because of actual damage.

Chapter 11 outlines a process for avoiding and addressing potential problems from the public related to blasting. The following process, which focuses on vibration from construction activities and facility operations, is modeled after that process. Every attempt should be made to mitigate the adverse vibration effects from construction activities through the use of modern techniques, procedures, and products. It is equally important to develop a process to avoid and, if necessary, address problems identified by the public that can arise from construction activities, even when the levels of vibration are well below the levels at which damage to structures or excessive annoyance to humans are expected to occur. The following steps should be taken:

1. Identify potential problem areas surrounding the project site
2. Determine conditions that exist before construction begins
3. Inform the public about the project and potential vibration-related consequences
4. Schedule work to reduce adverse effects
5. Design construction activities to reduce vibration
6. Notify nearby residents and property owners that vibration-generating activity is imminent
7. Monitor and record vibration from the activity
8. Respond to and investigate complaints

These steps are described below.

9.2.1 Step 1. Identify Potential Problem Areas Surrounding the Project Site

The first step is to identify the types of dynamic equipment that will be used on the project. As previously discussed, pile drivers and crack-and-seat equipment tend to be the most common source of vibration concerns. In some cases, vibration from the operation of a new or modified highway may need to be evaluated. Prediction methods discussed in Chapter 7 should then be used to estimate distances at which vibration could exceed perception thresholds and structural damage thresholds.

A question that must be answered before determining a preconstruction survey radius is whether the intent is to prevent structural damage or to prevent the perception that structural damage is occurring. In general it is impractical to survey all locations where vibration could be perceptible or where there could be the perception of damage. Regardless of the radius selected for preconstruction surveys, there have been numerous instances where claims of damage came from locations far beyond the surveyed areas. Hence, there is no reasonable standard distance beyond which no complaints can be assured.

Bearing in mind human perceptions and economic considerations, the best solution might be to select structures for preconstruction surveys as follows:

- those structures or groups of structures closest to the vibration source,
- structures within a radius where the effects are estimated to be strongly perceptible and,
- any structures at greater distances that, because of historic value or special conditions, are deemed to deserve special attention.

If the surrounding residents do not view the project as necessarily beneficial to them, or if the project is otherwise unpopular, the distances should probably be increased accordingly.

After the decision has been made as to the limit of preconstruction surveys, anticipate that damage claims may come from residents outside the limit that would have to be resolved through forensic investigation. This is discussed in Step 8.

In some special circumstances, an assessment of the vibration propagation characteristics of the project site may be warranted to improve the accuracy of the vibration predictions. These special circumstances may include situations with special receivers, such as a hospital, research facility, or high-technology facility with vibration-sensitive equipment. Other circumstances might include situations where vibration is known to propagate efficiently though the soil on the site.

A method that Caltrans has used to determine site-specific vibration drop-off characteristics involves the generation of vibration on the site and measurement of the response of the ground at various distances. To generate a strong vibration signal, Caltrans has driven a heavily loaded water truck or dump truck at high speed over a series of five 2- by 4-in. or 2- by 6-in. wood boards spaced 25 ft. apart. This method has been proven to generate a recognizable signal at 90 m (300 ft.). Other methods of generating vibration are also available and include drop-balls, impact hammers, and vibratory rollers.

With this method, a minimum of two sensors must be used simultaneously: one reference sensor and one or more response sensors. Refer to Chapter 10 for a discussion of vibration measurement instrumentation. The reference sensor remains fixed at 5 m (16 ft.) from the centerline of travel (or any convenient distance near the source) opposite the last board to be run over (most forward in line with the direction of travel). The response sensors are positioned at various distances from the source. Because of the steepness of the drop-off curve near the source, it is a good idea to cover shorter-distance intervals near the source and longer ones away from the source. To adequately cover the entire range of the drop-off curve, six to eight locations should be monitored and at least five truck pass-bys measured at each location. Frequently, simulations are not possible on the site of interest because of space limitations. Nearby empty lots or open fields, or data from other sites known or judged to have similar soil conditions, can then be used. However, care must be exercised in choosing a representative site because subsurface conditions can vary substantially.

Once the measurements have been made, the data at each location should be averaged. Using the reference position and at least two others (including the farthest one), the soils coefficient of attenuation (or alpha value, α) can be calculated using Eq. 6. Ideally, the alpha value should remain constant for each location, but in reality it will vary as a function of frequency and position. The average of several values can then be used to develop a drop-off curve. The vibration amplitudes at all measured locations should then be plotted to determine how well they fit this curve. Assuming they fit reasonably well, a normalized drop-off curve can be developed and used with any source reference level, to predict the future level at any distance within the range of the curve.

Another method that can be used to determine vibration propagation characteristics on a site involves measuring the transfer mobility of the ground. This procedure involves dropping a heavy weight on the ground, and then measuring the forces into the ground and the response at several distances from the impact. This procedure is discussed in detail in Federal Transit Administration 1995.

If it is possible to do the simulations at the site, measurement locations both inside and outside the buildings of concern should be included to measure the effects of building amplification or attenuation. Ambient vibration should also be measured both inside and outside the building to document vibration before the construction activity. Any claims that a Caltrans activity or project has increased ground vibration can then be assessed by comparing project-related vibration compared to the existing vibration.

Using the information collected from this study, future vibration can be predicted and compared to existing ambient vibration, perception and damage thresholds, or any other applicable criteria. In some cases where disturbance thresholds for sensitive equipment are not known, vibration measured near the sensitive equipment can be correlated with the disturbance of the equipment to establish a threshold.

The methods described here are generally sufficient for identifying the potential for adverse effects on sensitive equipment. Most situations involving construction operations near sensitive equipment will require consulting experts with specialized expertise in this area.

9.2.2 Step 2. Determine Conditions That Exist Before Construction Begins

There are various methods that can be used to conduct preconstruction surveys, but all must meet the primary purpose of documenting all the defects and existing damage in the structures concerned. An inadequate preconstruction survey can be worse than no preconstruction survey at all. Preexisting defects that are not listed in the preconstruction survey will probably then be attributed to the construction by the property owner. Unless these can be refuted through forensic investigation, the complainant will probably be successful.

Secondary purposes of the preconstruction survey include answering any questions the homeowner may have regarding the project and looking for anything that might require correcting before construction starts or that may place an unexpected limit on blast design. Examples include antique plates that are leaning against a wall or precariously balanced figurines. These should be secured for the duration of the project if there is any concern.

Surveys can consist of drawings on paper, high-resolution video, black and white photography, or any other method that adequately documents existing defects and damage. It is also helpful if the possible cause of the defect can be determined and listed. Oriard (1999) and Dowding (1996) describe preconstruction survey methods in detail.

In some instances, homeowners will prefer that their homes not be surveyed. This is usually for the sake of the owners' privacy, and a notation should be made for that structure as to the time and date, the specific comment made and the person who made it. On some occasions, a homeowner may terminate a preconstruction survey before it is complete. Again, the survey should be annotated accordingly.

It is usually advantageous to conduct postconstruction surveys to verify that no additional damage has been caused by the construction activity.

All residential structures suffer from normal shrinkage of materials caused by diurnal thermal strains and possible settling that start to occur soon after construction. This can present a problem on long-term projects when relatively new homes are included in the preconstruction survey. The normal shrinkage cracks and defects may not show up before the preconstruction survey, but may be there for any postconstruction inspection. The only solution is to investigate them thoroughly to determine whether it was possible that construction activity caused the defect. This will normally require the services of an experienced forensic investigator.

It is also good practice to examine homes both near and far from the construction activity. If cracks or other defects are consistent throughout the area, they are likely the result of thermal stresses or settlement. Cracks or defects that diminish with distance from the vibration source may be indicative of effects caused by the source. Cracks that occur only on surfaces exposed to the sun are indicative of thermal cracking.

There is a tendency for insurance companies to settle smaller claims rather than pay the cost involved in determining the actual cause. This is not only technically and philosophically unsound, but also an open invitation for additional claims from surrounding neighbors.

9.2.3 Step 3. Inform the Public about the Project and Potential Construction-Related Consequences

Good public relations with the neighbors nearest the project, as well as all interested parties, are always beneficial. Most homeowners do not have experience with construction vibration, and may have concerns about their own safety and the safety of their homes.

If the situation warrants, a meeting should be held and a presentation made that explains the reason for the project, that construction will be necessary, what the residents can expect to hear and feel from the construction, any specific warning signals that will be used, and the intent of the preconstruction survey. Knowledgeable persons should attend to answer questions. There should be a handout that explains all of the above information and includes phone numbers to call if there are problems or questions. The person or company that will conduct the preconstruction surveys should be introduced. The main purpose of such a meeting is to educate the neighbors and to put their minds at ease. Such a meeting, conducted properly, can greatly reduce the potential for problems with neighboring property owners.

Another opportunity to conduct good public relations is during the preconstruction survey. The informational sheet from the meeting should be distributed during the survey. The person or persons that conduct the survey should be conversant enough about the project to answer any questions that homeowners might have.

Homeowners should be provided with a procedure for registering complaints with Caltrans in the event that vibration is found to be excessive. This procedure should identify a contact person and phone number or email address.

9.2.4 Step 4. Schedule Work to Reduce Adverse Effects

As long as safety considerations can be met, construction activity should be scheduled to occur during times of maximum human activity, rather than during times of extreme quiet. In some cases, nearby sources of noise and/or vibration can be used to mask the noise from construction activities. For example, if highway work can be conducted during daytime hours, normal traffic noise may mask much of the construction noise. Night work should be avoided, although night work is required to avoid disruption of commute traffic flows in many cases.

Other factors may need to be considered as well. A survey of the area should disclose locations with critical activities that might require close coordination. For example, if a hospital where surgery is conducted or other facilities with equipment highly sensitive to vibration are nearby, coordination is necessary so that construction does not interfere with operations of those facilities. Medical equipment that is particularly sensitive to vibration include magnetic resonance imaging (MRI) systems, scanners, and microscopes.

9.2.5 Step 5. Design Construction Activities to Minimize Vibration

Where adverse vibration effects are anticipated, reasonable efforts should be made to reduce those effects. Chapter 8 discusses methods to reduce vibration from construction.

9.2.6 Step 6. Notify Nearby Residents and Property Owners That Vibration-Generating Activity Is Imminent

Once work has been scheduled, nearby residents and property owners should be notified about the specific times and dates that vibration-generating activity will occur. Many complaints occur because a resident or property owner was not aware that the construction activity would occur.

9.2.7 Step 7. Monitor and Record Vibration Effects from Construction

Although it is possible to estimate the levels of construction-induced vibration with some confidence, field monitoring and recording of vibration effects is sometimes warranted. Monitoring records provide excellent tools for evaluating the potential for damage from construction activities. The monitoring and recording should be conducted with equipment specifically intended for this purpose, including accelerometers, velocity sensors, and data-recording or data-logging devices. Equipment used to collect and evaluate vibration data is discussed in Chapter 10.

In situations in which there is considerable opposition to a project and damage claims are anticipated, monitoring and recording should be conducted by a third party. In situations in which there is little chance for claims or where monitoring is being done solely to ensure that specifications are being met, the construction contractor could conduct the monitoring, although it is advisable for the contractor to have a third-party vibration consultant oversee and approve the monitoring and recording process.

9.2.8 Step 8. Respond to and Investigate Complaints

An adequate process for handling complaints should be established. Neighboring residents should know whom to contact with a concern or complaint, regardless of whether it involves a claim of damage. In all instances, a form that documents the details should be initiated on receipt of a complaint. A sample construction vibration complaint form is provided in Appendix B.

For minor complaints, responsible, knowledgeable contractor personnel might conduct the investigation. It is advisable to have a qualified forensic investigator look into claims of damage. The investigator might be the same party that conducted the preconstruction survey or conducted the monitoring. Prompt investigation is advisable. Correction of the problem, if caused by the construction activity, should also be handled promptly.

A vibration specification can be valuable in avoiding problems resulting from construction vibration. Because it is impossible to foresee all variables that may be encountered on various project sites, specifications should be developed specifically for each construction site. A sample vibration specification developed for a construction site with nearby historic structures is provided in Appendix C.

9.3 Vibration Study Reports

Any time a vibration field study is conducted, the results should be documented in a report. Depending on the number of sites measured, amount of data collected, methodologies used, and the importance of the study, the report may range from a simple one or two paged memo, to a report of twenty or more pages long. A vibration study can be considered a mini-research project, and should contain enough information for the reader to independently come to the same conclusions.

Normally, a vibration report should contain the following topics:

- project title and description;
- introduction;
- objectives;
- background;

- study approach;
- instrumentation;
- measurement sites;
- measurements;
- data reduction;
- measurement results;
- data analysis;
- results and comparison with criteria;
- conclusions and recommendations;
- tables showing all measured data, summaries of results, analysis, and standards;
- figures showing site layouts and cross sections, instrument setups, drop-off curves, and other pertinent illustrations; and
- references cited.

In short and simple vibration studies, the above topics may be described within a few sentences in a memorandum. In more complex studies, a fairly extensive report is usually required. Refer to Appendix A for more detailed information on vibration study reports.

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Chapter 10
Vibration Measurement and Instrumentation

10.1 Vibration Measurement Equipment

Ground vibration is typically measured with a sensor that produces an electrical signal that is proportional to amplitude amplitude of the ground motion. These sensors are called transducers because they "transduce" the ground motion into an analogous electronic signal. Transducers can be designed to produce a signal that is analogous to the displacement, velocity, or acceleration of the ground motion. Velocity transducers (seismometers) and acceleration transducers (accelerometers) are the most widely used transducers for measuring ground motion. Vibration transducers measure vibration in one axis. These transducers can be combined into a triaxial array to simultaneously measure vibration in three orthogonal axes.

During the period between 1958 and 1994, all vibration monitoring conducted by Caltrans was performed by staff from the Caltrans Translab. A transducer calibration system consisting of a shaker table mounted on a concrete vibration isolation pad and a camera/amplifier system that measured displacement allowed Translab to calibrate its own transducers with traceability to the National Institute of Standards and Technology (NIST), formerly known as the National Bureau of Standards (NBS). Transducers were calibrated by mounting them on the shaker table and running the table at a known frequency and displacement. Translab is no longer responsible for vibration studies. These studies are now conducted by Caltrans headquarters staff and vibration consultants retained by Caltrans.

Historically, Caltrans used both seismometers and accelerometers to measure ground motion. Seismometers used by Caltrans measure vibration at relatively low frequencies, usually between 1 and 200 Hertz (Hz), through magnetic induction that produced a voltage proportional to velocity. Because seismometers are typically large and can weigh as much as about 7 kilograms (kg) (15 pounds [lbs]), they typically can be placed directly on the ground without special mounting attachments if the mounting surface is stiff, such as hard soil, a concrete sidewalk, flagstone, or asphalt. If used on soil, the seismometer should be firmly embedded in the soil by embedding the entire base in the soil.

An accelerometer measures acceleration directly. When used with an integrator, an accelerometer can also measure velocity and displacement. Accelerometers used by Caltrans have piezoelectric (charge-generating) crystals. As the transducer vibrates with the surface it is mounted on, acceleration changes the compression of the crystal, which in turn causes variations in the electrical charge across the crystal faces. These charge variations are proportional to acceleration.

Accelerometers are typically small and not as sensitive as seismometers. The advantage is that they have a wider frequency range, typically from 1 Hz to several kilo-Hertz (kHz). Because of their small size and lack of mass, accelerometers should not be placed directly on the ground, floor, or other vibrating surface without proper mounting. Accelerometers can be mounted in various ways, depending on the surface. Accelerometers can be adhered to a vibrating surface such as floors, sidewalks, or walls using scientific wax, beeswax, or other special wax provided by the accelerometer manufacturer can be used. Threaded studs adhered to the surface with epoxy can also be used. For good high frequency (up to 100 Hz) coupling to soil, accelerometers should be mounted to an aluminum spike.

An accelerometer can also be mounted via a magnet (or adhesive) to a heavy block of steel weighing 5–10 kg (10–20 lbs). The steel block can then be placed directly on the ground or other surface if the steel block does not rock. The mass of the steel block provides adequate coupling of the accelerometer with the ground for the low-frequency, low-level vibrations generated by transportation facilities and construction activities. Other mounting options are also available. Refer to the accelerometer manufacturer's recommendations for other mounting options.

The signal from a vibration transducer can be directly conditioned and displayed with stand-alone equipment or it can be recorded with an analog or digital recording device for subsequent analysis. Stand-alone or software-based digital fast fourier transform (FFT) analyzers are commonly used to evaluate the recorded signal. Most analyzers can integrate the signal so that velocity and displacement values can be determined from an acceleration signal. Overall peak amplitudes (i.e., PPV) in the time domain can be displayed or, if desired, the frequency spectrum of the signal can be evaluated in the frequency domain (i.e., one-third octave band or narrow band spectrum). A variety of averaging methods is often available.

Chapter 11
Vibration and Air Overpressure from Blasting

11.1 Introduction to Blasting

Often, the only means of loosening a rock mass and reducing it to a material of manageable size is to blast using explosives placed within drilled holes. Many variables relate to the execution of a blast, only some of which are within the control of the blaster. Some of these variables are difficult, if not impossible, to adequately define. As such, blasting is still part "science" and part "art," based on the laws of physics and the capability and experience of the blaster.

11.1.1 Blasting Terminology

The following terms are commonly used in blasting and should be understood by anyone involved in the subject.

- **Downhole blasting:** Downhole blasting is a type of blasting in which explosives are loaded into drilled holes, as opposed to charges being placed on the surface. Surface charges do not have application in conventional construction blasting situations, especially in urban settings.

- **Burden:** Burden represents that volume of material that a detonating hole or holes are expected to fragment and shift. There are two types of burdens: drilled burden and shot burden. Drilled burden is the distance between a row of holes and the nearest free face, and is measured perpendicular to the row of holes. It is also the distance between two rows of holes. Shot burden represents the distance between a hole that is detonating and the nearest free face that is developing in the blast. Unless otherwise specified, the term usually refers to the drilled burden.

- **Spacing:** Spacing represents the distance between holes in a row. A drill pattern is always described in terms of (in order) burden and spacing (e.g., a 6-foot by 8-foot pattern has a burden of 6 ft. and a spacing of 8 ft.)

- **Subdrilling:** Subdrilling is the amount of hole that is drilled below the intended floor of the excavation. Except in situations in which the rock is in flat bedding planes, the detonating charge usually leaves a crater at the bottom of the hole rather than shearing the rock on a horizontal plane. Accordingly, it is not uncommon to subdrill a distance that approaches half of the burden distance to be able to excavate to the intended depth.

- **Stemming:** To confine the energy from the explosive, the top portion of the hole is stemmed (back-filled) with inert material. Because of their proximity to the hole, drill cuttings are usually used, although other material such as stemming plugs can be used. Crushed stone chips are superior to drill cuttings for stemming material because they tend to lock in place under pressure.

- **Decks or decking:** Decks or decking is a means of separating two or more charges within a hole. This step is usually taken to (1) reduce the amount of explosive detonating in a given instant by having the decks fired on different delays, or (2) to avoid loading explosives in weak zones or mud seams in the rock. Decks are separated by inert stemming material and require some means of initiating each deck. Most blasters prefer to avoid the use of decking, however, because it increases the chances for misfired holes and is fairly labor intensive.

- **Primary (production) blast:** A primary (or production) blast is intended to adequately fragment a given volume of rock. The rock may be removed in one or more primary blasts. If the depth of an excavation is sufficient to require removal in more than one lift, each lift would be removed using one or more primary blasts.

- **Secondary blast:** Secondary blasts may be required to remove or reduce material that is not adequately fractured in primary blasts (i.e., trimming blasts or removing high bottom). Also secondary blasts are used for boulders whether or not primary blasting was conducted.

- **Powder factor:** The powder factor is the ratio between explosives consumed and material blasted, usually defined in pounds per cubic yard for construction blasts. When discussing powder factors, it is important to know whether one is using "shot powder factor" or "pay [or yield] powder factor." Shot powder factor includes the material in the subdrilling zone in the calculations, while pay powder factor does not.

- **Detonator:** Detonators are devices, either electric or nonelectric, that are used to detonate the explosive charges.

- **Delay:** The delay is the time interval between detonators (and their corresponding explosive charges) exploding. Because modern initiation systems provide for further subdividing of the delay times in conventional detonators, delay times can be tuned for specific blasting needs.

- **Initiation system:** The initiation system is the entire system for initiating the blast, including the blasting machine or starter, detonators, delay devices, and interconnecting parts.

- **Dynamite:** Dynamite was one of the earliest explosive charges. It was originally sensitized with nitroglycerin, but now uses other sensitizers.

- **Slurry, watergel, emulsion:** These products are modern explosive products in which portions of the ingredients have been replaced with water and various emulsifiers, gums, and other substances. These products come in either packaged or free-flowing form, and poured or pumpable forms.

- **ANFO:** ANFO is an inexpensive blasting agent consisting of 94% prilled ammonium nitrate and 6% #2 diesel fuel (by weight). There are variations of this product in which other materials are added to increase the energy yield. Because of the reduced sensitivity of this material, it requires the use of a more-sensitive explosive for initiation.

- **Booster:** A booster is a fairly sensitive charge that is used to initiate less-sensitive explosive charges. A booster is often in a cast form with a detonator well or detonating cord tunnel, but it can also be a cartridge product.

- **Detonating Cord:** Detonating Cord consists of a core charge of pentaerythritol tetranitrate (PETN) wrapped with layers of plastics and textiles. It is available in various core loadings, all of which detonate at approximately 23,000 ft/sec. Originally developed as an initiation system, it has also been used in specialized blasting situations as the primary charge. Because of the extremely high noise level, this product is not normally used on urban blasting projects. (PETN is also the base charge in most detonators and is an ingredient in most cast boosters.)

- **Presplitting:** Presplitting is a procedure in which a row of lightly loaded holes is detonated ahead of the main production blast. It is intended to propagate a crack along the row of holes to protect the final perimeter wall by allowing expanding gases to vent and preventing back-break from subsequent detonating production holes. It has been shown that a presplit crack has little or no effect in reducing vibration from subsequent blasts; in fact, a presplitting blast creates more vibration per unit of explosive than other forms of blasting.

- **Smooth blasting:** Smooth blasting is similar to presplitting, except that the holes are detonated after the production holes in the main blast. The intent is not to form a crack, but to blast loose the remaining burden with the lighter charges without causing excessive damage to the perimeter wall. In this instance, the charge weights in the nearest production holes are usually reduced.

- **Sinking cut:** A sinking cut is a blast in which no free vertical (or sloped) face exists and in which it is necessary to ramp down into a horizontal surface. In this type of blast, a portion of the blasted material must be expelled upward to make room for the expanding material from subsequent holes detonating. Some flyrock may occur and must be taken into account.

- **Throw or heave:** Throw or heave is movement or shifting of the blasted material an intended distance and direction.

- **Flyrock:** Flyrock is material that is expelled from the blast and travels farther than expected or intended.

- **Blasting mats:** Blasting mats are mats used to cover a blast in an urban situation where flyrock cannot be tolerated and where the situation dictates that explosives be loaded fairly high in the holes. (It is not practical to cover large blast areas, and prevention of flyrock is best addressed in blast design for those situations.) Blasting mats are usually fabricated from sections of rubber tires, manila rope, used conveyor belting, or other similar materials. Many contractors cover the blast with soil, sand, or other fine material; this step can be successful, but it is necessary to use a sufficient amount of covering and to use covering that does not contain rock or other projectiles. Blast covering with any of these materials or devices must be done carefully so that the initiation system is not damaged.

- **Scaled distance (square root or cube root):** Scaled distance is a means of scaling a ratio of distance and charge weight so that effects from various blasts can be compared or estimated. Once a blaster has recorded data from a given blast site, scaled distance can be used as a tool to assist in designing future blasts. Square-root scaled distance is derived by dividing the distance between the detonating charge and the object of interest by the square root of the charge weight. Square root scaling is used for vibration estimations where linear charges (length is more than twice the diameter) are used. Cube-root scaled distance is derived similarly, using the cube root of the charge weight instead of the square root. It is conventional to use cube root scaling for estimating air overpressure and for infrequent instances in which vibration estimations involve a spherical charge (diameter is greater than half the length).

- **Overburden:** Overburden is soil and other materials that overlay the rock to be blasted. Overburden is usually removed before drilling, but it is occasionally left in place to confine the blast and to allow loading explosives higher in the hole (nearer to the top of the rock).

11.1.2 Blasting Process

After the decision has been made to conduct blasting at a construction site, the necessary permits obtained, and arrangements made for explosives storage, the first consideration is usually the size of the drill that will be used. For large excavations, large-diameter drills (4–6 in.) will provide better production than smaller drills, but will result in larger material. A larger number of smaller holes (2–3 in.) will take longer to drill and load, but will provide better fragmentation and easier handling of material. Other considerations are the size of the digging and hauling equipment, the location of any local utilities, nearby structures, vibration and air overpressure or airblast limitations for the specific site, and the lengths of drill steel available.

The blaster uses the borehole diameter and the considerations above to formulate blast designs—laying out burden and spacing, depth of hole (including subdrilling), type of initiation system, explosive products, and sequence of initiation. The blaster often uses timing and the sequence of initiation to control the direction of heave and to allow time for the earlier rows' burden to begin to move before the later rows detonate.

At this point, the blaster can document his intentions on a blasting plan, but he must have the latitude to make changes as drilling progresses and more is learned about the site geology. One or more test blasts are not unusual. The rock from a preceding blast will usually be removed before the succeeding blast is loaded and shot, thus providing a space for the expansion, or swell, of the material in the succeeding blast. If circumstances dictate, however, a portion of the shot rock may be left in place to help contain the material in the front row of the succeeding blast.

The actual loading process will depend on the type of explosives to be used, but will generally consist of the following. (Please note that only the blaster and those persons necessary for the loading process are allowed within 50 ft. of a blast while it is being loaded.)

1. The detonators are laid out near the holes according to the desired initiation sequence.

2. The primer is made up by inserting the detonator securely into the priming charge and is lowered to the bottom of the hole.

3. A denser bottom charge (if desired) is loaded. If there is water in the holes, a water-resistant explosive is loaded until the column builds up out of the water. The main explosive charge then is loaded. Holes are normally loaded to a specific height; however, in cases where the exact quantity of explosive is critical, holes might be loaded with a specific number of cartridges or containers of bulk product. If bulk loading equipment is used, the density of the product and the quantity loaded can be controlled by the operator.

4. A second primer is added, if desired.

5. After a hole is loaded with the desired quantity of explosive, the remainder of the hole is stemmed or backfilled with inert material.

6. After all holes are loaded and stemmed, the initiation system, except for the starter or blasting machine, is connected and checked. In the case of electric detonators, a Blaster's Galvanometer or Blaster's Multimeter is used to check the resistance of the system. Other systems are usually checked visually.

7. Blasting mats or other coverings are put in place, if they are to be used.

8. When the blast is ready to be detonated, the area is cleared, the blasting signals are initiated, and the blaster prepares to connect the starter or blasting machine.

9. Just before initiation, the blaster connects the starter or blasting machine, then detonates the blast at the proper time.

10. During and immediately following the blast, the blaster and his crew watch for any sign of a possible misfire. If a misfire is suspected, the area remains secured and no one, including the blaster, is allowed to approach the blast for at least 30 minutes. (This is a California Occupational Health and Safety Administration–mandated time

period. Although seldom used in construction blasting, the use of cap and fuse would mandate a 60-minute wait.)

11. As soon as it is safe to do so (and following the mandatory wait if a misfire is suspected), the blaster inspects the site.

12. After any misfires are cleared and the site inspection is complete, the "all clear" signal can be given and personnel are allowed back into the blast area.

As blasting proceeds through the project, the blaster can fine-tune his blast designs. Quite often, the best blasts will occur near the end of the blasting program because the blaster will have gradually increased his or her knowledge of how the rock on the site breaks.

11.2 Vibration and Air Overpressure Concerns that Arise from Blasting

When a blast is detonated, only a portion of the energy is consumed in breaking up and moving the rock. The remaining energy is dissipated in the form of seismic waves expanding rapidly outward from the blast, either through the ground (as vibration) or through the air (as air overpressure or airblast). While a blaster can quite easily design his blasts to stay well below any vibration or air overpressure levels that could cause damage, it is virtually impossible to design blasts that are not perceptible by people in the vicinity.

As seismic waves travel outward from a blast, they excite the particles of rock and soil through which they pass, causing them to oscillate. Spherical spreading, imperfect coupling, and other factors cause seismic waves to dissipate rapidly with distance, normally by two-thirds for each doubling of distance from the source. The motion of particles at a given point in the earth is measured when blast vibration is recorded. Blast vibration is described using the following terms.

- **Displacement:** Displacement is the farthest distance that the ground moves before returning to its original position. For blasting, displacement is usually only a few thousandths or ten-thousandths of an inch.

- **Particle velocity:** Particle velocity is the velocity at which the ground moves.

- **Peak particle velocity (PPV):** PPV is the greatest magnitude of particle velocity associated with an event.

- **Acceleration:** Acceleration is the rate at which particle velocity changes. Acceleration is measured in in/sec^2, mm/sec^2, or g.

- **Frequency:** Frequency is the number of oscillations per second that a particle makes when under the influence of seismic waves. Frequency is measured in Hz.

- **Propagation velocity:** Propagation velocity is the speed at which a seismic wave travels away from the blast. Propagation velocity is measured in ft/sec. (Please note that propagation velocity is several orders of magnitude greater than particle velocity.)

When blast vibration is recorded with a seismograph, three mutually perpendicular sensors record particle velocities in longitudinal (radial), transverse, and vertical axes; the PPVs recorded for each axis are the main data of interest for comparison with damage criteria. Because the data are recorded against a time base, other information such as frequency, displacement, acceleration, and true vector sum (resultant) can be calculated and included on the record.

The resultant particle velocity is the highest particle velocity in any direction. Although the resultant particle velocity is the highest particle velocity in any direction, the conventions and standards currently in use are based on data that were gathered when it was impractical to obtain true resultant data. Resultant values have become easily obtainable since the development of the digital seismograph and digital recording techniques. Therefore, when using modern prediction curves or blasting level criteria that are based on older data, one should use individual axis peaks rather than the resultant. If it is desirable to use the resultant instead of individual peaks, allowances need to be made that consider the higher numbers that would be obtained. (The true resultant PPV could be as much as 1.73 times the highest individual peak, although in actual practice it is usually only about 10–20% greater.)

In all instances, body waves (compression and shear waves that pass through the ground) and surface waves (waves that travel along the surface of the ground) diminish with distance, although they dissipate at differing rates. Body waves typically have a higher frequency than surface waves and are dominant close to the blast; therefore, the frequencies of the PPVs closer to the blast will be higher. As the distance from the blast increases, body waves dissipate faster than surface waves; therefore, the surface waves become dominant and the frequencies (and intensities) of the PPVs are lower. Exceptions can occur when waves propagate in underlying stiff soil or rock, and emerge as the dominant wave at large distances.

When the distance between the recording point and the blast is large enough, waves that have traveled different paths arrive at different times with spreading and some overlap. Recorded at greater distances, the entire blast begins to take on the characteristics of a single point detonation of relatively long duration.

Although residential structures may not be as strongly constructed as engineered structures, it is unusual to find damage to them from blast vibration. In numerous instances, vibration levels far greater than the maximum levels recommended by the U.S. Bureau of Mines (USBM) or Office of Surface Mining and Reclamation Enforcement (OSMRE) failed to cause damage. With regard to residences, the main issue with blast vibration is the perception of some residents that, because they could hear and feel the blast vibration, the vibration must have caused some damage to their residence. It is not unusual for a homeowner to be unaware of cracks or other defects in his or her residence that have developed slowly because of settlement or thermal strains. When a nearby blast is detonated and the homeowner examines his or her structure more closely, it is not surprising that defects are attributed to the event.

Homeowners with wells, especially in times of drought, can have major concerns over the effects of blast vibration on their water source, although vibration alone would not be expected to damage a well. If a blast was detonated in close enough proximity that rock-block movement pinched off a well, the well could sustain damage, but it would not have been caused by vibration (Robertson 1980; Rose 1991). In some situations, vibration is used by the oil industry to enhance permeability and well production.

11.3 Methods of Predicting Blast Vibration and Air Overpressures

To predict the intensities of blast-induced vibration and air overpressures from blasting, a scaling method is usually used that considers the energy released, the distance to the blast, and their relationship to the intensities derived. Other variables affect the intensities to a lesser extent.

11.3.1 Predicting Blast Vibration

Square-root scaled distance is a scale that divides the distance from the point of interest to the blast by the square root of the largest charge weight detonated on one delay period. All explosives detonating within any given 8-millisecond (ms) time period are typically counted as having been detonated on the same delay. (The blaster may be separating his detonating charges by more or less than 9 ms. In any case, all explosives detonating within any 8-ms period are combined for typical prediction calculations.)

The most commonly accepted blast vibration prediction curves in use were developed by Lewis L. Oriard, a noted seismologist from Huntington Beach, California (now retired), and are based on data gathered from a large number of blasts in various geological settings. Other researchers have come to similar conclusions, with their estimations falling within Oriard's parameters.

Figure 6 contains curves representing Oriard's upper and lower bounds for typical down-hole blasting, with a higher approximation for those instances where there is very high confinement, such as in presplitting. Because of the many variables involved in blast design and site-specific geology, data points could fall above or below the bounds for typical data shown on the graph.

Oriard's basic formula for predicting blast vibration is:

$$PPV = K\,(D_S)^{-1.6} \qquad \textit{(Eq. 13)}$$

Where:

PPV – peak particle velocity (in in/sec),

D_S = *square-root scaled distance (distance to receiver in ft. divided by square root of charge weight in lbs.)*

K = a variable subject to many factors, as described below

This equation is similar to Eq. 7 presented in Chapter 4 and Eqs. 1–4 in Chapter 2. The K factor (and the resulting PPV) decreases with the following:

- decreased confinement of energy,
- decreased elastic moduli of the rock,
- increased spatial distribution of the energy sources,
- increased time of energy release or timing scatter, and
- decreased coupling of the energy sources.

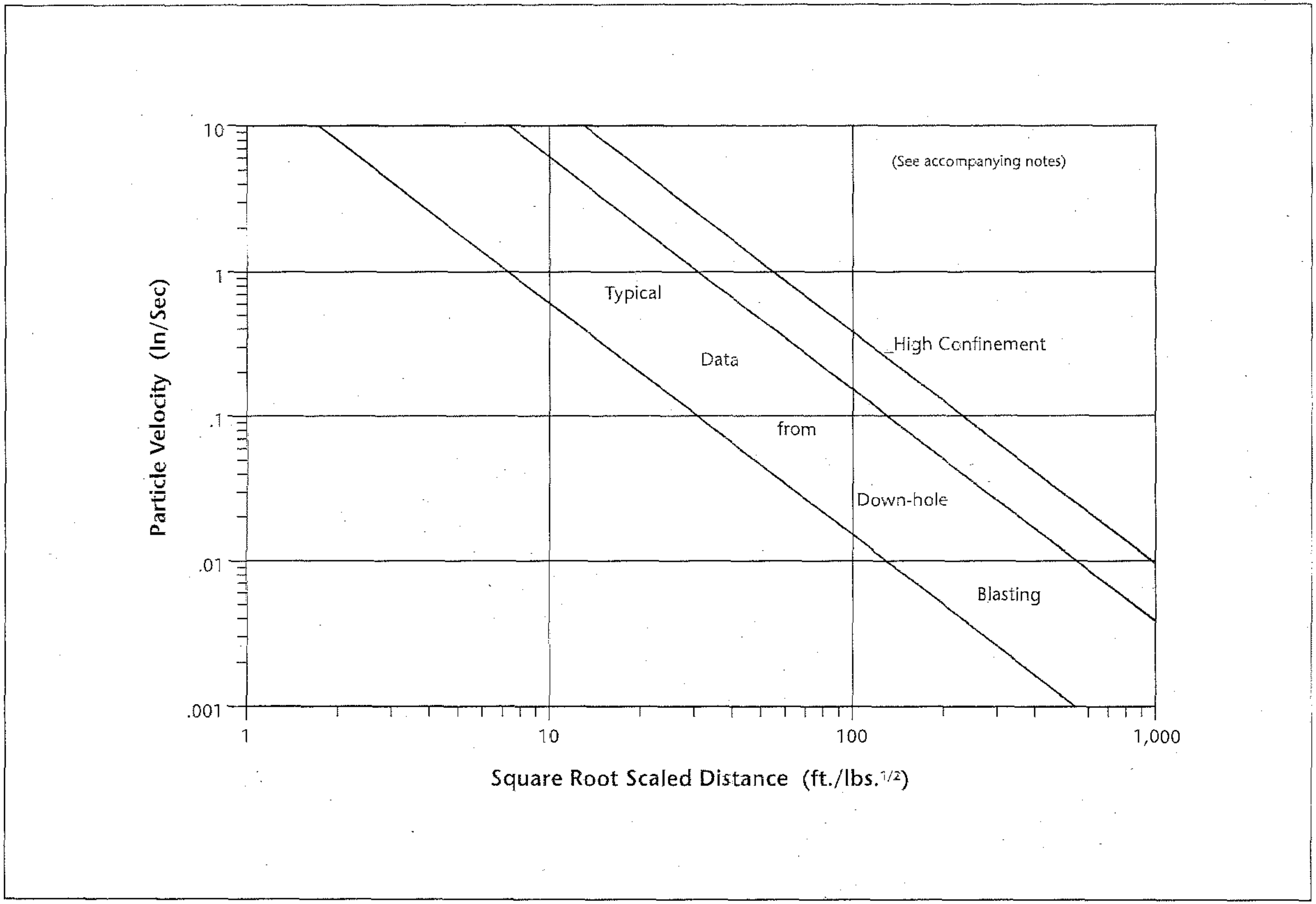

Figure 6
Blast Vibration Prediction Curves (Oriard, 1999,2000)

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PPV increases when these changes are reversed. Of the factors listed above, confinement of the explosive energy will probably be the most-important factor after charge weight and distance. Confinement of the energy is increased as the burden, depth of burial, and quality of rock increase. The combined K factor for Oriard's upper and lower bounds are 242 and 24, respectively. Most conventional blasts will fall between these bounds. The combined K factor for a blast under extremely high confinement is 605.

An exponent of –1.6 is typical. This exponent may be more negative for body waves in very close proximity to the blast or less negative where surface waves dominate.

The exponent –1.6 is more negative than the value of –1.0 to –1.4 recommended for construction equipment in Table 17. This suggests that blast vibration amplitudes in general attenuate at a higher rate than vibration from construction equipment. Persons experienced in blast vibration prediction will use the range given in the curves (or formulas) as a basis and adjust them for any blast-specific variables that they can quantify through experience. They will need information from the blaster (or the blaster's records) regarding charge weights per delay, timing schemes, and other factors.

In addition to ensuring that the charge weights obtained from the blaster are accurate, the correct number of holes per delay should be verified and, if more than one hole or deck will detonate simultaneously, the spatial separation of those holes or decks should be noted. Two holes that detonate simultaneously will not generate the same vibration as a single hole containing the same weight as the two holes combined; the greater the distance between holes detonating simultaneously, the less they cooperate in increasing vibration.

With regard to distance measurements, blast-induced ground vibration can travel only through the ground; it cannot jump across an open space. The shortest path through the ground between the detonating hole and the object of interest should be the distance used. The correct square-root scaled distance is the lowest number calculated for various configurations within the blast and will more closely relate to the intensity of vibration. Technically speaking, there are as many square-root scaled distances as there are holes detonating. If all the holes are loaded identically and are detonated on individual delays, the closest hole will naturally yield the lowest number. If the blast has varying charge weights (the shot may be deeper in some areas), the lowest square-root scaled distance may actually be calculated from a hole that is farther away.

A site-specific prediction curve is initiated when results from several recorded blasts have been plotted on a graph, although it should not be assumed that all future blasts will follow the results of just a few blasts. The confidence level increases as additional data are added, although some scatter in the data points can be expected. It is also helpful to have PPV readings over a wide range of distances (and square-root scaled distance) to provide linearity to the plot. If all recordings are made at one distance, the data points will be clustered in a general zone on the chart and it will be difficult to obtain a reasonable regression plot.

11.3.2 Predicting Air Overpressures from Blasting

Air overpressures from blasting can be predicted by using curves in a manner similar to vibration prediction; however, cube-root distance scaling, not square-root distance scaling, is normally used. Figure 7 depicts curves that are based on data gathered from blasts in various locations and from research conducted by various individuals and organizations, including USBM. Again, because of the variables, many of which are difficult to quantify, data points for a given event may fall above or below the bounds shown on the graph. The prediction curves were established using the basic formula for estimating air overpressures:

Peak air overpressure (in pounds per square inch [psi]) $= K\,(D_S)^{-1.2}$ *(Eq. 14)*

Where:

> D_S = *cube-root scaled distance (distance to receiver in ft, divided by cube root of charge weight in lbs.)*

The curves representing the normal upper and lower bounds for confined charges use combined K factors (intercepts at a D_s of 1) of 2.5 and 0.78, respectively. The curve for unconfined charges uses a combined K factor of 82.

The attenuation slope of –1.2 is typical for static conditions and represents a reduction of approximately 7.2 dB for each doubling of distance. Some researchers have used attenuation slopes as flat as –1.0 (corresponding to 6 dB per doubling of distance), but the difference does not become a major factor until a considerable distance has been reached. Atmospheric variables such as wind and temperature inversions have a greater effect on attenuation.

In addition to charge weight and distance (which affect the cube-root scaled distance), the following factors affect air overpressure intensity.

- depth of burial of the charge;

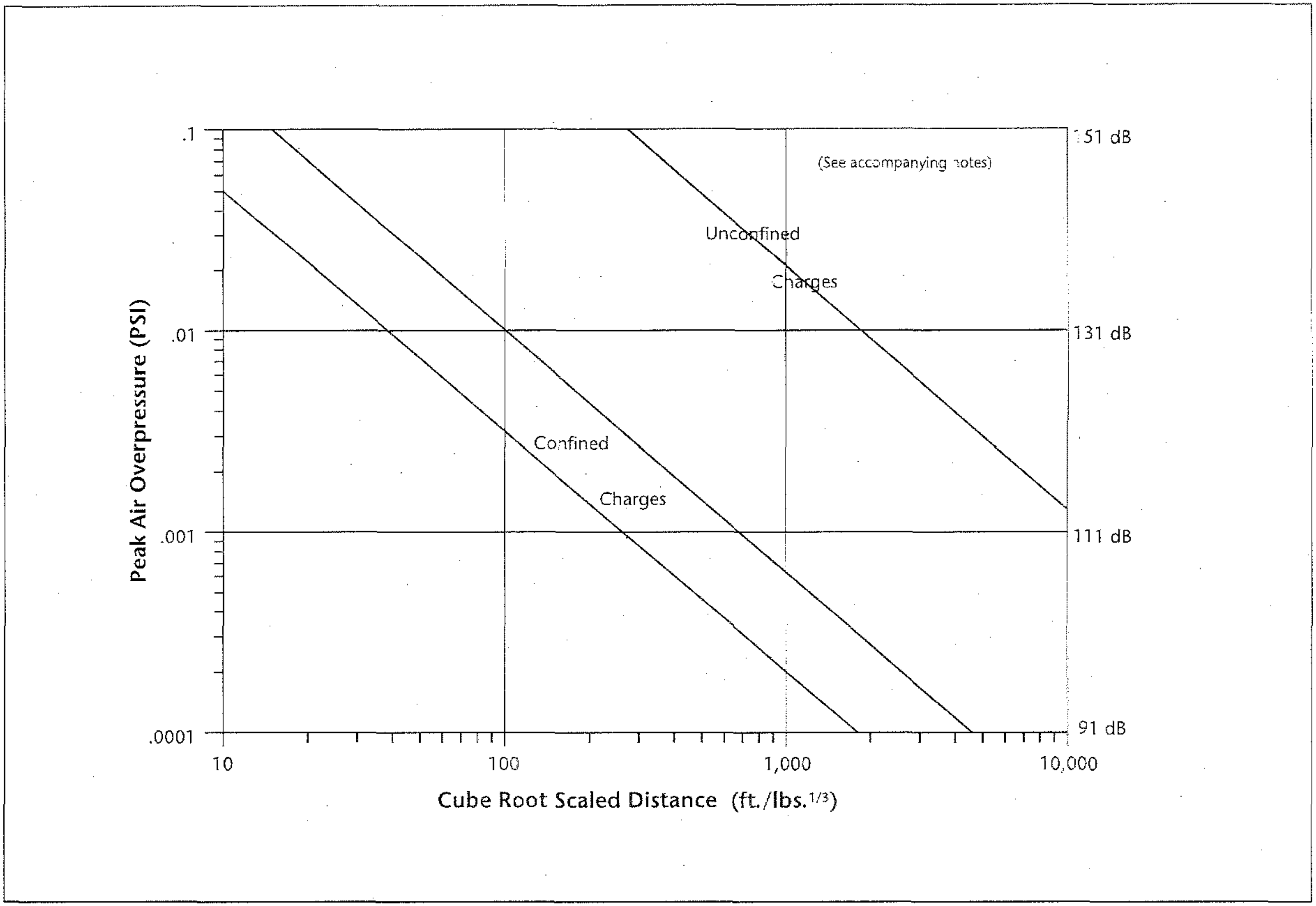

Figure 7
Air Overpressure Prediction Curves

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- terrain features, trees, foliage, and other screening;
- orientation of the blast face (facing toward the recording point increases intensity);
- velocity of blast progression (across the face or along the surface);
- explosive composition (elapsed time of energy release, a minor effect that can normally be disregarded for conventional explosive products);
- atmospheric conditions:
  - changes in barometric pressure (a minimal effect normally disregarded), and
  - humidity (normal daily fluctuations may be disregarded, but the difference between a very dry day and a rainy one can be quite noticeable); and
- temperature gradients:
  - normal or lapse conditions (temperature decreases with elevation; sound energy is refracted upwards and the air overpressure will attenuate at a greater rate than isothermal conditions),
  - inversion conditions (temperature decreases with elevation; sound energy is refracted downwards and air over pressure will attenuate at a lower rate than for isothermal conditions; a temperature inversion has little effect in the immediate area of the blast and usually only affects air overpressure beyond a radius equal to the height of the inversion layer), and
  - wind direction and velocity (wind can have a major impact on air overpressure; downwind from the blast, the overpressure will not attenuate as rapidly as it would upwind from the blast because the wave front and the sound energy is being refracted or bent downward; this can add from several to as much as about 20 dB to the overpressure).

If it is desirable to convert psi to decibels, the following formula can be used:

$$dB = 20 \log (psi / 2.9 \times 10^{-9}) \qquad (Eq.\ 15)$$

In addition to the cautions concerning charge weights and delays discussed above, the shortest distance through the air should be used. Depending upon terrain, this may not always be a straight line.

The estimation of air overpressures is more difficult than estimating vibration due to variables that can change from moment to moment. For this reason, allow a greater margin of error when estimating air overpressures. Gathering data for specific sites and accurately noting weather conditions at blast times can assist in building prediction curves for specific operations or specific sites.

11.4 Criteria for Assessing Human Response to Blasting and Potential for Structural Damage

11.4.1 Human Response

Human response to blast vibration and air overpressures from blasting is difficult to quantify. Ground vibration and air overpressures can be felt at levels that are well below those required to produce any damage to structures. The duration of the event has an effect on human response, as does the frequency. Events are of short duration, 1–2 seconds, for millisecond-delayed blasts. Typically, the longer the event and the higher the frequency, the more adverse the effect on human response. Factors such as frequency of occurrence, fright or "startle factor," level of personal activity at the time of the event, health of the individual, time of day, orientation of the individual (standing up or lying down), the perceived importance of the blasting operation, and other political and economic considerations also affect human response.

Although the duration of an event affects human response, some researchers have found that fewer blasts of a longer duration are preferable to many blasts with shorter durations. There would be fewer times of perceived disturbance. Fixed locations such as quarries may be able to take advantage of this. Construction projects, however, usually have constraints such as smaller volumes of material to be blasted and sequence of the work that would preclude this.

Table 21 indicates the average human response to vibration and air overpressures that may be anticipated when the person is at rest, situated in a quiet surrounding.

Table 21. Human Response to Blasting Ground Vibration and Air Overpressure

Average Human Response	PPV (in/sec)	Airblast (dB)
Barely to distinctly perceptible	0.02–0.10	50–70
Distinctly to strongly perceptible	0.10–0.50	70–90
Strongly perceptible to mildly unpleasant	0.50–1.00	90–120
Mildly to distinctly unpleasant	1.00–2.00	120–140
Distinctly unpleasant to intolerable	2.00–10.00	140–170

In reviewing the above responses, one must distinguish between the average individual and those who may reside at either end of the human response spectrum. At one end are persons who might perceive some financial benefit or common good from the project. Although they may not appreciate the inconvenience of the blasting, unless they are physically damaged in some manner, they may not complain. At the other end of the spectrum, individuals who do not want the project to take place may be disturbed by the slightest inconvenience and will generally make their feelings known.

The listing of vibration levels and air overpressure levels on the same comparison chart above does not indicate that there is any connection between the two, except as the particular levels apply to human response. In blasting, an increase in vibration can often be accompanied by a decrease in air overpressures, and vice versa.

11.4.2 Effect of Blast Vibration on Materials and Structures

Table 22 summarizes the effects of peak particle velocities on structures and materials that have been documented by various researchers and organizations. The listing is intended to provide some idea of what various particle velocities represent and the effects that might be expected. This listing is not intended to be used to establish specific limits. In some instances equivalent velocity levels were derived from strain measurements.

Several valuable points can be drawn from review of Table 22 and associated references:

- Concrete is difficult to damage with normal construction blast vibration, although unsupported concrete slabs can eventually crack from their own weight. Extremely close blasts could damage concrete from rock block movement, but this would not be considered vibratory damage.

- The average residence experiences far greater stress from daily environmental changes than from construction blasting if blast vibration intensities are kept at or below USBM or OSMRE limits.
- Water wells and buried pipelines can survive rather high-vibration intensities because they are constrained by the soil and bedding materials surrounding them.

Table 22. Effect of Blasting Vibration on Materials and Structures

PPV (in/sec)	Application	Effect	Reference
600	Explosives inside concrete	Mass blowout of concrete	Tart et al. 1980
375	Explosives inside concrete	Radial cracks develop in concrete	Tart et al. 1980
200	Explosives inside concrete	Spalling of loose/weathered concrete skin	Tart et al. 1980
>100	Rock	Complete breakup of rock masses	Bauer and Calder 1978
100	Explosives inside concrete	Spalling of fresh grout	Tart et al. 1980
100	Explosives near concrete	No damage	Oriard and Coulson 1980
50–150	Explosive near buried pipe	No damage	Oriard 1994
25–100	Rock	Tensile and some radial cracking	Bauer and Calder 1978
40	Mechanical equipment	Shafts misaligned	Bauer and Calder 1977
25	Explosive near buried pipe	No damage	Siskind and Stagg 1993
25	Rock	Damage can occur in rock masses	Oriard 1970
10–25	Rock	Minor tensile slabbing	Bauer and Calder 1978
24	Rock	Rock fracturing	Langefors et al. 1948
15	Cased drill holes	Horizontal offset	Bauer and Calder 1977
>12	Rock	Rock falls in underground tunnels	Langefors et al. 1948
12	Rock	Rock falls in unlined tunnels	E. I. du Pont de Nemours & Co. 1977
<10	Rock	No fracturing of intact rock	Bauer and Calder 1978
9.1	Residential structure	Serious cracking	Langefors et al. 1948
8.0	Concrete blocks	Cracking in blocks	Bauer and Calder 1977
8.0	Plaster	Major cracking	Northwood et al. 1963
7.6	Plaster	50% probability of major damage	E. I. du Pont de Nemours & Co. 1977
7.0–8.0	Cased water wells	No adverse effect on well	Rose et al. 1991
>7.0	Residential structure	Major damage possible	Nichols et al. 1971
4.0–7.0	Residential structure	Minor damage possible	Nichols et al. 1971
<6.9	Residential structure	No damage observed	Wiss and Nichols 1974
6.3	Residential structure	Plaster and masonry walls crack	Langefors et al. 1948
5.44	Water wells	No change in well performance	Robertson et al. 1980
5.4	Plaster	50% probability of minor damage	E. I. du Pont de Nemours & Co. 1977
4.5	Plaster	Minor cracking	Northwood et al. 1963
4.3	Residential structure	Fine cracks in plaster	Langefors et al. 1948
>4.0	Residential structure	Probable damage	Edwards and Northwood 1960
2.0–4.0	Residential structure	Plaster cracking (cosmetic)	Nichols et al. 1971
2.0–4.0	Residential structure	Caution range	Edwards and Northwood 1960
2.8–3.3	Plaster	Threshold of damage (from close-in blasts)	E. I. du Pont de Nemours & Co. 1977
3.0	Plaster	Threshold of cosmetic cracking	Northwood et al. 1963
1.2 3.0	Residential structure	Equates to daily environmental changes	Stagg et al. 1980
2.8	Residential structure	No damage	Langefors et al. 1948
2.0	Residential structure	Plaster can start to crack	Bauer and Calder 1977
2.0	Plaster	Safe level of vibration	E. I. du Pont de Nemours & Co. 1977
<2.0	Residential structure	No damage	Nichols et al. 1971
<2.0	Residential structure	No damage	Edwards and Northwood 1960
0.9	Residential structure	Equivalent to nail driving	Stagg et al. 1980
0.5	Mercury switch	Trips switch	Bauer and Calder 1977

PPV (in/sec)	Application	Effect	Reference
0.5	Residential structure	Equivalent to door slam	Stagg et al. 1980
0.1–0.5	Residential structure	Equates to normal daily family activity	Stagg et al. 1980
0.3	Residential structure	Equivalent to jumping on floor	Stagg et al. 1980
0.03	Residential structure	Equivalent to walking on floor	Stagg et al. 1980

11.4.3 Government-Published Vibration Limits

11.4.3.1 U.S. Bureau of Mines

In 1974, USBM began a study to gather and update available blast vibration data. Work was included in the area of structural and human response to vibration. This resulted in the publishing in 1980 of USBM RI 8507, "Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting." Some of the conclusions contained in the report are as follows:

- PPV is the most practical descriptor of vibration as it applies to the damage potential for residential structures.
- The potential for damage to residential structures is greater with low-frequency blast vibration (below 40 Hz) than with high frequency blast vibration (40 Hz and above).
- The type of residential construction is a factor in the vibration amplitude required to cause damage.
- For low-frequency blast vibration, a limit of 0.75 in/sec for modern drywall construction and 0.50 in/sec for older plaster-on-lath construction was proposed. For frequencies above 40 Hz, a limit of 2.0 in/sec for all types of construction was proposed.
- Alternative blasting-level criteria were also proposed that used the above limits over a wide range of frequencies and included some limits on displacement.

Figure 8 depicts the alternative blasting level criteria proposed by USBM. (These curves also have been applied to impact rate driving vibration.)

11.4.3.2 Office of Surface Mining and Reclamation Enforcement

In 1983, OSMRE established regulations controlling vibration at all surface coal mining operations. Three optional methods of limiting vibration are allowed:

1. The first option limits PPV based on the distance to the nearest protected structure. Each blast must be monitored by a seismograph. With this option, velocities must be kept at or below the following levels:
   - Distances up to 300 ft.: 1.25 in/sec
   - Distances of 301–5,000 ft.: 1.00 in/sec
   - Distances beyond 5000 ft.: 0.75 in/sec
2. The second option does not require monitoring, but requires the operator to design his blasts utilizing Square-Root Scaled Distances (D_s). The calculated Scaled Distances must not fall below the following values:
   - Distances up to 300 ft.: 50
   - Distances of 301–5000 ft.: 55
   - Distances beyond 5000 ft.: 65
3. The third option requires an operator to monitor his blasts with a seismograph and use PPV limits that vary with frequency, similar to the alternative blasting level criteria proposed in USBM Report of Investigations (RI) 8507. The OSMRE option differs from RI 8507 in two areas: (1) it does not differentiate between drywall and plaster-on-lath construction, allowing 0.75 in/sec in the medium frequencies for either case, and (2) it allows a particle velocity of 2.0 in/sec down to a frequency of 30 Hz rather than 40 Hz.

Figure 9 depicts OSMRE optional criteria. An analysis of the OSMRE options discloses the following:

- Option 1 is reasonable for mine-type blasts, which are usually larger than construction blasts and generally result in larger charge weights and lower frequencies. The nearest structures of concern are usually at greater distances than would be expected in construction blasts where

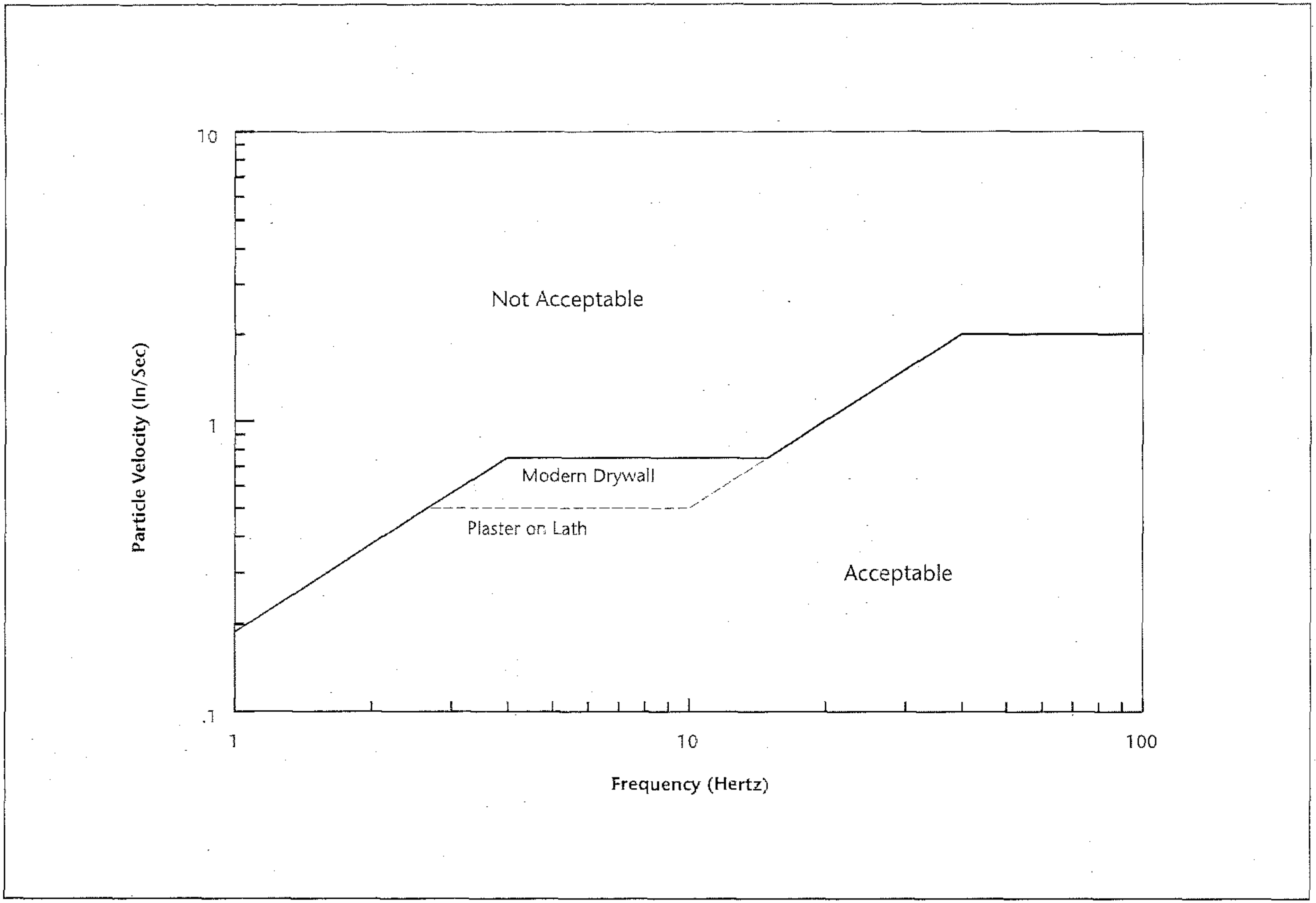

Figure 8
R18507 Alternative Blasting Level Criteria

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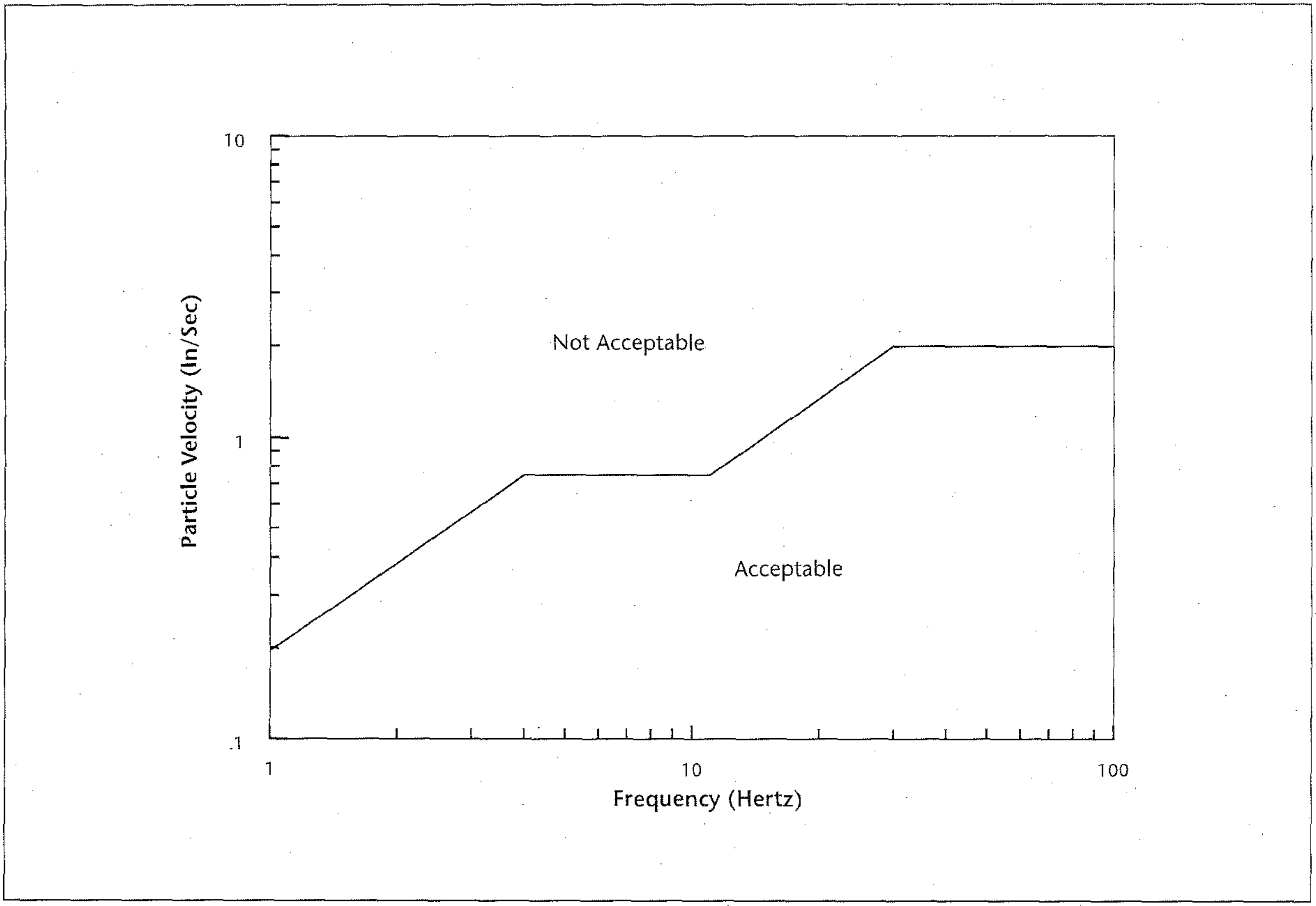

Figure 9
OSMRE Alternative Blasting Criteria
(30 CFR Part 816.67(d)(4)

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charges are usually smaller and frequencies higher. Option 1 would be somewhat conservative for construction blasts.

- Option 2 is quite conservative and uses blast design criteria rather than limiting the effects of the blast. Because no recording is required, a larger safety factor is built into this option. Unfortunately, this option also has the unintended effect of limiting the blaster's use of modern technology to improve blast efficiency while at the same time keeping adverse effects within acceptable limits.

- Option 3, which requires vibration recording with a capability of determining frequencies, is a more practical limit and can be equally applied to both mine and construction blasting.

11.4.3.3 Vibration Limits for Other than Residential Structures

Massive concrete structures, bridges, and other well-engineered structures are far more capable of withstanding blast vibration intensities than residential structures. Massive structures do not respond adversely to the relatively high-frequency and low-displacement vibration waves that result from nearby construction blasting. (On the other hand, the large displacements and low frequencies encountered in earthquakes must always be considered when designing these structures.) A PPV limit of 4.0–10.0 or 12.0 in/sec is not uncommon where the mass of a structure precludes it from being damaged by blast vibration, and it is unusual to find situations in which rock has been blasted away at the base of such structures without causing damage. Blast vibration limits are best addressed for engineered structures on a case-by-case basis.

Buried pipelines, being constrained by the bedding material and soil surrounding them, can also withstand high-vibration intensities (Oriard 1994; Siskind and Stagg 1993). When blasting in close proximity to these pipelines or in close proximity to most structures, rock block movement and cracks emanating from the crater zone toward the object can become more of a concern than vibration.

Special care should be taken when blasting in close proximity to historically important structures. Such structures are usually of older, less-competent construction, and lower vibration limits for them are often justified. These should be addressed on a case-by-case basis.

11.4.4 Effects of Air Overpressure (Airblast)

Although the term "airblast" has been used to describe all air overpressures from blasting, it is more correctly applied only to high-frequency air overpressures resulting from the detonation of explosives on the surface or in the air and that result in high intensities in close proximity to the detonation. Detonation of such charges should not have a part in construction blasting, especially in urban settings. Air overpressures from fully confined charges in normal down-hole blasting are lower frequency pressure pulses that result from movement or bulking of the blasted material, bench-face movement, and the vertical component of ground vibration waves in the vicinity of an air overpressure recording device. All blasting involves expanding cases that induce a positive pressure pulse (hence the term "overpressure").

Overpressure at higher frequencies can be startling in a quiet surrounding, but it will not normally cause damage unless it exceeds approximately 150 dB (linear, unweighted). Low-frequency overpressures, although they might be below the range of human hearing, can impact the side of a residential structure, resulting in windows rattling and other noise. On hearing this noise, the average homeowner will not be able to distinguish between air overpressure or ground vibration as the source but will generally incorrectly attribute the effect to the latter.

11.4.5 Government-Published Air Overpressure Limits

USBM RI 8485 (1980), "Structure Response and Damage Produced by Airblast From Surface Mining," generally recommends a maximum safe overpressure of 0.014 psi (134 dB, linear, unweighted) for residential structures. The first occurrence of airblast damage is usually the breakage of poorly mounted windows at approximately 152 dB (0.11 psi). A limit of 134 dB is sufficiently low to prevent damage but may not address the annoyance of individuals.

OSMRE also addressed air overpressure limits in its 1983 regulations. It considered the characteristics of the recording systems and established the following limits:

Table 23. OSMRE Overpressure Limits

Recording Device Characteristics	Limit
Lower Limit of 0.1 Hz*	134 dB
Lower Limit of 2.0 Hz	133 dB
Lower Limit of 6.0 Hz	129 dB
C-weighted, slow response*	105 dBC

* To be used only with prior approval of OSMRE.

Most modern seismographs with air overpressure recording capability have a frequency response of from 2–250 Hz; hence, the 133-dB limit would be appropriate where they were used for recording.

For several years, an air overpressure limit of 140 dB was used primarily to prevent injury to workmen's' hearing; it also successfully prevented damage to structures. In recent times, lower limits have been used, mostly in attempts to reduce annoyance.

11.5 Procedures for Mitigating Blast Vibration and Air Overpressures from Construction Blasting

Every attempt should be made to mitigate the adverse effects from blasting on construction projects by using modern techniques, procedures, and products. It is equally important to put in place a process to avoid and, if necessary, deal with problems from the public that can arise from blasting, even when the levels of vibration and air overpressure are well below the levels at which damage to structures or excessive annoyance to humans is expected to occur. Taking the following steps is suggested to avoid and/or deal with potential problems from the public.

1. Identify potential problem areas surrounding the project site
2. Determine the conditions that exist prior to commencement of construction
3. Inform the public about the project and potential blasting-related consequences
4. Schedule the work to reduce adverse effects
5. Design the blast to reduce vibration and air over pressure
6. Use blast signals to notify nearby residents that blasting is imminent

7. Monitor and record the vibration and air overpressure effects of the blast

8. Respond to and investigate complaints

Steps 1–3 are closely related. Step 1 involves determining the radius within which a preblast survey should be conducted. Step 2 involves the actual preblast survey. Step 3 is related to the preblast survey but incorporates a larger radius and should be offered to all interested parties.

A blasting specification is a tool that can be used to identify blast vibration limits, surveys, monitoring instruments, and other key methods to avoid and minimize the effects of blasting. This chapter concludes with a discussion of blasting specifications.

11.5.1 Step 1. Identify Potential Problem Areas Surrounding the Project Site

The scope of blasting anticipated for a project will be part of the process of identifying potential problem areas. If only a very small portion of rock would be blasted at one end of the project, for example, there may be no need for a preblast survey of structures at the other end. Therefore, it must be determined how far away from the proposed blasting the surveys must be conducted. There is no standard distance that would be appropriate for all projects or all locations.

One method of determining the preblast survey radius is to estimate the blast vibration and survey to a radius at which the anticipated vibration levels drop below the threshold of human detection (0.01–0.02 in/sec PPV). This method would be economically feasible in rural areas where such a radius might include only a few structures, but may not be economically feasible in more densely populated areas. In a study conducted by Caltrans (Egan et al. 2001), it was suggested that a preblast survey radius of 100 m (328 ft.) appeared to be reasonable to take in all structures susceptible to blast vibration damage. Any distance selected must consider the volume of material to be blasted and the probable charge weights to be used.

One question that must be answered before any preblast survey radius is mandated is whether the intent is to prevent structural damage or to prevent the perception that structural damage is occurring. Egan (2001) notes in his study that structures beyond 35 m (115 ft.) would not have experienced blast vibration in excess of 2.0 in/sec, the Caltrans threshold for damage prevention at the time. Although this may have served well to prevent damage to structures, such vibration levels will usually result in claims of perceived damage from nearby neighbors. It would not prove excessively costly to base the preblast survey radius on preventing actual damage, but it could be very expensive if the radius were based on preventing human perception.

Regardless of the radius selected for preblast surveys, there have been numerous instances in which claims of damage came from locations far beyond the surveyed areas. Therefore, there is no reasonable standard distance beyond which no complaints can be assured.

Bearing in mind human perceptions and economic considerations, the best solution might be to select structures for preblast surveys as follows:

1. those structures or groups of structures closest to the blasting,
2. structures within a radius where the effects are estimated to be strongly perceptible and,
3. any structures at greater distances that, because of historic value or precarious condition, are deemed to deserve special attention (if the project is viewed by the surrounding residents as not necessarily being to their benefit or is otherwise unpopular, the distances should probably be increased accordingly).

After a decision has been made about the limit of preblast surveys, damage claims should be anticipated from residents in other structures that will probably need to be resolved through forensic investigation. This is discussed in Step 8.

11.5.2 Step 2. Determine the Conditions That Exist Before Construction Begins

Oriard (1999) and Dowding (1996) describe preblast survey methods in detail. Various methods can be used to conduct preblast surveys, but all must meet the primary purpose of documenting all defects and existing damage in the structures concerned. Secondary purposes of preblast surveys are to answer any questions homeowners have about the project, and to look for anything that might require correction before construction begins or that may unexpectedly limit blast design, such as antique plates that are leaning against a wall or precariously balanced figurines (which could probably be secured for the duration of the project). It is usually advantageous to conduct postblast surveys to verify that no additional defects have been caused by the blasting.

Surveys can be documented using drawings on paper, high-resolution video, black-and-white photography, or any other method that adequately documents existing defects and damage. It is also helpful if the possible causes of defects can be determined and listed. All residential structures suffer from normal shrinkage of materials, possible settling, and thermal stresses, which start to occur soon after their construction. Both factors can present problems on long-term projects for which relatively new homes are included in the preblast survey. Normal shrinkage cracks and defects might not be apparent during the preblast survey while being apparent during a postblast inspection. To determine whether it is possible that blasting caused the defect, the only solution is to investigate the defects thoroughly, which will normally require an experienced forensic investigator.

It is also good practice to examine homes both near and far from the construction activity. If cracks or other defects are consistent throughout the area, they are likely the result of regional settlement. Cracks or defects that diminish with distance from the vibration source may be indicative of effects caused by the source.

An inadequate preblast survey can be worse than no preblast survey at all; preexisting defects not listed in the preblast survey will likely be attributed to the blasting by the property owner. Unless such claims can be refuted through forensic investigation, the complainant will probably be successful. Insurance companies tend to settle smaller claims rather than pay the costs involved in determining the actual cause. Such action is technically and philosophically flawed, and is effectively an open invitation for additional claims from surrounding neighbors.

Homeowners will sometimes prefer that their homes not be surveyed, usually for the sake of privacy. A notation should be made for that structure as to the time and date, the specific comment made, and the person who made it. A homeowner might also terminate a preblast survey before it is complete. Again, the survey should be annotated accordingly.

11.5.3 Step 3. Inform the Public about the Project and Potential Blasting-Related Consequences

Establishing good public relations with those nearest the project and any other interested parties is always beneficial. Most homeowners do not have experience with blasting or its effects (other than spectacular events on television) and may have concerns for the safety of themselves and their homes.

A meeting should be held and a presentation made that explains the reason for the project, the necessity of blasting, the effects that the residents might experience (hear and/or feel), the specific blasting signals that will be used, and the intentions of the preblast survey. Knowledgeable persons should attend to answer questions. A handout should be provided that explains all of the above and includes phone numbers in case of a problem or questions. The person or company that will conduct the preblast surveys should be introduced. The main purpose of this meeting is to educate the neighbors, but it also tends to put their minds at ease. Such a meeting, conducted properly, can greatly reduce the potential for problems with neighboring property owners.

Another opportunity to establish good public relations is the preblast survey. The informational sheet that was used in the meeting should be distributed in the course of the survey. The person or persons conducting the survey should be conversant enough about the project to answer any questions from homeowners.

Homeowners should be provided with a procedure for registering complaints with Caltrans in the event that vibration is found to be excessive. This procedure should identify a contact person and phone number or email address.

11.5.4 Step 4. Schedule the Work to Reduce Adverse Effects

As long as safety considerations can be met, blasting should be scheduled for times of maximum human activity rather than times of extreme quiet. In some cases, other nearby sources of noise and/or vibration can be used to mask construction activities. (In one case, blasting complaints on a project near Reno were eliminated by detonating blasts only when planes were taking off from the nearby airport. Although this is an extreme example, it illustrates the concept well.)

In situations where only one blast is needed on a project (which are infrequent), providing a safe viewing location and invite neighboring residents to view the event can be beneficial. The residents will appreciate being included and will better understand the blasting process. A safe viewing location is key; there cannot be any chance that flyrock could reach the spectators.

There are other considerations in scheduling blasting. A survey of the area should disclose locations that might require close coordination. If hospitals where surgery is conducted or other facilities with equipment highly sensitive to vibration are nearby, coordination is necessary so that blast effects do not interfere with the operations of these facilities. Also, in areas prone to lightning storms, blasting schedules must be adjusted so that there is minimal interruption to the work. Blasts may need to be loaded and detonated during times when thunderstorms are not likely to occur.

11.5.5 Step 5. Design the Blast to Minimize Vibration and Air Overpressure

Most of the factors involved in blast design are interrelated or interactive; correcting one problem may prompt others. Safety is paramount. The first consideration in blast design must be the safety of all personnel and surrounding structures and objects.

Blast vibration is affected by the following list of variables. These are in turn affected by blast design factors as indicated. Fixed variables, which cannot be controlled by the blaster, are listed below.

- **Distance:** As the distance from the blast increases, the vibration decreases. However, the blasting must be conducted where it is needed, and smaller charge weights may be necessary if blasting is needed in close proximity to structures.

- **Site geology:** As the distance between the blast and the recording point increases, geology plays a more dominant role in determining the frequency of the blast vibration and the speed at which the vibration dissipates.

- **Weather:** The blaster cannot control the weather, but can work to avoid blasting when windy conditions might increase the intensity of air overpressures at nearby residences.

Variables that the blaster can control are listed below.

- **Quantity of explosive per delay:** The quantity of explosive per delay is one of the major variables in blast design for mitigating vibration. Blast design factors that can affect this include hole diameter and depth, the number of explosive decks, and the method of initiation. Generally, reducing this quantity will reduce the vibration generated, but the powder factor must remain high enough to adequately fracture the material (see third item in list below).

- **Confinement of the explosive energy:** Confinement is affected by burden and spacing, the quantity (and quality) of stemming, amount of subdrilling, and the location of the initiating device. Highly confined blasts, such as presplitting, generate higher vibration levels per unit weight of explosive. If a certain amount of throw or heave is acceptable or if means are employed to prevent excessive throw, reducing burdens can lower vibration levels appreciably. If confinement is reduced to any great extent, one must be careful of increased air overpressures. Bottom initiation will generally result in slightly more vibration than top initiation. However, any vibration benefit that might be gained from shooting from the top down or from reducing the amount of subdrilling can be offset by any additional blasts that may be required if the primary blast does not fracture rock to the full depth.

- **Powder factor:** The powder factor is affected by almost all blast design factors. The keys are to use as close to the optimum amount of explosive as possible and to distribute it through the material to be blasted in such a way that it will adequately fracture and shift the mass. If the powder factor is too low, it will not adequately fragment the material and a large portion of the available energy will be lost as seismic energy, resulting in excessive blast vibration. If the powder factor is too high, it can result in flyrock and excessive air overpressures, as well as increased vibration intensities.

- **Explosive/borehole coupling:** Although explosive/borehole coupling can affect vibration, the effect is minimal. For example, presplitting uses decoupled charges (there is an annular space between the charge and the wall of the borehole), but results in high vibration levels because the increased burden has a greater impact than the decoupling. Decoupling of explosive charges normally is not used to reduce vibration.

- **Spatial distribution of the energy source:** The spatial distribution of the energy source can affect vibration in terms of intensity and frequency. There are two examples of this. In the first example, two holes separated by a reasonable distance and detonated simultaneously will generate less vibration than one hole containing as much explosive as the two holes combined. The resulting vibration will also be of a higher frequency. The extent of this effect depends largely on the separation distance between the two holes. In a second example, a long column of explosive will generate less vibration than a spherical charge of the same weight. Although the detonation velocity of a column of explosive has some effect on the spatial distribution of energy (and time of energy release), it is not usually a large enough factor to consider in blast design. The explosive properties are usually selected to match the rock conditions. As stated above, it is not wise to select a low-energy explosive to reduce adverse effects if more blasts would be needed to excavate the material to grade.

- **Timing of detonating charges:** Some regulatory agencies specify a minimum of 9 ms between detonating charges and consider all explosives detonating in any given 8-ms period to have detonated in the same instant; this is done solely for determining explosive weight for scaled distance calculations and has no basis in reducing vibration. In actual practice, while 9 ms may be used in some situations, various delay intervals may be appropriate depending on the conditions. It is not unusual for delay intervals of as little as 5 ms to be used in very close-in blasting situations. When the nearest structures are at greater distances, longer delay periods are often used. After first considering safety issues, the blaster should try to determine a delay timing scheme that would minimize vibration or air overpressures, although this might not always be possible. Extending the delay time can reduce the amount of energy released per unit of time, reducing vibration to some extent.

- **Timing of blast progression:** Air overpressures from blasting can be excessive when the velocity of initiation along a free face meets or exceeds the speed of sound; this occurs to a lesser extent on the surface of the blast. Reducing the velocity of the blast progression along the face to half the speed of sound reduces the effect considerably. The delay timing must not be increased, thereby reducing the blast progression, to the point of causing misfires through cutoff in initiation systems or explosive columns. The blaster must incorporate into the design a buffer zone that consists of several or more rows of holes between a hole that is detonating and detonators in holes in which the initiation signal has not been received. If this step is not taken, misfires often result. Although not required, many successful blasters prefer to use delay timing between holes in a row of 2–5 ms per foot of burden. Many also prefer to use delay timing from row to row that is double (or nearly double) the delay timing in a row.

- **Blast orientation:** Blast orientation is usually mandated by terrain and the physical layout of the rock. As a general rule, the highest vibration amplitudes will usually be in a direction opposite of that in which the rock is being heaved or thrown, although local geology may affect the actual direction of maximum intensity. In side-hill situations, the rock movement would be downhill or along the side-hill, almost never uphill. Site safety conditions will dictate the actual design, but blasting against gravity can increase problems for flyrock and vibration.

11.5.6 Step 6. Use the Blast Signals to Notify Nearby Residents That Blasting Is Imminent

Although blasting signals were originally intended to provide a means of clearing a blast site before the blast is detonated, they also serve to alert nearby residents that a blast is about to occur. This helps to reduce the "startle" effect. After hearing 5- and 1-minute warnings, the average resident will anticipate the event and the intensities will not appear as severe as they would have if the person had not been warned. The blasting signals currently mandated by the California Occupational Safety and Health Administration for blasting on construction sites are contained under "Sample Specifications" in Appendix D.

11.5.7 Step 7. Monitor and Record the Vibration and Air Overpressure Effects of the Blast

Although blast-induced vibration and air overpressures can be estimated with some confidence, monitoring and recording these effects is far more effective. Records from blasting seismographs, when combined with the written blaster's report, provide excellent tools for evaluating the potential for damage from blast-induced vibration and air overpressure. Recording should be conducted with calibrated seismographs specifically intended for the purpose. Such instruments include a microphone channel for recording air overpressures; most have the ability to print a graph that compares vibration magnitudes and frequencies against accepted national standards.

In situations where there is considerable opposition to a project and damage claims are anticipated, third-party monitoring should be conducted. In situations where there is little chance for claims or where monitoring is being done solely to ensure that specifications are being met, the contractor might conduct his or her own monitoring. In such a case, a third-party vibration consultant is advisable to oversee and approve the contractor's monitoring and recording process. Damage claims should always be anticipated.

11.5.8 Step 8. Respond to and Investigate Complaints

An adequate process for handling complaints should be established. Neighboring residents should know whom to contact with a concern or complaint, whether or not it involves a claim of damage. In all instances, a form that documents the details of a complaint should be initiated when the complaint is received. A sample construction/blast complaint form is provided in Appendix B.

For minor complaints, responsible, knowledgeable contractor personnel might conduct the investigation. A qualified forensic investigator is advisable to look into claims of damage. The investigator could be the same person that conducted the preblast survey, the monitoring, or both. A prompt investigation is advisable. If the problem was caused by the blasting, correction of the problem should also be handled promptly.

11.6 Blasting Specifications

Anticipation of all variables that may be encountered on various project sites is not possible. For each project, a site-specific blasting specification should be developed that considers the peculiarities of the project location. In particular, the areas of blast vibration limits, preblast surveys, the number of recording instruments and their locations, the times and days of scheduled blasting, and cautious blasting techniques (if any) should be addressed. A sample blasting specification has been developed to provide a starting point for writing a blasting specification for construction blasting; the sample is provided in Appendix D.

Chapter 12
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Appendix A. Technical Advisory TAV-02-01-R9601

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California Department of Transportation
Division of Environmental Analysis
Office of Noise and Hazardous Waste Management
Sacramento, CA

TRANSPORTATION RELATED EARTHBORNE VIBRATIONS

(Caltrans Experiences)

Technical Advisory, Vibration
TAV-04-01-R0201

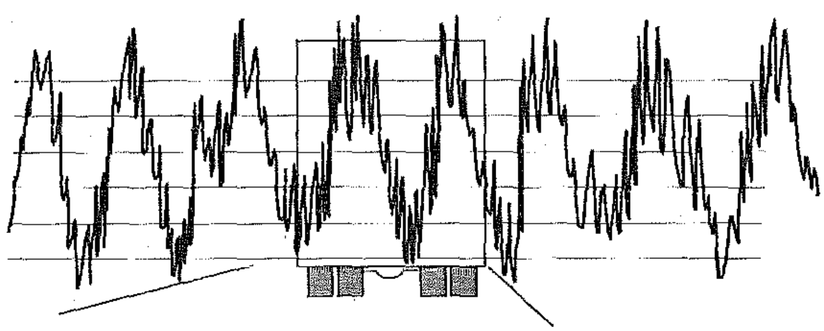
January 23, 2004

Prepared by Rudy Hendriks – Caltrans Retired Annuitant

NOTICE:

This document is a revision of technical advisory TAV-02-01-R9601 with the same title, prepared by the same author, dated February 20, 2002. As a result of a final review, minor editorial changes were made and a cautionary note was added to a method of coupling an accelerometer to the measuring surface. The basic information was not changed from the earlier version. This version of the technical advisory is included as Appendix A in the Transportation and Construction-Induced Vibration Guidance Manual, prepared by Jones & Stokes, Sacramento, CA, for Caltrans.

This document is not an official policy, standard, specification or regulation and should not be used as such. Its contents are for informational purposes only. Any views expressed in this advisory reflect those of the author, who is also responsible for the accuracy of facts and data presented herein. The latter were derived from Caltrans vibration studies from 1958 to 1994, and the author's vibration experiences from 1980 to 1994 at the Caltrans Transportation Laboratory (Translab) in Sacramento, CA.



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INTRODUCTION

This Technical Advisory is intended to give district environmental, materials, design, construction and other concerned personnel a basic understanding of transportation related earthborne vibrations. The advisory covers general vibration principles, vibrations caused by construction and operation of transportation facilities, criteria used by the California Department of Transportation (Caltrans), impacts, vibration study approaches, possible mitigation, and screening procedures to identify potential vibration problems in the field.

District personnel are usually the first to be contacted by the public when vibration problems occur. Until 1994, the district personnel in turn contacted the Caltrans laboratory (TransLab) and requested either an assesment of the problem or a vibration field study. In 1994, Translab discontinued the field studies because of a reorganization. Presently, HQ Division of Environmental Analysis, Noise, Air Quality and Hazardous Waste Management Office, Noise and Vibration Branch is responsible for providing guidance on potential vibration problems.

The information in this advisory will enable district personnel to participate in assessing and screening routine vibration complaints as well as provide background information for the oversight of more complex studies. This advisory will also be a useful source of information for developing contract specifications and oversight.

BACKGROUND

Caltrans has performed earthborne vibration studies since 1958. In 1976, a landmark TransLab vibration research report titled "Survey of Earth-borne Vibrations due to Highway Construction and Highway Traffic", Report No. CA-DOT-TL-6391-1-76-20, compiled a summary of results, findings, and conclusions of 23 studies completed in the 17 year period between 1958 and 1975. Since then many more studies have been performed. Most of these fall into the following three categories:

- Highway traffic vibrations
- Construction vibrations
- Train/light rail vibrations

The main concerns of vibrations involve:

- Annoyance
- Damage
- Disruption of vibration sensitive operations or activities
- Triggering of land slides

The sites investigated included private residences, factories, aerospace and defense plants, electronic laboratories, radio station, movie studio, etc., and even a major cake and pastry bakery.

Because of similarities between the disciplines of noise and vibrations, the former Noise Section took over the responsibilities for vibration studies from the Electrical Instrumentation Testing and Research Section in July, 1980. Almost two-thirds of the above mentioned studies were performed by the Noise Section, which, in 1994 was absorbed by the newly created Office of Environmental Engineering of the Environmental Program. The individual study reports are on file at the Office of Environmental Engineering. This advisory incorporates information and experience gained in all Caltrans vibration studies from 1958-1994.

FUNDAMENTALS OF EARTHBORNE VIBRATIONS

Vibration Sources

Sources of earthborne vibrations include natural phenomena (earthquakes, volcanic eruptions, sea waves, landslides, etc.), or manmade causes (explosions, machinery, traffic, trains, construction equipment, etc.). Vibration sources may be continuous such as factory machinery, and transient, such as explosions.

A distinction must be made between earthborne and airborne vibrations. Some sources, such as jet aircraft, rockets, explosions, sonic booms, locomotives, and even trucks under certain conditions, can create low frequency airborne noise of enough intensity to be felt, as well as heard. These low frequency airborne blasts or rumbles are often erroneously perceived as earthborne vibrations.

As is the case with airborne sound,, earthborne vibrations may be described by amplitude and frequency.

Amplitude and Frequency

In airborne sound, amplitude is described by common logarithm of the square of the ratio of pressure fluctuations around mean air pressure divided by a reference pressure, and is expressed in logarithmic units of decibels. The pressure fluctuations propagate in waves of alternating compressed and rarefied air. The rate at which these waves radiate outward from their source is called the speed of sound, which is the wave velocity. Air is an elastic medium through which the waves travel.

In earthborne vibrations, amplitude is described by the local movement of soil particles. This movement must not be confused with wave velocity.

To distinguish between wave velocity and particle motion, consider the analogy of ripples on a lake and a floating cork. Wave velocity (in air, speed of sound) is analogous to the velocity of the ripples. Particle motion may be compared to the bobbing of the cork as the ripples pass by. The bobbing of the cork represents the local movement of the soil particles as earthborne vibration waves pass through the soil. The soil acts as an elastic medium.

The amplitude of particle motion may be described three ways:

1. **Particle displacement** - the distance the soil particles travel from their original position. Units are millimeters (mm). inches (in)

2. **Particle velocity** - the velocity of the soil particles. Units are inches per second (in/sec) or millimeters per second (mm/sec). Sometimes expressed logarithmically in decibels (dB) with reference to a specified unit of velocity such as .001 in/sec (1μ in/sec), or 0.001 mm/sec.

3. **Particle acceleration** - the acceleration of the soil particles. Units are inches per second per second (in/sec^2), millimeters per second per second (mm/sec^2), or g-force (g = acceleration of gravity = 32.2 feet per second per second (ft/sec^2) = 9.81 meter per second per second (m/sec^2). Sometimes expressed logarithmically in decibels (dB) with reference to a specified unit of acceleration, such as 1 g, or 0.001g (1μg).

For a perfect sine wave produced by a single vibration frequency there exists a simple relationship between the above three measures of amplitude (see Appendix). If the frequency and amplitude of one descriptor is known, the other two can easily be calculated. For waves consisting of many frequencies, and therefore not sine waves, the relationships become much more complicated.

There is a 90 degree phase shift between the three descriptors, i.e. velocity is 90 degrees out of phase with displacement, acceleration is 90 degrees out of phase with velocity, and acceleration is 180 degrees out of phase with displacement. To illustrate this, we might imagine a pendulum just released from a point furthest away from its stationary position. If we arbitrarily call this position the extreme positive (+) position of the pendulum, the stationary point 0, and the region beyond the stationary point a negative (-) position, we observe the following:

- at the point of release, the displacement (distance from stationary or 0 displacement position) is maximum and positive (+).
- the velocity at the point of release is 0.
- the acceleration at the point of release is at its maximum, in the direction towards the negative (-).

This can be worked out the same for other pendulum positions. For instance, as the pendulum swings through the stationary position, the displacement is 0, the velocity is maximum in the negative (-) direction, and the acceleration is 0. Once past the stationary point the pendulum decelerates in the negative (-) direction which is the same as increasing acceleration in the positive (+) direction.

Vibration amplitudes are usually expressed as either "peak", as in peak particle velocity, or "rms" (root mean square), as in rms acceleration. The relationship between the two is the same as with noise. The rms value is approximately 0.71 x the peak value for a sine wave representing either displacement, velocity, or acceleration.

Finally, the direction in which vibrations are measured, analyzed or reported should be specified (vertical, horizontal longitudinal, horizontal transverse, or the resultant of all three motions). For example, Caltrans most often uses a peak vertical particle velocity descriptor, because vibrations along the ground surface are most often (although not always) greatest in the vertical direction.

Propagation

Propagation of earthborne vibrations is complicated because of the endless variations in the soil through which waves propagate.

The relationship between frequency (f), period (T), wave length (λ), and wave velocity (c) is the same as that in noise, that is:

$f=1/T$ and $f=c/\lambda$

However, the wave velocity (c, sometimes also called the phase velocity) in soils varies much more than the speed of airborne sound does, and is often also frequency dependent (in the atmoshere, the speed of sound only varies with temperature). As a consequence, wavelength cannot readily be calculated when frequency is known and vice versa, unless the wave velocity happens to be known also.

There are three main wave types of concern in the propagation of earthborne vibrations:

1. **Surface or Rayleigh waves**, which as the name implies, travel along the ground surface. They carry most of their energy along an expanding cylindrical wave front, similar to the ripples produced by throwing a rock into a lake. The particle motion is retrograde elliptical, more or less perpendicular to the direction of propagation.
2. **P-waves, or compression waves.** These are body waves that carry their energy along an expanding spherical wave front. The particle motion in these waves is longitudinal, "push-pull". P-waves are analogous to airborne sound waves.
3. **S-waves, or shear waves.** These are also body waves, carrying their energy along an expanding spherical wave front. Unlike P-waves, however, the particle motion is transverse, or perpendicular to the direction of propagation.

As wave fronts move outward from a vibration source, their energy is spread over an ever increasing area. The more rapidly this area increases, the more quickly the energy intensity (energy per unit area) decreases. The areas of cylindrical Raleigh wave fronts do not increase as rapidly with distance as do the body (P- and S-) waves. Consequently, the energy intensities of Raleigh waves attenuate at a lesser rate with distance than those of body waves.

The spreading of energy over ever increasing areas is called geometric spreading (geometric attenuation) and the difference in attenuation rates between surface and body waves is analogous to that of line sources and point sources, respectively, in airborne sound. Geometric attenuation also results of encountering more soil mass as the area of the wave front increases.

Geometric attenuation is not the only attenuation encountered with distance. Hysteretic attenuation, or material damping, results from energy losses due to internal friction, soil layering, voids, etc. The amount of hysteretic attenuation varies with soil type, condition, and frequency of the source.

These variations make it much more difficult to predict vibration amplitudes at specific locations, than it is to predict noise levels.

In general, manmade earthborne vibrations attenuate rapidly with distance from the source. Even the more persistent Rayleigh waves decrease relatively quickly. Manmade vibration problems are therefore confined to short distances from the source.

In contrast, natural vibration problems are often wide spread. An obvious example is an earthquake which can cause damage over large areas, due to the release of enormous quantities of energy at longer wavelengths.

TRANSPORTATION RELATED EARTHBORNE VIBRATIONS

Sources

Caltrans is most commonly concerned with three types of transportation related earthborne vibration sources:

- Normal highway traffic - heavy trucks, and quite frequently buses, generate the highest earthborne vibrations of normal traffic. Vibrations from these vary with pavement conditions. Pot holes, pavement joints, differential settlement of pavement, etc., all increase the vibration amplitudes.
- Construction equipment - pile driving, pavement breaking, blasting, and demolition of structures generate among the highest construction vibrations.
- Heavy and light rail operations - diesel locomotives, heavily loaded freight cars, and operations such as coupling create the highest rail traffic vibrations.

Of the above three types, construction vibrations are of greatest concern. The four operations mentioned under construction vibrations are potentially damaging to buildings at distances of less than 7.5 m (25 ft) from the source.

Descriptor Used By Caltrans

With the exception of some construction operations such as pile driving, pile hole drilling, and perhaps some deep excavations, all vibrations generated by construction or operation of surface transportation facilities are mainly in the form of surface or Raleigh waves. Studies have shown that the vertical components of transportation generated vibrations are usually the strongest and that peak particle velocity correlates best with damage and complaints. For these reasons, Caltrans adopted the Peak Vertical Particle Velocity descriptor, with units of mm/sec or in/sec.

A great advantage of using this descriptor is that for a frequency range of 1 - 80 Hz damage amplitudes in terms of velocity tend to be independent of frequency. The same is true for complaint amplitudes within a range of 8 - 80 Hz. Velocity is the product of frequency, displacement and a constant (see appendix). It appears that within the above frequency ranges a doubling of frequency will offset a halving of displacement and vice versa; i.e. the effects of the product of the two tend to remain equal. Typical transportation and construction vibrations fall within the above frequency ranges. They typically range from 10 - 30 Hz, and usually center around 15 Hz.

From the above we can surmise that not only the effects of displacement are frequency dependent, but also those of acceleration. The latter is related to the former by the frequency times a constant squared (see appendix). Thus, criteria amplitudes in terms of displacement or acceleration need to be accompanied by a frequency.

Propagation of Transportation Related Vibration

Raleigh (Surface) Wave Drop-off - Surface waves generated by traffic, trains, and most construction operations tend to attenuate with distance according to the following equation:

$$V = V_0(D_0/D)^{0.5}e^{\alpha(D_0-D)} \qquad \text{(eq. 1)}$$

where: V = Peak particle velocity at distance D
V_0 = Peak particle velocity at reference distance D_0
D_0 = Reference distance
D = Distance for which vibration amplitude needs to be calculated
e = Base of natural logarithm = 2.718281828
α = Soil parameter

The soil parameter α can be determined by simultaneous vibration measurements at a minimum of two different distances from a source. One distance should be near the source, ideally between4.5 and 7.5 m (15 -25 ft). The other should be farther away from the source, ideally at or beyond the farthest point of interest, but at a location where the source is still measurable and not contaminated by other vibrations. A third point in between is recommended for confirmation. Note that the value of α depends on the distance units used. The reason for this is that the exponential $(D_0 - D)\,\alpha$ needs to be a constant value while the value of $(D_0 - D)$ changes with the units used (normally, m or ft). Therefore, the relationship between α (based on m) and α (based on ft) is:

α (based on m) = 3.281α (based on ft), and
α (based on ft) = 0.305 α (based on m)

α can be calculated from the vibration measurements by rewriting eq. 1 as:

$$\alpha = (\ln V^2 + \ln D - \ln V_0^2 - \ln D_0)/2(D_0 - D) \qquad \text{(eq. 2)}$$

where "ln" denotes "natural logarithm"

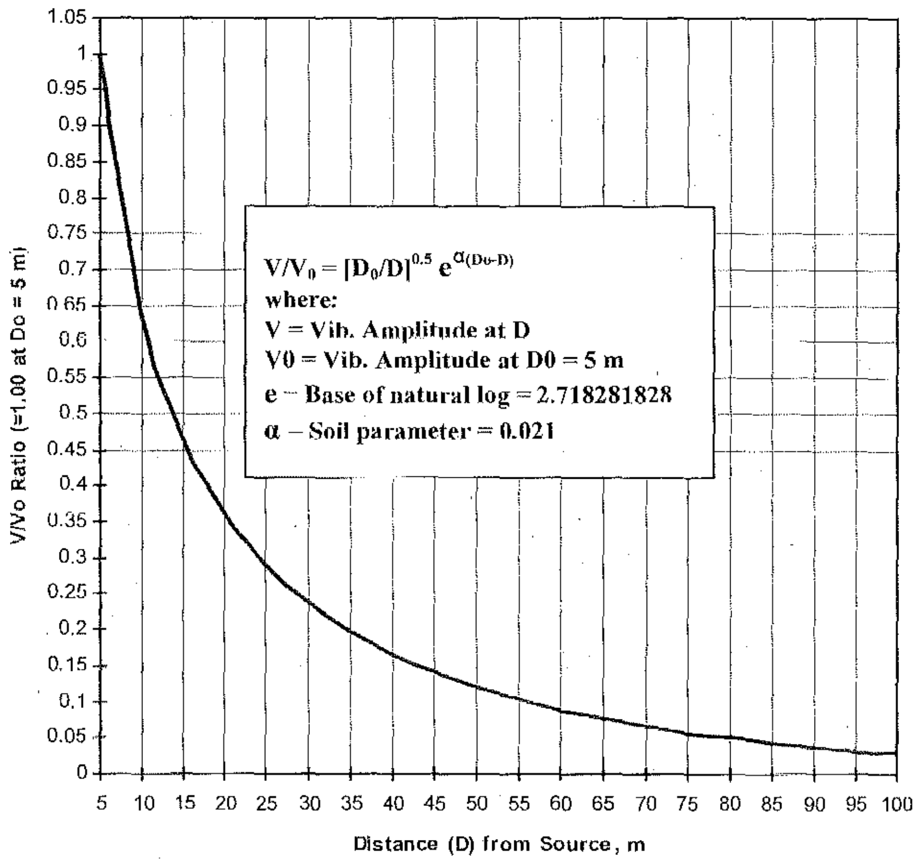
Once α is calculated from the measurements it can be used in eq. 1 to calculate vibrations for any other distance, given the same reference source.

Figure 1 shows a drop-off curve expressed as a ratio of V/V_0, using a reference distance D_0 of 5 m (16 ft). This is a normalized curve for $\alpha = 0.021$ (distance in m), or $\alpha = 0.006$ (distance in ft), derived from data measured in the City of Lynwood to calculate α for the LA-105 Alameda Viaduct vibration study, involving traffic effects on Westech Gear Corporation (formerly Western Gear) close tolerance manufacturing operations. The attenuation curve in Figure 1 is valid for the soils stratification derived from Caltrans boring logs for the Alameda Viaduct, shown in Table 1.

Table 1. - Soils Classifictaions for Figure 1.

Depth, m (ft)	Soil Description
0	
	Sand-Silt
1.5 (5)	
	Clayey Silt
9 (29)	
	Silty Sand
12 (40)	
	Sandy Silt
15.5 (51)	
	Sand
19.5 (64)	

Figure 1. Typical Normalized Distance Attenuation Ratio Curve of Earthborne Surface Vibrations (Reference Distance, Do = 5 m)



The curve is representative of many locations in the L.A. Basin, and also of various locations in Sacramento, and can be used for estimating traffic, train, and most construction vibration drop-offs with distance. To use the curve, the vibration amplitude V_1 must be known at a given distance D_1 near the source, preferably between 5 and 15 m (16 and 50 ft). The vibration amplitude V_2 at the distance of interest D_2 can then be calculated as follows:

$$V_2 = (V_2/V_0)/(V_1/V_0)\cdot V_1$$

(the ratio's V_2/V_0 and V_1/V_0 can be obtained from Figure 1)

For example, if the vibration amplitude is known to be 3.2 mm/s (peak particle velocity) at a distance of 12 m, the vibration amplitude at 58 m can be estimated from (0.09/0.55) x 3.2 mm/s = 0.5 mm/s.

Pile Driving Vibration Drop-off - During pile driving, vibration amplitudes near the source depend mainly on the soil's penetration resistance. In soils such as sand and silt, this resistance is relatively low with the result that a large portion of the impact energy is used to advance the pile. Less energy is then available for generating ground vibrations. In clay soils, however, the penetration resistance is higher and more energy is available for ground vibrations. The resistance provided by the soils consists of friction along the sides of the pile as well as compressional resistance due to the transfer of energy of the pile tip to the soil. This appears to generate body waves as opposed to surface waves by other construction operations.

The energy of a pile driver is of course also influential on the vibration amplitude at the source. There is a relationship between vibration amplitude and energy. If pile driver energy changes from E_1 to E_2, the vibration amplitude at a certain location changes from V_1 to V_2, where:

$$V_2 = V_1\left(\sqrt{\frac{E_2}{E_1}}\right) \qquad \text{(Eq. 3)}$$

Example: E_1 = 68,000 J (50,000 ft lbf)

E_2 = 111,900 J (82,500 ft lbf)

V_1 = 2.8 mm/s

Then: $V_2 = 2.8\left(\sqrt{\frac{111{,}900}{68{,}000}}\right) = 3.6$ mm/sec

Vibrations of pile driving appear to drop off differently than the Raleigh waves, probably due to the presence of a significant proportion of body waves. Pile driving vibrations tend to drop off with distance according to the following equation:

$$V = V_0.(D_0/D)^k \qquad \text{(Eq. 4)}$$

where: V, V_0, D_0, and D are same as defined in Eq. 1, and
k = soil parameter (no units)

(Note that α and k are different parameters; whereas the value of α is dependent on the distance units used (m or ft), the value of k - which depends only on the ratio of distances - is independent of distance units used.)

Generally, the values of "k" lie between 1 to 1.5 (approaching 1 for sandy soils and 1.5 for clay soils), although values < 1 and > 1.5 have been encountered.

The value of "k" can be determined experimentally at different distances from a pile driver, similarly to the previously described derivation of α. For this purpose, Eq. 4 can be rewritten as:

$$k = (\text{Log}V - \text{Log}V_0)/(\text{Log } D_0 - \text{Log}D) \qquad \text{(eq. 5)}$$

Caltrans Vibration Criteria

There are no FHWA or state standards for vibrations. The traditional view has been that highway traffic and construction vibrations pose no threat to buildings and structures, and that annoyance to people is no worse than other discomforts experienced from living near highways.

Damage - A considerable amount of research has been done to correlate vibrations from single events such as dynamite blasts with architectural and structural damage. The U.S. Bureau of Mines has set a "safe blasting limit" of 50 mm/s (2 in/sec). Below this amplitude there is virtually no risk of buiding damage.

“Safe” amplitudes for continuous vibrations from sources such as traffic are not as well defined. The Transport and Road Research Laboratory in England has researched continuous vibrations to some extent and developed a summary of vibration amplitudes and reactions of people and the effects on buildings (Table 2). These are the criteria used by Caltrans to evaluate the severity of vibration problems. Traffic, train, and most construction vibrations (with the exception of pile driving, blasting, and some other types of construction/demolition) are considered continuous. The "architectural damage risk amplitude" for continuous vibrations (peak vertical particle velocity of 5 mm/sec or 0.2 in/sec) shown in Table 2 is one tenth of the maximum “safe” amplitude of 50 mm/sec (2 in/sec) for single events.

All damage criteria for buildings are in terms of ground motion at the buildings' foundations. No allowance is included for the amplifying effects of structural components. Obviously, the way a building is constructed and the condition it is in determines how much vibration it can withstand before damage appears. Table 2 shows a recommended upper amplitude of 2.0 mm/s (0.08 in/sec) for continuous vibrations to which "ruins and ancient monuments" should be subjected. This criterion amplitude may also be used for historical buildings, or buildings that are in poor condition.

Relatively little information is available concerning the damaging effects of pile driving. Although technically a series of single events, pile driver blows occuring often enough in a confined area could cause damage at a lower amplitude than the single event criterion of 50 mm/s (2 in/sec). Caltrans has experienced minor damage from sustained pile driving at about 7.5 - 9 mm/s (0.30 - 0.35 in/sec) peak vertical particle velocity vibration on the ground next to an existing parking structure. The extent of the damage was some crumbling of mortar used to fill wall joints. In that instance the

Table 2 - Reaction of People and Damage to Buildings at Various <u>Continuous</u> Vibration Amplitudes

Vibration Amplitude (Peak Particle Velocity)*			
mm/s	**in/sec**	**Human Reaction**	**Effect on Buildings**
0.15-0.30	0.006-0.019	Threshold of perception; possibility of intrusion	Vibrations unlikely to cause damage of any type
2.0	0.08	Vibrations readily perceptible	Recommended upper amplitude of the vibration to which ruins and ancient monuments should be subjected
2.5	0.10	Amplitude at which continuous vibrations begin to annoy people	Virtually no risk of "architectural" damage to normal buildings
5.0	0.20	Vibrations annoying to people in buildings (this agrees with the amplitudes established for people standing on bridges and subjected to relative short periods of vibrations)	Threshold at which there is a risk of "architectural" damage to normal dwelling - houses with plastered walls and ceilings Special types of finish such as lining of walls, flexible ceiling treatment, etc., would minimize "architectural" damage
10-15	0.4-0.6	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Vibrations at a greater amplitude than normally expected from traffic, but would cause "architectural" damage and possibly minor structural damage.

** The vibration amplitudes are based on peak particle velocity in the vertical direction. Where human reactions are concerned, the value is at the point at which the person is situated. For buildings, the value refers to the ground motion. No allowance is included for the amplifying effect, if any, of structural components.*

Source: "A Survey of Traffic-induced Vibrations" by Whiffen and Leonard, Transport and Road Research Laboratory, RRL Report LR418, Crowthorne, Berkshire, England, 1971.

distance to the pile driving was slightly greater than 5 m (17 ft). The pile driver energy and the soil conditions were unknown. It is likely that the ground vibrations were amplified by the structure, causing the damage.

On the whole, the architectural damage criterion for continuous vibrations, 5 mm/s (0.2 in/sec) appears to be conservative even for sustained pile driving. Pile driving amplitudes often exceed 5 mm/s (0.2 in/sec) at distances of 15 m (50 ft), and 13 mm/s (0.5 in/sec) at 7.5 m (25 ft). Pile driving has been done frequently at these distances without apparent damage to buildings (with the previously mentioned exception). The criterion amplitude for pile driving is therefore somewhere between 5 and 50 mm/s (0.2 and 2 in/sec). The 50 mm/s (2 in/sec) single event criterion is still being used by some organizations and engineering firms as a safe amplitude for pile driving. Although never measured by Caltrans, calculations show that this amplitude will be probably exceeded within 2 m (6 ft) from a 68,000 J (50,000 ft lbf) pile driver. This amplitude is probably a "safe" criterion to use for well engineered and reinforced structures. For normal dwellings, however, pile driving peaks should probably not be allowed to exceed 7.5 mm/s (0.3 in/sec). In any case, extreme care must be taken when sustained pile driving occurs within 7.5 m (25 ft) of <u>any</u> building, and 15-30 m (50-100 ft) of a historical building, or building in poor condition.

When high amplitudes of construction vibrations (such as from pile driving, demolition, and pavement breaking) are expected at residences or other buildings, it is recommended that a detailed "crack survey" be undertaken BEFORE the start of construction activities. The survey may be done by photographs, video tape, or visual inventory, and should include inside as well as outside locations. All existing cracks in walls, floors, driveways, etc. should be documented with sufficient detail for comparison after construction to determine whether actual vibration damage has occurred.

<u>Annoyance</u> - The annoyance amplitudes in Table 2 should be interpreted with care. Depending on the activity (or inactivity) a person is engaged in, vibrations may be annoying at much lower amplitudes than those shown in Table 2. Elderly, retired, or ill people staying mostly at home, people reading in a quiet environment, people involved in vibration sensitive hobbies or other activities are but a few examples of people that are potentially annoyed by much lower vibration amplitudes. Most routine complaints of traffic vibrations come from people in these categories. To them, even vibrations near the threshold of perception may be annoying.

Frequently, low amplitude traffic vibrations can cause irritating secondary vibrations, such as a slight rattling of doors, windows, stacked dishes, etc. These objects are often in a state of neutral equilibrium and readily respond to very low amplitudes of vibrations. The rattling sound gives rise to exaggerated vibration complaints, even though there is very little risk of damage.

Other criteria At times, other criteria may be necessary to address very specific concerns. For example, vibration sensitive manufacturing or calibration processes, such as close tolerance machining, laboratories calibrating sensitive electronic equipment, use of electron microscopes, etc. often require vibration criteria that are much lower than the threshold of perception amplitude.

Determining the specific criterion amplitude for such sites is no easy task, and requires the cooperation of the engineers, technicians, or managers involved with the operations. Frequently, even those experts do not know at what amplitude of vibrations their operations will be disturbed, and tests involving generation of vibrations (such as running a heavy truck over 2"x4" wooden boards outside the plant), vibration monitoring equipment, and a test operation must be performed.

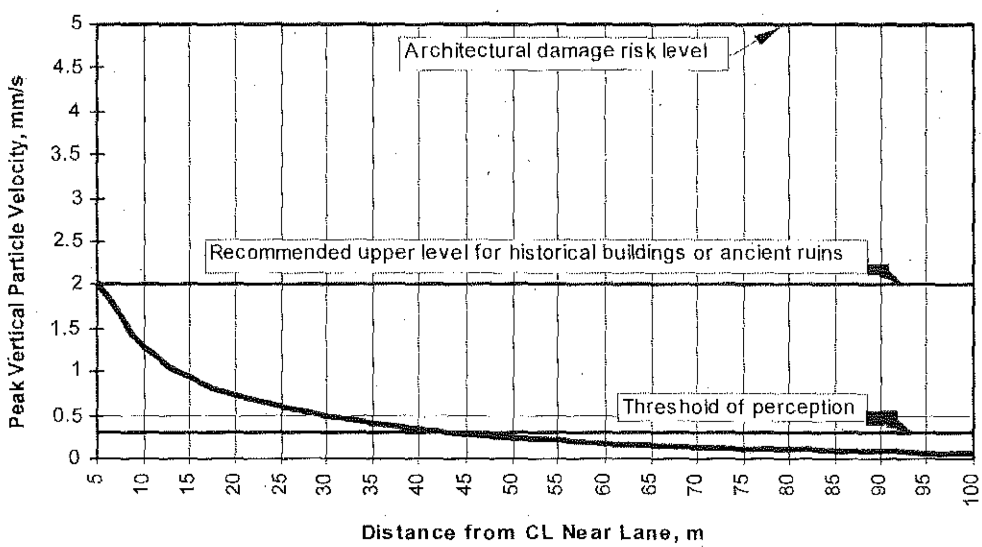
Typical Traffic Vibration Amplitudes

From Figure 1 typical relationships of traffic vibrations vs. distance from a freeway can be developed. For instance, vibration data of truck passbys are characterized by peaks that are considerably higher than those generated by automobiles. These peaks last no more than a few seconds and often only a fraction of a second, indicating a rapid drop-off with distance. Figure 1 showed that at 15 m (50 ft) from the centerline of the nearest lane, truck vibrations are about half of those measured near the edge of shoulder (5 m, or about 15 ft from the centerline of the near lane). At 30 m (100 ft) they are about one fourth, at 60 m (200 ft) about one tenth, and at 90 m (300 ft) less than one twentieth. These rough estimates are supported by years of measurements throughout California.

Because of the rapid dropoffs with distance, even trucks traveling close together often do not increase peak vibration amplitudes substantially. In general, more trucks will show up as <u>more</u> peaks, not necessarily <u>higher</u> peaks. Wavefronts emanating from several trucks closely together may either cancel or partially cancel (destructive interference), or reinforce or partially reinforce (constructive interference) each other, depending on their phases and frequencies. Since traffic vibrations can be considered random, the probabilities of total destructive or constructive interference are extremely small. Coupled with the fact that two trucks cannot occupy the same space, and the rapid drop-off rates, it is understandible that two or more trucks normally do not contribute significantly to each other's peaks. It is, however, good practice to try and include the worst combinations of truck clusters with heavy loads in traffic passby vibration measurements. This obviously requires a good view of the traffic, or an observer who is in communication with the instrument operator.

Figure 2 is a plot of maximum highway truck traffic vibrations vs. distance from the centerline of the nearest freeway lane. The curve was compiled from the highest measured vibrations available from previous studies. Some of the Table 2 criteria are also plotted, for comparison. The graph indicates that the highest traffic generated vibrations measured on freeway shoulders (5 m from center line of nearest lane) have never exceeded 2.0 mm/s, with worst combinations of heavy trucks. This amplitude coincides with the maximum recommended "safe amplitude" for ruins and ancient monuments (and historical buildings). The graph illustrates the rapid attenuation of vibration amplitudes, which dip below the threshold of perception for most people at about 45 m (150 ft).

Figure 2. Maximum Highway Truck Traffic Vibration Levels vs. Distance



Automobile traffic normally generates vibration peaks of one fifth to one tenth of truck vibrations. Traffic vibrations generally range in frequencies from 10-30 Hz, and tend to center around 15 Hz. However, it is not uncommon to measure lower frequencies, even down to 1-2 Hz. Due to their suspension systems, city buses often generate low frequencies around 3 Hz, with high velocities (indicating high displacements). It is more uncommon, but possible, to measure frequencies above 30 Hz for traffic.

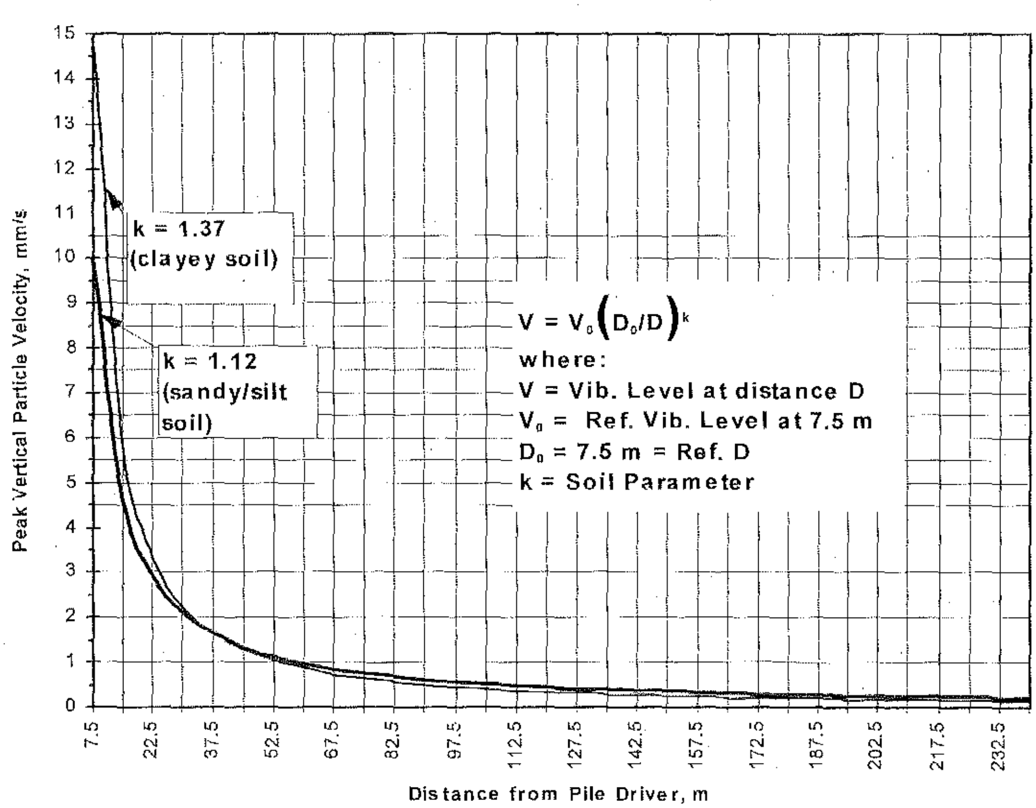
Construction Vibration Amplitudes

With the exception of a few instances involving pavement breaking, pile driving, all Caltrans construction vibration measurements have been below the 5 mm/s (0.2 in/sec) architectural damage risk amplitude for continuous vibrations. The highest measured vibration amplitude was 73.1 mm/s (2.88 in/sec) at 3 m (10 ft) from a pavement breaker. This instance marked the only time that the single event safe amplitude of 50 mm/s (2 in/sec) was exceeded during vibration monitoring by Caltrans.

Other construction activities and equipment, such as D-8 and D-9 Caterpillars, earthmovers and haul trucks have never exceeded 2.5 mm/s (0.10 in/sec) or one half of the architectural damage risk amplitude, at 3 m (10 ft)). Depending on the activity and the source, construction vibrations vary much more than traffic vibrations.

Figure 3 shows typical pile driving vibrations with distance, for a 68,000 J (50,000 ft lbf) energy impact pile driver, for two different soils (clayey and sandy with silt). Clay

Figure 3. Expected Vibration Levels Generated by a 68,000 J (50,000 ft lbf) Impact Pile Driver



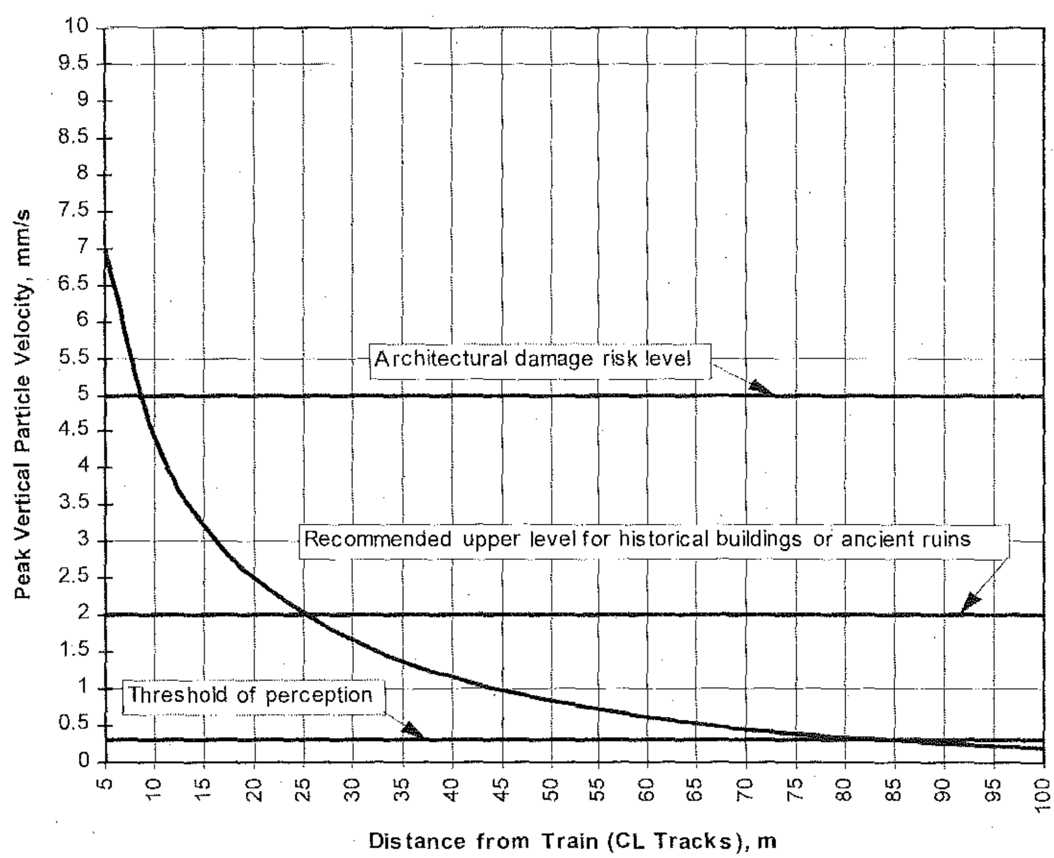
soils provide more resistance to advancing piles and therefore generate higher vibration amplitudes near the source than those in sandy soils. Vibrations in clay soils, however, tend to drop off more rapidly with distance than those in sandy soils.

Frequency ranges of construction vibrations, (including pile driving) tend to be the same as for traffic vibrations, mostly in the 10-30 Hz range, centered around 15 Hz, once in a while lower than 10 Hz, and rarely higher than 30 Hz.

Train Vibration Amplitudes

Train vibration amplitudes may be quite high, depending on the speeds, load, condition of track, amount of ballast used to support the track, and the soil. The highest train vibration measurement was 9.1 mm/s (0.36 in/sec) at 3 m (10 ft), in Sacramento. Using this information with the drop-off curve in Figure 1, we can construct a train vibration curve vs. distance. This is shown in Figure 4, beginning at 5 m (16 ft) where

Figure 4. Maximum Train Vibration Levels vs. Distance



the vibration amplitude is calculated at 7 mm/s. The curve represents maximum expected amplitudes from trains, and thus is very conservative. Measurements at various distances at other locations and different freight trains averaged about two-thirds of those shown in the curve.

Train vibrations tend to be in the same frequency ranges as traffic and construction vibrations. In some cases higher frequencies are encountered, especially in curves, caused by wheel chatter and squeal.

Impacts

Architectural and Structural Damage - The above discussions indicate that in any situation the probability of exceeding architectural damage risk amplitudes for continuous vibrations from construction and trains is very low and from freeway traffic practically non-existent. However, if vibration concerns involve pavement breaking, extensive pile driving, or trains, 7.5 m (25 ft) or less from normal residences, buildings, or unreinforced structures, damage is a real possibility. This may also be true if these operations occur within 15 m – 30 m (50 ft- 100 ft) from historical buildings, buildings in poor condition, or buildings previously damaged in earthquakes.

Pile driving in close proximity (say within 3 m or 10 feet) of structures can cause additional problems, depending on the soils and configurations of substructures. An example was the reconstruction of San Francisco-Oakland Bay Bridge Toll Plaza in June 1987. A number of piles were driven in soft clay soils ("bay mud") close to the existing booth access tunnel underneath the freeway. Due to the large number of piles, and the proximity and configuration of the old substructure, the lateral soil movement, caused by piles permanently displacing the clay, was resisted. The resulting conflict of forces was relieved by structure uplift and damage (cracks in the reinforced concrete tunnel).

Annoyance - As was discussed before, the annoyance amplitude shown in Table 2 is highly subjective, and does not take into consideration elderly, retired, ill, and other individuals that may stay home more often than the "average" person. Nor does it account for people involved in vibration sensitive hobbies or activities, and people that like to relax in quiet surroundings without noticing vibrations. The threshold of perception, or roughly 0.25 mm/s (0.01in/sec) may be considered annoying by those people. Low amplitude vibrations may also cause secondary vibrations and audible effects such as a slight rattling of doors, windows and dishes, resulting in additional annoyance. Annoying low frequency airborne noise can sometimes accompany earthborne vibrations.

Vibration Sensitive Operations - Aerospace and electronic laboratories, close tolerance manufacturing, calibration of sensitive instruments, radio & TV stations, recording studios, etc., require additional attention. Shutting down their operations, even temporarily, could be extremely costly to the state. As was previously discussed vibration criteria for these operations are not well defined, for two main reasons. First, the operations are often classified and their precise nature is therefore not always known. Secondly, the engineers involved in the critical operations often do not know how much vibration can be tolerated, or what operations they may be involved with in the future.

Heavy truck traffic on freeways within 30 m (100 ft), major construction within 60 m (200 ft), freight trains within 90 m (300 ft) and pile driving within 180 m (600 ft) may be potentially disruptive to sensitive operations.

Mitigation

Unlike with noise, there are no easy ways to mitigate earthborne vibrations. There are, however, a limited number of options available.

When designing new transportation facilities, reasonable amounts of care should be taken to keep these facilities away from vibration sensitive areas.

When dealing with existing transportation facilities, obvious vibration causes, such as pot holes, pavement cracks, differential settlement in bridge approaches or individual pavement slabs, etc., may be eliminated by resurfacing. In certain situations a ban of heavy trucks may be a feasible option.

The use of alternate construction methods and tools may reduce construction vibrations. Examples are predrilling of pile holes, avoiding cracking and seating methods for resurfacing concrete pavements near vibration sensitive areas, using rubber tired as opposed to tracked vehicles, placing haul roads away from vibration sensitive areas.

Scheduling construction activities (particularly pile driving) for times when it does not interfere with vibration sensitive operations (e.g. night time) may be another solution, especially in industrial areas.

Train vibrations may be reduced by using continuous, welded rails, vibration damping pads between rails and ties, and extra ballast.

Link With Historical Data

A considerable amount of effort has gone into the field measurements, reduction, documentation and reporting of vibration data since 1958. As data sets are accumulated with each vibration study, a more complete picture emerges of the generation and propagation of vibration waves under various conditions of geometry, soil, and source types.

Due to the lack of accurate subsurface information, empirical data is of utmost importance and can be used for future estimates when conditions are alike. Historical data that can be linked to the present and future play a very important role in estimates and predictions of future vibrations.

Present and future personnel charged with the responsibility of performing vibration studies and maintaining vibration files should make every effort necessary to maintain a good correlation between any new and old instrument systems, calibration procedures, and measuring methods. The link between present and valuable historical data must be preserved.

Vibration Monitoring Equipment

During the period of 1958 - 1994 all of Caltrans vibration monitoring was performed by Translab. A transducer calibration system consisting of a shake table mounted on a concrete vibration isolation pad, and an Optron camera/amplifier system, measuring displacement allowed Translab to calibrate its own transducers with traceability to the National Institute of Standards and Technology (NIST), formerly known as the National Bureau of Standards (NBS). Transducers were calibrated by mounting them on the shake table and running the latter at a known frequency and displacement.

Two types of sensors (transducers) were used by Caltrans. The first type was the seismometer. A seismometer measures vibrations at relatively low frequencies usually 1 - 200 Hertz (Hz), is very sensitive to low amplitudes of vibrations and, through magnetic induction produces a voltage proportionally to velocity. It measures velocity directly via a signal conditioner, and is therefore called a velocity transducer. It is large, weighs about 7 kg (15 lbs), and, because of its mass, can be placed directly on the ground without further mounting attachments.

The second type of transducer was an accelerometer. As the name implies, this type of transducer measures acceleration directly. Used with an integrator it can also measure velocity and displacement.

The type of accelerometer used by Caltrans has a piezoelectric (pressure sensitive) crystal. As the transducer vibrates with the surface it is mounted on, acceleration changes the compression of the crystal, which in turn causes variations in the electrical charge across the crystal faces. These charge variations are proportional to acceleration.

An accelerometer is small, not as sensitive as the seismometer and has a wide frequency range, from 1 Hz to several KHz (1 KHz = 1000 Hz). Larger, more sensitive accelerometers, weighing about 1 lb, are available with a narrower frequency range from 0.1 Hz to 1KHz. Due to their small size and lack of mass, accelerometers should not be placed directly on the ground, floor, or other vibrating surface without proper mounting. When properly mounted, accelerometers are excellent transducers for vibration monitoring. They can be mounted various ways, depending on the surface.

For earthborne vibration work an accelerometer can be mounted via a magnet (supplied with it) to a block of steel of, say 5-10 kg (10-20 lbs). The steel block can then be placed directly on the ground, or other surface. However, the steel block should be firmly embedded in loose soil. On harder surfaces such as pavements, the block can only be used on friction surfaces that are perfectly amplitude without high spots to avoid rocking of the block. Correlation tests conducted by Caltrans using this method and the heavy seimometers, concluded that the mass of the steel block provided adequate coupling of the accelerometer with the ground for the low frequency, low amplitude vibrations generated by transportation facilities and construction.

Vibration Study Approach and Instrument Setup

Vibration studies can be classified into two main categories:

1. Studies involving existing transportation operations and facilities
2. Studies involving future transportation operations and facilities

Vibration Studies for Existing Construction Operations and Transportation Facilities - These studies consist of mainly addressing vibration complaints due to existing traffic, or construction operations. Understandably, pile driving near homes or businesses will normally generate many noise and vibration complaints. Other construction operations can also be responsible. Traffic vibration complaints are often due to poor pavement conditions. Other reasons may be increases in traffic, heavy trucks, buses, etc. Sudden increases in traffic vibrations may be due to opening of new transportation facilities, or redirecting traffic.

Although complaints can originate from the entire spectrum of receptors, most are from residences, or businesses that have vibration sensitive equipment or operations.

The first step in investigating complaints should be interviewing the complainant(s). The screening procedures outlined later in this document cover the most important questions to ask. For the purposes of performing a vibration study, the most important issues are:

- The type and location of the vibration source(s)
- The complainant(s)' concerns, i.e., annoyance, damage, disruption of operations.
- The location that is most sensitive, or where vibrations are most noticeable.

Vibration monitoring of existing operations or facilities ranges from simple, single location measurements to more complex multi-instrument, simultaneous measurements. The former consists of taking measurements at the most sensitive location, or location perceived by the complainant to have the worst vibrations. The latter usually involves placing a sensor close to the source as a reference, and one or more sensors at the critical location(s) ("response sensors"). Simultaneous measurements will then positively identify the vibration source, the drop-off and the response (vibration amplitude) at the location(s) of interest. The reference sensor remains fixed in one location near the source, while the response sensor(s) may be moved to different locations.

Sufficient data should be collected for each location. For highway traffic vibrations, 10 passbys of heavy trucks (preferably worst case combinations of several trucks) for each location should be sufficient. For pile driving, at least one pile closest to the receptor should be monitored at each location of interest.

The highest vibration amplitude at each location can then be compared to Caltrans or other appropriate criteria.

<u>Vibration Studies for Future Construction Operations and Transportation Facilities</u> - Studies involving predictions of construction and operation vibrations of future transportation facilities often require vibration simulations to determine a site-specific drop-off curve. In order to generate vibrations that can still be measured at 60-90 m (200 to 300 ft) to develop the curve, the site must be free of high ambient vibrations (preferably less than 0.13 mm/s or 0.005 in/sec at the 90 m or 300 ft distance), and the generated vibrations must be relatively high. From Figure 1 we can calculate approximately how high the reference vibration V_0 at 5 m should be to detect the vibrations at 90 m. The V/V_0 ratio at that distance = 0.038; assuming we want V to be at least 0.13 mm/s; then V_0 = 1/0.038 x 0.13 = 3.4 mm/s (0.13 in/sec). If a low-vibration site cannot be found, either the distance for the drop off curve must be shortened, or the reference vibrations increased. Caution must be used to apply the drop-off curve to pile driving projections, due to the previously discussed differences in propagation characteristics.

To generate data for the drop-off curve, a heavily-loaded water truck, or dump truck (preferably 25 tons or greater GVW) is run at high speed over 2" x 4", or 2" x 6" wooden boards. Normally, five boards are laid perpendicular to the direction of travel, and spaced 7.5 m (25 ft) apart along the direction of travel. The advantage of this arrangement is that the generated vibration "signature" is normally recognizable at 90 m (300 ft).

A minimum of two sensors must be used simultaneously: one reference sensor, and one or more response sensors. The reference sensor remains fixed at 5 m (16 ft) from centerline of travel, (or any convenient distance near the source) opposite the last board to be run over (most forward in line with the direction of travel). The response sensor(s) is (are) positioned at various distances away from the source. Because of the steepness of the curve near the source it is a good idea to cover shorter distance intervals near the source and longer ones away from the source. To adequately cover the entire range of the drop-off curve, 6 to 8 locations must be monitored, and at least 5 truck passbys per location.

Frequently it is not possible to do the simulations on the site of interest, because of space limitations. Nearby empty lots or open fields, or data from other sites known or judged to have similar soil conditions can then be used.

Once the measurements have been made, the data at each location should be averaged. Using the reference location, and at least two others (including the furthest one), the soil parameter "α" can be calculated using equation 2. Ideally, "α" should remain constant for each location, but in reality it will vary. The average of several values can then be used to develop a drop-off curve. The vibration amplitudes at all measured locations should then be plotted to determine how well they fit this curve. Assuming they fit reasonably well, a normalized drop-off curve using V/V_0 ratios and distances (similar to Figure 1) can then be developed and used with any source reference amplitude, to predict the future amplitude at any distance within the range of the curve.

If it is possible to do the simulations at the site, inside/outside building locations should be included to measure the building amplification or attenuation ratio.

The next step is to measure ambient amplitudes at the site. Outside as well as inside building locations should be included for these measurements.

Using all the above information, future amplitudes can be predicted and compared to existing ambient amplitudes, Caltrans guidelines, or any other appropriate or required standard.

Concerns for vibrations of future transportation facilities are usually raised by vibration sensitive factories, laboratories, or other vibration sensitive sites. Unless construction activities are expected to occur very close to residential or other structures, or near historical buildings, these receptors are not routinely included in vibration studies for future facilities.

Vibration field studies including simulations are expensive. Unless the consequences of transportation and construction generated vibrations may be costly to Caltrans, the curves and techniques described in this document can be used to estimate "ball park" vibration amplitudes, in lieu of field studies.

Vibration Reports

Each vibration field study should be documented in a report. Depending on the amount of sites measured, amount of data collected, methodologies used, and the importance of the study, the report may range from a simple one or two paged memo, to a report of twenty or more pages. A vibration study can be considered a mini-research project, and should contain enough information for the reader to independently come to the same conclusions.

As a norm, vibration reports contain the following topics, which will be described in greater detail:

* Project title and description
* Introduction
* Objectives
* Background
* Study Approach
* Instrumentation
* Measurement Sites
* Measurements
* Data Reduction
* Measurement Results
* Data Analysis
* Results and Comparison with Standards
* Conclusions and Recommendations
* Tables showing all measured data, summaries of results, analysis and standards
* Figures showing site layouts and cross sections, instrument setups, drop-off curves, and other pertinent illustrations
* References cited

In short, simple vibration studies, the topics may be described in a few sentences in a memo. In more complex studies, a fairly extensive report is usually required.

Project Title and Description - If the report consists of a short memo this info. can be put in the "Subject:" space. In a long report it should be put on a separate title page, with the date, who did the study (Div.or District, Branch, and personnel involved), and author of report.

Introduction - Typical opening sentences: "This report (memo) presents the results of a vibration study at .... The study was requested by ......, in response to concerns by .... that vibrations of .... would interfere with ....operations. The study was performed by ..... (branch or section) on .... (dates)."

Objectives - This is often combined with the introduction. Example: "The purpose of the study was to provide baseline data for estimating vibration amplitudes in sensitive areas of Hughes Aircraft facility generated by construction and traffic of the proposed LA-105 Freeway."

Background - Used only when there is a long and complicated history connected with the reasons for the studies. Useful for documenting all the facts leading up to the study for litigation purposes. Dates first contacted, correspondence, actions taken, and other pertinent details may be appropriate in this section. Not necessary in most studies.

Study Approach - May be combined with other sections. A short description of how the study was done. Example:

"First, vibrations generated by a 25 ton GVW three-axle water truck driven over five 2"x4" wooden boards .... were measured at various distances to measure the vibration attenuation with distance. This info. was then used to develop a drop-off curve....., etc." For simple studies, such as residential complaints: "The sensor was set up at four different locations where, according to the homeowner, vibrations were most noticeable. Five heavy truck passbys on Route ..... were measured at each of the locations. ..."

Instrumentation - Always include description, manufacturer, model, serial no. of each vibration equipment components used. It is also extremely important to include the date instruments were last calibrated, by whom, where the records are on file, and whether calibration was traceable to the NIST (National Institute of Standards and Technology, formerly NBS). Essential in court cases!

Measurement Sites - Include a sketch, preferably to scale, of the relationship between source and measurement locations. Plot and number the sites on the sketch. Include typical cross sections if there are significant elevation differences between source and receptors. Plot significant structures. Show enough dimensions to pinpoint each measurement location. Show detailed descriptions, and instruments or sensors used at each location in the text, or in a separate table if there are many. Once locations are numbered and described, they can be referred to by number only.

Measurements - This section may also include the study approach. Basically explains the methods used, how sensors were mounted, number of measurements taken, what sources were measured (e.g. heavy trucks on Route 5), descriptor used and why, and other pertinent information concerning the vibration measurements. When possible, include a description of soil type and structure. This info. can often be extracted from nearby boring logs. Be sure to include ambient or background measurements.

Data Reduction - A short description of how the data was reduced can effectively be combined with the measurement section. Only if the reduction method is unusual or complex should it be discussed in a separate section.

Measurement Results - May also be combined with the measurement section. Briefly summarize data in the text by giving highest values, ranges, and averages. Should be accompanied by a table summarizing measurement run No. (or just Run No.), date and time, measurement location, source (heavy truck in N/B lane No.4), distance, vibration amplitude, dominant frequency, and optional remarks. This table may be put in the text or in an appendix with all other tables and figures. All individual measurements should be included as part of the report, for possible future use. Ambient or background vibration measurements can be expressed as a range of vibrations, typical frequency ranges, time period during which they were measured, and if possible the range of sources and distances.

Data Analysis - Developing drop-off curves, predicting future amplitudes, calculating amplitudes at specific distances not measured, etc. all should be in this section. May not be necessary for simple studies involving residential complaints, monitoring for compliance with a standard, or any other study involving vibration measurements only.

Results and Comparisons to Standards - Existing measured, projected, and predicted vibration amplitudes and frequencies are summarized and compared to pertinent standards in this section. This is usually done in tabular form, and accompanied by Table 1, which shows the vibration criteria used by Caltrans.

Conclusions and Recommendations - Conclusions are drawn from the previous comparisons with standards. Typically for highway vibration complaints would be: "Although vibrations generated by heavy trucks on I-5 may at times be felt, they are far below the 'architectural damage risk amplitude' criterion of 0.2 in/sec used by Caltrans."

Recommendations for mitigation are rather limited (see "Mitigation" section). However, in some cases strategies such as pile driving at night may solve interference with vibration sensitive manufacturing processes during day time. When ever possible, such recommendations should be included.

References - In complex reports, relying partly on previously gathered data, it may be beneficial to cite other reports or references by number. A listing of these references should then be included at the end of the report.

Field Review and Screening of Possible Vibration Problems

The following procedures were designed to screen vibration complaints near existing transportation facilities. They are intended to accomplish two things: 1) to evaluate the severity of the vibration problem, and 2) obtain preliminary information for a vibration study, should one be necessary.

The procedures are divided in two parts: problem definition and actions to take. An outline of the steps in each part follows:

I. Problem Definition

A. Interview resident at the site of concern. Ask the following questions:

1. What is the exact problem in the resident's opinion?

Many people confuse low frequency airborne noise with earthborne vibrations.

2. What are the sources in the resident's opinion?

Trucks on freeway?; city traffic?; trains? (sources may not be our jurisdiction.)

3. What are the specific concerns?

Annoyance?, interference with activities?, damage to the residence? If damage is the main concern, ask for evidence look for stucco cracks, cracks in driveways, walkways, walls, stucco, etc. Compare with other residences further away from the transportation facility. If these also have cracks, then it is safe to assume that the facility is not responsible.

4. Where are the vibrations most noticeable?

Which room?; which part of the yard? (Let resident point out the critical locations.)

5. What time of the day and/or what day of the week does the resident feel vibrations the most?

6. When did the resident become aware of the vibrations?

Try to correlate with changes in nearby traffic patterns, due to truck bans elsewhere, new industrial development, or other reason for truck increases.

B. Feel the vibrations

1. Stand at critical locations and try to feel vibrations when trucks pass by.

Place finger tips on furniture, walls, uncarpeted floor, ground outside the residence, patio floor, etc.

2. Have someone walk nearby; feel these vibrations and compare with the traffic vibrations. Also compare other in-house generated vibrations.

Walking, air conditioners, heater blowers, and garbage disposals, etc. often generate more vibrations than traffic.

3. Stand on freeway shoulder, sidewalk next to highway, or anywhere close to the suspect source. Feel vibrations and compare with those felt at the receptor.

Place finger tips on ground or pavement surface.

4. Look for obvious causes of excessive vibrations.

Pot holes, pavement joints, sag, and pavement cracks, or anything that could cause above normal vibrations; also look for drainage or other structures transmitting vibrations to the receptor without benefit of soil attenuation.

C. Evaluate severity of the problem.

The graphs in Figures 1 - 4 show typical vibration attenuations with distance for various sources. Use these to evaluate typical relationships of near and far source vibration amplitudes. If vibrations appear to dropoff at a significantly lesser rate, then suspect that something unusual is going on. For instance, vibrations may be transmitted by underground structures, which can cause problems at the receptor.

1. If vibrations feel as strong (or almost as strong) at the receptor as they do near the source (such as on a freeway shoulder), consider problem severe.

2. If vibrations at the receptor are readily noticeable and appear to interfere with activities or vibration sensitive operations, consider problem severe.

3. If vibrations of any amplitude are an issue in litigation, consider the problem severe.

4. If after this screening procedure uncertainty still exists, consider problem severe.

II. Actions To Take

A. If problem is not severe:

1. If there are obvious causes for excessive vibrations, such as pot holes, etc., contact Maintenance or other departments and find out if scheduled for repair or resurfacing.

2. Write memo to resident explaining your findings.

If there are obvious solutions such as patching or resurfacing, tell the resident. If there are no obvious solutions, explain to the resident that although vibrations may be felt, they are not damaging. Use background info. in this document.

B. If problem is considered severe, or if the resident keeps insisting on actual monitoring, consider contracting out vibration monitoring or a complete vibration study.

APPENDIX
BASIC VIBRATION FORMULAE

APPENDIX

BASIC VIBRATION FORMULAE

Symbols

A = Zero-to-Peak, or Peak Acceleration (Units: m/sec^2, mm/sec^2, ft/sec^2, in/sec^2)

A_g = Zero-to-Peak, or Peak Acceleration (Units: "g" = acceleration of gravity), where:

1 g = 9.807 m/sec^2
= 9807 mm/sec^2
= 32.174 ft/sec^2
= 386.102 in/sec^2

D = Peak-to-Peak Displacement (Units: m, mm, ft, in) (Normally of interest)

D/2 = Zero-to-Peak, or Peak Displacement (Units: m, mm, ft, in)

f = Frequency (Units: Hertz)

V = Zero-to-Peak, or Peak Particle Velocity (Units: m/sec,mm/sec, in/sec)

π = 3.14159etc.....

Formulae for Sinusoidal Waves

Units need to be consistent; for example, if D is in mm, then V must be in mm/sec, and A either in mm/sec^2 or units of "g" (9807 mm/sec^2).

With displacement, we are normally interested in the peak-to-peak value or in other words, the total displacement (distance between the + peak and - peak) soil particles travel. Sometimes, however we may also be interested in the zero-to-peak displacement, or displacement relative to a stationary (zero) reference position. For sinusoidal waves, the + side of reference and the - side are symmetrical, and zero-to-peak values are D/2.

With velocity and acceleration, however, we are always interested in the zero-to-peak values. These give an indication of maximum value, without regard of the direction.

Acceleration is most commonly used in units of g.

Following are formulae expressing the relationships between displacement, velocity, and acceleration for sinusoidal vibration waves.

Velocity and Displacement:

$V = 2\pi f(D/2)$ (Eq.A-1)

$V = \pi fD$ (Eq.A-2)

$D/2 = V/(2\pi f)$ (Eq.A-3)

$D = V/(\pi f)$ (Eq.A-4)

Acceleration and Displacement:

$A = (2\pi f)^2(D/2)$ (Eq.A-5)

$A = 2\pi^2 f^2 D$ (Eq.A-6)

$A_g = (2\pi^2 f^2 D)/g$ (Eq.A-7)

If D is in inches:

$A_g = (2\pi^2 f^2 D)/386.102 = 0.0511f^2D$ (Eq.A-8)

If D is in mm:

$A_g = (2\pi^2 f^2 D)/9807 = 0.00201f^2D$ (Eq.A-9)

Acceleration and Velocity:

$A = 2\pi fV$ (Eq.A-10)

$A_g = (2\pi fV)/g$ (Eq.A-11)

If V is in inches per second:

$A_g = (2\pi fV)/386.102 = 0.0163fV$ (Eq.A-12)

If V is in mm per second:

$A_g = (2\pi fV)/9807 = 0.000641fV$ (Eq.A-13)

Acceleration or Velocity in Decibels:

$A(dB) = 20Log(A/A_0)$; $V(dB) = 20Log(V/V_0)$ (Eq.A-14)

where A = acceleration, A_0 = reference acceleration,

V = velocity, and V_0 = reference velocity (units must be consistent)

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Appendix B. Sample Vibration Screening Procedure and Vibration Complaint Form

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Vibration Screening Procedure

The vibration screening procedure is divided in two parts: problem definition and actions to take.

I. Problem Definition

A. Interview resident at the site of concern. Ask the following questions.

1. *What is the exact problem, in the resident's opinion?*
   Confirm that the vibration is from a Caltrans facility or activity and that vibration is really the issue. Many people confuse low frequency airborne noise with earthborne vibrations.

2. *What are the sources of vibration, in the resident's opinion?*
   Identify the sources of vibration (e.g., trucks on freeway, city traffic, trains, construction equipment). Sources such as trains may not be within Caltrans' jurisdiction.

3. *What are the specific concerns?*
   Identify the specific concern (e.g., annoyance, interference with activities, damage to the residence). If damage is the main concern, ask for evidence and look for cracks in driveways, walkways, walls, stucco, etc. Compare these conditions with other residences farther away from the transportation facility or construction activity. If distant locations have similar conditions, it is likely that the damage is not the result of the facility or construction activity.

4. *Where is the vibration most noticeable?*
   Identify where the vibration is most noticeable (e.g., specific rooms, yard outside). Let resident point out the critical locations.

5. *What time of the day and what day of the week does the resident feel vibrations the most?*
   Identify when the vibration is most noticeable.

6. *When did the resident become aware of the vibrations?*
   Try to correlate the detection of vibration with changes in nearby traffic patterns, changes in heavy truck percentages, or the presence of new vibration sources.

B. Feel the vibrations.

1. *Stand at critical locations and try to feel vibrations when trucks pass by.*

   Place fingertips on furniture, walls, uncarpeted floor, ground outside the residence, patio floor, etc., to sense where vibration is most noticeable.

2. *Have someone walk nearby; feel these vibrations and compare with the traffic vibrations. Also compare other vibrations generated in-house.*

   People walking, air conditioners, heater blowers, garbage disposals, etc. often generate more vibrations than traffic. Try to see how vibration from these sources compares to vibration from the sources identified by the resident.

3. *Stand on freeway shoulder, sidewalk next to highway, or anywhere close to the suspected source. Feel vibrations and compare with those felt at the receptor.*

   Place fingertips on ground or pavement surface to sense vibration near the source of concern.

4. *Look for obvious causes of excessive vibrations.*

   Identify potholes, pavement joints, sag, pavement cracks, or anything that could cause above-normal vibration. Also look for drainage pipes or other structures that can transmit vibration directly to the receptor without benefit of soil attenuation.

C. Evaluate the severity of the problem.

If the vibration level appears to drop off at a significantly lower rate than would be expected, something unusual may be occurring on the site. For example, vibration may be transmitted by underground structures, which can cause vibration to be transmitted over longer-than-normal distances. A vibration problem should be considered severe if:

1. vibration feels as strong (or almost as strong) at the receptor as it does near the source (such as on a freeway shoulder),

2. vibration at the receptor is readily noticeable and appears to interfere with activities or vibration-sensitive operations,

3. vibration at the receptor is readily noticeable and appears to have resulted in structural or cosmetic damage,

4. vibration of any amplitude is an issue in litigation, or

5. uncertainty still exists as to the source of vibration.

II. Actions to Take

A. If problem is not severe:

1. *Identify the obvious causes for excessive vibrations.* These causes could include pavement imperfections that result in vibration from truck pass-bys or unusual building resonances that amplify vibration at the receiver. For issues within Caltrans' control, such as pavement conditions, contact the appropriate Caltrans department and find out whether the pavement is scheduled for repair or resurfacing.

2. *Prepare a memo to explain your findings.* If there are obvious solutions, such as pavement patching or resurfacing, explain these, along with actions that will or will not be taken to address the issue. If there are no obvious solutions, explain that, although vibration may be felt, it is not enough to cause damage.

B. If problem is considered severe, or if the resident keeps insisting on actual monitoring, conduct a vibration monitoring study to further investigate the issue.

Vibration Complaint Report

Complaint received: Date: ______________ Time: ______________

Complainant's name: ____

Address: ________________________________ Phone: ____________

Specific complaint: ____

____

____

____

Date and specific time of occurrence (as reported by Complainant):

Date: ______________ Time: ______________

Complaint received by: _____________________________________

Results of Investigation: ____________________________________

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Investigated by: ____

Disposition of Complaint: ___________________________________

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Appendix C. Sample Vibration Specifications

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VIBRATION MONITORING

DESCRIPTION

1.01 GENERAL

A. The Work of this Section includes furnishing, installing and maintaining vibration-monitoring instrumentation; collecting vibration data; and interpreting and reporting the results. The Contractor shall implement required remedial and precautionary measures based on the vibration-monitoring data.

B. The purpose of the vibration-monitoring program is to protect the following properties from excess vibration during demolition and construction activities associated with the ______________________________ Project:

1. Building name and address

2. Building name and address

3. Building name and address

4. Building name and address

C. Caltrans is not responsible for the safety of the Work based on vibration-monitoring data, and compliance with this Section does not relieve the Contractor of full responsibility for damage caused by the Contractor's operations.

1.02 RESPONSIBILITIES OF CONTRACTOR

A. Furnish and install vibration-monitoring instrumentation.

B. Protect from damage and maintain instruments installed by the Contractor and repair or replace damaged or inoperative instruments.

C. Collect, interpret and report data from instrumentation specified herein.

D. Implement response actions.

1.03 QUALIFICATIONS OF VIBRATION MONITORING PERSONNEL

A. The Contractor's vibration-monitoring personnel shall have the qualifications specified herein. These personnel may be on the staff of the Contractor or may be on the staff of a specialist subcontractor. However, they shall not be employed nor compensated by subcontractors, or by persons or entities hired by subcontractors, who will provide other services or material for the project.

B. The Contractor's vibration-monitoring personnel shall include a qualified Vibration Instrumentation Engineer who is a registered Professional Engineer in the State of California, who has a minimum of a Bachelor of Science degree in civil engineering, and who has at least 4 years of experience in the installation and use of vibration-monitoring instrumentation and in interpreting instrumentation data. The Vibration Instrumentation Engineer shall:

1. Be on site and supervise the initial installation of each vibration-monitoring instrument.

2. Supervise interpretations of vibration-monitoring data.

C. The Contractor's vibration-monitoring personnel shall be subject to the review of the Engineer.

1.04 QUALITY ASSURANCE

A. A record of laboratory calibration shall be provided for all vibration-monitoring instruments to be used on site. Certification shall be provided to indicate that the instruments are calibrated and maintained in accordance with the equipment manufacturer's calibration requirements and that calibrations are traceable to the U. S. National Institute of Standards and Technology (NIST).

1.05 SUBMITTALS

A. As soon as feasible after the Notice to Proceed, submit manufacturer's product data describing all specified vibration-monitoring instruments to the Engineer for review, including requests for consideration of substitutions, if any, together with product data and instruction manuals for requested substitutions.

B. Within 3 weeks after the Notice to Proceed, submit to the Engineer for review the resumes of the Vibration Instrumentation Engineer and any vibration monitoring technical support personnel, sufficient to define details of relevant experience.

C. Within 5 Workdays of receipt of each instrument at the site, submit to the Engineer a copy of the instruction manual and the laboratory calibration and test equipment certification.

D. Prior to the start of construction and prior to performing any vibration monitoring, the Contractor shall submit to the Engineer for review a written plan detailing the procedures for vibration monitoring. Such details shall include:

1. The name of the Firm providing the vibration monitoring services.

2. Description of the instrumentation and equipment to be used.

3. Measurement locations and methods for mounting the vibration sensors.

4. Procedures for data collection and analysis.

5. Means and methods of providing warning when the Response Values, as specified in Article 3.07, are reached.

6. Generalized plans of action to be implemented in the event any Response Value, as specified in Article 3.07, is reached. The generalized plans of action shall be positive measures by the Contractor to control vibrations (e.g. using alternative construction methods).

E. Submit data and reports as specified in Article 3.04.

MATERIALS

2.01 GENERAL

A. Whenever any product is specified by brand name and model number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the product desired. The term "acceptable equivalent" shall be understood to indicate a product that is the same or better than the product named in the specifications in function, quality, performance, reliability, and general configuration. This procedure is not to be construed as eliminating other manufacturers' suitable products of equal quality. The Contractor may, in such cases, submit complete comparative data to the Engineer for consideration of another product. Substitute products shall not be used in the Work unless accepted by the Engineer in writing. The Engineer will be the sole judge of the suitability and equivalency of the proposed substitution.

B. Any request from the Contractor for consideration of a substitution shall clearly state the nature of the deviation from the product specified.

C. The Contractor shall furnish all installation tools, materials, and miscellaneous instrumentation components for vibration monitoring.

2.02 SEISMOGRAPHS

A. Provide portable seismographs for monitoring the velocities of ground vibrations resulting from construction activities. Provide model DS-477 Blastmate II as manufactured by Instantel Inc., Kanata (Ottawa), Ontario, Canada, model VMS-500 as manufactured by Thomas Instruments, Inc., Spofford, NH, or model NC5310/D, as manufactured by Nomis Inc., Birmingham, AL, or acceptable equivalent. The seismograph shall have the following minimum features:

1. Seismic range: 0.01 to 4 inches per second with an accuracy of ±5 percent of the measured peak particle velocity or better at frequencies between 10 Hertz and 100 Hertz, and with a resolution of 0.01 inches per second or less.

2. Frequency response (±3 dB points): 2 to 200 Hertz.

3. Three channels for simultaneous time-domain monitoring of vibration velocities in digital format on three perpendicular axes.

4. Two power sources: internal rechargeable battery and charger and 115 volts AC. Battery must be capable of supplying power to monitor vibrations continuously for up to 24 hours.

5. Capable of internal, dynamic calibration.

6. Direct writing to printer and capability to transfer data from memory to 3-1/2 inch magnetic disk. Instruments must be capable of producing strip chart recordings of readings on site within one hour of obtaining the readings. Provide computer software to perform analysis and produce reports of continuous monitoring.

7. Continuous monitoring mode must be capable of recording single-component peak particle velocities, and frequency of peaks with an interval of one minute or less.

CONSTRUCTION METHODS

3.01 INSTALLATION OF SEISMOGRAPHS

A. The Contractor shall install seismographs at four points near the corners of the buildings that are closest to the project site; these points are denoted as locations 1 through 4 in Figure 1.

B. The seismograph vibration sensors shall be located at points on the ground between 3 and 6 feet from the building facades.

C. The seismograph vibration sensors shall be firmly mounted on the surface slab of concrete or asphalt, or firmly set in undisturbed soil

3.02 FIELD CALIBRATION AND MAINTENANCE

A. The Contractor's instrumentation personnel shall conduct regular maintenance of seismograph installations.

B. All seismographs shall have been calibrated by the manufacturer or certified calibration laboratory within one year of their use on site. A current certificate of calibration shall be submitted to the Engineer with the Contractor's data.

3.03 DATA COLLECTION

A. The Contractor shall collect seismograph data prior to any vibration-producing demolition or construction activities to document background vibrations at each monitoring location. This monitoring shall consist of a continuous recording of the maximum single-component peak particle velocities for one-minute intervals, which shall be printed on a strip chart. The background monitoring shall be performed for a minimum of two non-consecutive workdays, spanning the hours during which demolition and construction activities will take place.

B. The Contractor shall monitor vibration during demolition and other significant vibration-producing construction activities as determined by the Engineer. This monitoring shall consist of a continuous recording of the maximum single-component peak particle velocities for one-minute intervals, which shall be printed on a strip chart. During the monitoring, the Contractor shall document all events that are responsible for the measured vibration levels, and submit the documentation to the Engineer with the data as specified in Article 3.04. A record form for documenting these events is included herein as Figure 2.

C. All vibration monitoring data shall be recorded contemporaneously and plotted continuously on a graph by the data acquisition equipment. Each graph shall show time-domain wave traces (particle velocity versus time) for each transducer with the same vertical and horizontal axes scale.

D. The Contractor shall notify the Engineer at least 24 hours prior to starting a new vibration-producing construction task, and shall have the seismographs in place and functioning properly prior to any such activity within 200 feet of the monitoring locations. No significant vibration-producing activity shall occur within this zone unless the monitoring equipment is functioning properly.

E. The equipment shall be set up in a manner such that an immediate warning is given when the peak particle velocity in any direction exceeds the Response Values specified in Article 3.07. The warning emitted by the vibration-monitoring equipment shall be instantaneously transmitted to the responsible person designated by the Contractor by means of warning lights, audible sounds or electronic transmission.

3.04 DATA REDUCTION, PROCESSING, PLOTTING AND REPORTING

A. Within 10 working days after the completion of the background vibration monitoring, the Contractor shall submit to the Engineer a hard copy report documenting the results at each of the monitoring locations.

B. During bridge demolition and construction, the Contractor shall provide weekly, hard copy reports summarizing any vibration monitoring data collected at the specified vibration-monitoring locations. The reports for each week shall be submitted on or before the end of the following week.

C. All reports shall be signed by the approved Vibration Instrumentation Engineer, and shall include the following:

1. Project identification, including District, County, Route, Post Mile, Project Name and Bridge number as shown on the project plans.

2. Location of the monitoring equipment, including address of adjacent building.

3. Location of vibration sources (e.g. traffic, demolition equipment, etc.)

4. Summary tables indicating the date, time and magnitude and frequency of maximum single-component peak particle velocity measured during each one-hour interval of the monitoring period.

5. Field data forms (construction vibration monitoring only).

6. Appendix graphs of the strip charts printed during the monitoring periods.

D. In addition to the hard copy data specified herein, the Contractor shall provide data on 3.5-inch diskettes with each report. Electronic data files for all instrument data shall be provided in dBASE IV (.DBF) format.

3.05 DAMAGE TO INSTRUMENTATION

A. The Contractor shall protect all instruments and appurtenant fixtures, leads, connections, and other components of vibration-monitoring systems from damage due to construction operations, weather, traffic, and vandalism.

B. If an instrument is damaged or inoperative, the Contractor's instrumentation personnel shall repair or replace the damaged or inoperative instrument within 72 hours at no additional cost to Caltrans. The Contractor shall notify the Engineer at least 24 hours prior to repairing or replacing a damaged or inoperative instrument. The Engineer will be the sole judge of whether repair or replacement is required.

3.06 DISCLOSURE OF DATA

A. The Contractor shall not disclose any instrumentation data to third parties and shall not publish data without prior written consent of Caltrans.

3.07 DATA INTERPRETATION AND IMPLEMENTING PLANS OF ACTION

A. The Contractor shall interpret the data collected, including making correlations between seismograph data and specific construction activities. The data shall be evaluated to determine whether the measured vibrations can be reasonably attributed to construction activities.

B. The Response Values for vibration include a Threshold Value of 0.2 inches per second and a Limiting Value of 0.3 inches per second. The actions associated with these Response Values are defined below. Plans for such actions are referred to herein as plans of action, and actual actions to be implemented are referred to herein as response actions. Response Values are subject to adjustment by the Engineer as indicated by prevailing conditions or circumstances.

C. If a Threshold Value is reached, the Contractor shall:

1. Immediately notify the Engineer.

2. Meet with the Engineer to discuss the need for response action(s).

3. If directed by the Engineer during the above meeting that a response action is needed, submit within 24 hours a detailed specific plan of action based as appropriate on the generalized plan of action submitted previously as part of the vibration-monitoring plan specified in Article 1.05.

4. If directed by the Engineer, implement response action(s) within 24 hours of submitting a detailed specific plan of action, so that the Limiting Value is not exceeded.

D. If a Limiting Value is reached, the Contractor shall:

1. Immediately notify the Engineer and suspend activities in the affected area, with the exception of those actions necessary to avoid exceeding the Limiting Value.

2. Meet with the Engineer to discuss the need for response action(s).

3. If directed by the Engineer during the above meeting that a response action is needed, submit within 24 hours a detailed specific plan of action based as appropriate on the generalized plan of action submitted previously as part of the vibration-monitoring plan specified in Article 1.05.

4. If directed by the Engineer, implement response action(s) within 24 hours of submitting a detailed specific plan of action, so that the Limiting Value is not exceeded.

3.08 DISPOSITION OF INSTRUMENTS

A. The Contractor shall remove salvageable instruments only when directed by the Engineer.

B. All salvaged instruments shall become the property of the Contractor.

COMPENSATION

4.01 BASIS OF PAYMENT

A. The contract lump sum price paid for vibration monitoring shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for performing all work involving vibration monitoring, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

B. Any additional areas where vibration monitoring is required will be paid for as extra work as provided in the Standard Specifications.

[Show vibration monitoring locations here.]

FIGURE 1. VIBRATION MONITORING LOCATIONS

CONSTRUCTION VIBRATION MONITORING FIELD DATA FORM

Contract Number:

Contract Name:

Contractor: ______________________________

Observer: ______________________________

Seismograph Information

Manufacturer and Model: ______________________________

Serial Number: ______________________________

Current Calibration Date: ______________________________

Monitoring Location

Building: ______________________________

Address: ______________________________

Sensor Location (describe location and attach sketch)

____

Data Collection: 1-minute ppv Strip Chart (attach data)

Monitoring Period (date and time) Start: ______________ End: ______________

Observed Events

Date	Time	Source of Vibration (e.g. demolition, pile driving, compaction, excavation, tracked vehicles, etc.)	Distance From Sensor (ft)	Peak Particle Velocity (in./sec)	Frequency (Hz)

Attach additional sheets as necessary

FIGURE 2. CONSTRUCTION VIBRATION MONITORING DATA FORM

Appendix D. Sample Blasting Vibration Specifications

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Sample Blasting Specifications

It is impossible to foresee all of the variables that may be encountered on various project sites. A site-specific Blasting Specification should be developed for each project that takes into consideration the peculiarities of that project location. In particular, the areas of blast vibration limits, pre-blast surveys, the number of recording instruments and their locations, the times and days of scheduled blasting, and cautious blasting techniques (if any) should be addressed.

Considering the foregoing, the following represents a generic blasting specification that provides a starting point for writing a blasting specification for construction blasting.

1. GENERAL

All blasting operations on this project, including the storage, on-site transportation, loading and firing of explosives, shall be in strict compliance with this section.

2. PERMITS AND LICENSES

A. All blasting operations shall be conducted under the direct supervision of a blaster holding a current license issued by the California Division of Occupational Safety and Health (CALOSHA). The class of license held by the blaster shall include the type of blasting that is to be accomplished. Prior to commencing blasting operations, a copy of the Blaster's License shall be provided to the Engineer.

B. The Contractor shall be responsible for obtaining any explosives or blasting permits that may be required by state or local laws.

3. STORAGE OF EXPLOSIVES

Storage of explosives, if anticipated, shall comply with the applicable provisions of CALOSHA's Construction Safety Orders and with Title 27 CFR 181, Part 55, Subpart K, Commerce in Explosives. Adequate magazine records shall be maintained for stored explosives.

4. TRANSPORTATION OF EXPLOSIVES

A. Transportation of explosives to the project site shall be in accordance with current Federal Department of Transportation and California Highway Patrol regulations.

B. Transportation of explosives on the project site shall comply with provisions of the CALOSHA Construction Safety Orders.

5. BLASTING OPERATIONS

A. All blasting operations shall be conducted in compliance with the CALOSHA Construction Safety Orders and the provisions of this Section.

B. The time and date of blasting shall be coordinated in advance with the Engineer in order to minimize the impact on traffic and nearby residents.

C. Due to the potential presence of RF emitting devices in the vicinity, only initiation systems that are not affected by stray current or RF energy shall be utilized. Initiation systems consisting solely of cap and fuse shall not be used. Procedures in the use of the initiation system selected shall conform to the system manufacturer's recommendations. Regardless of other exclusions in this section, if deemed safe by the Contractor, an electric detonator may be utilized to start the initiation system. The electric cap or other starter shall not be brought onto the blast site nor shall it be connected to the initiation system until the area has been cleared and the blast is ready to be detonated.

D. Before commencing loading operations, warning signs shall be posted at points of access to the blasting site. Only the blaster, his loading crew and necessary supervisory personnel shall be allowed within 50 feet of the blast site during loading.

E. Only a reasonable quantity of explosives for each blast shall be brought to the blast loading site. When loading is complete, all excess explosive materials shall be removed from the site and returned to the storage magazine or the supplier's storage facility. In no instance shall explosives, blasting agents, detonators or loaded holes be left unguarded or unattended.

F. A lightning detector of a type approved by CALOSHA shall be utilized to detect the presence of lightning immediately prior to and during blast loading operations. Prior to commencing loading operations, if an electrical storm is detected whose approach is estimated to interfere with loading operations, loading shall not commence and the blast shall be rescheduled. If an approaching electrical storm is detected during loading that will present a hazard to loading operations, loading shall be discontinued and all personnel moved to a safe area. All approaches to the blast site shall be guarded and no one shall be allowed to return to the blast site until the storm has passed safely out of range.

G. All refuse from explosives loading such as empty boxes, bags, plastic, paper and fiber packing shall be removed from the project site and destroyed in accordance with the provisions of the Construction Safety Orders.

H. Prior to firing a blast, all personnel shall be cleared to a safe distance and all approaches to the blast site shall be guarded. Traffic shall be stopped at a safe distance and held until the all-clear signal. The blaster firing the blast shall be in a position where he can see the blast site and approaches and shall not detonate the blast until he is certain that no one remains in a hazardous location.

I. Blasting signals shall be conspicuously posted at the site. The signaling device shall be sufficiently loud so that the signals can be heard throughout the area to be cleared. The following blasting signals shall be used:

WARNING SIGNAL
5 minutes prior to the blast...a 1-minute series of long signals

BLASTING SIGNAL
1 minute prior to the blast.....a series of short signals

ALL-CLEAR SIGNAL
Following inspection of the blast....a prolonged signal

J. Misfires.

1. After the blast has been fired, an inspection shall be made by the blaster to determine that all charges have detonated. Only after the blaster is satisfied that the area is safe shall the ALL-CLEAR signal be given.

2. If, after a blast has been fired, the blaster suspects that a misfire has occurred, the Engineer shall be notified. The ALL CLEAR signal shall NOT be given, traffic shall not be released and the blast site shall continue to remain guarded. The blaster shall be in charge of investigating the misfire. He shall do so in accordance with the Construction Safety Orders.

3. If no misfire is found to exist after adequate inspection by the blaster, he shall so notify the Engineer and the ALL CLEAR signal can be sounded.

4. If a misfire is found to exist, the blaster shall immediately notify the Engineer and he shall then proceed to clear the misfire. While this is being accomplished, the blast site shall remain guarded.

5. Following the successful clearing of the misfire and a subsequent inspection of the blast site by the blaster, he shall give the order to sound the ALL CLEAR signal.

6. BLAST DOCUMENTATION (BLAST REPORT)

A. At least 24 hours prior to the loading of a blast, the Contractor shall submit to the Engineer a copy of the proposed blasting scheme for that particular blast. As a minimum, the Blast Report shall include:

1. A plan view of the blast showing the number and location of all holes.

2. The hole diameter(s) and depth(s).

3. The burden and spacing dimensions.

4. The type(s) of explosive to be used and the anticipated total quantity of each.

5. The quantity of explosive to be loaded in each hole and in each deck if decking of charges is anticipated.

6. The type and depth(s) of stemming material to be used.

7. The type, layout and timing of the initiation system to be used.

8. The method of starting the initiation system.

9. The maximum quantity of explosive that will be detonated within any 8 millisecond time period during the blast.

10. The name of the licensed blaster and his license number.

B. It is anticipated that minor changes could be necessary during loading of the blast due to lost holes, etc. Immediately following the blast, the blaster shall annotate a copy of the Blast Report with such changes, if any, and shall sign the Report and deliver it to the Engineer.

7. PROTECTION OF NEIGHBORING FACILITIES

A. The Contractor shall conduct his blasting operations in a manner that will preclude his causing damage to neighboring facilities. Compliance with the provisions of these specifications or acceptance by the Engineer of any blasting procedures or techniques shall not absolve the Contractor from full responsibility for any damage that may result from his blasting operations.

B. Blasts shall be designed so that vibration and air overpressure levels and flyrock do not exceed the limits stated in this Section.

C. All blasts shall be monitored by the Contractor with ___(qty)___ blast vibration seismograph(s). Each seismograph shall record blast-generated vibration in three mutually perpendicular axes and have a frequency response range of from 2 to 250 Hertz.

D. The seismograph(s) shall have received a factory calibration within the 12 month period preceding the blast recorded. Each seismograph shall produce a real-time graphical depiction of the particle velocities recorded for each individual axis for the duration of the event. The seismograph(s) shall also produce a numeric record of the peak particle velocities and principle frequencies of the vibration recorded for each axis during the event.

E. For each blast, the seismograph(s) shall be located in accordance with instructions from the Engineer. As a minimum, one seismograph shall be located at the nearest critical structure.

F. The peak particle velocities recorded on each of the three axes shall not exceed the frequency-dependent limits contained in Bureau of Mines RI 8507 Alternative Blasting Level Criteria (Figure ______) at any of the monitoring locations.

G. Air overpressures from each blast shall be recorded at the monitoring locations using the airblast channel of the blasting seismographs or with other suitable means. Readings shall be in decibels or in pounds per square inch (psi) and shall be recorded as a linear, unweighted value.

H. Air overpressures from blasting shall not exceed 133 dB (0.013 psi) at any of the monitoring locations.

I. Flyrock will not be tolerated and shall be controlled through proper blast design. If flyrock occurs, the cause shall be investigated by the blaster. Blasting shall not continue until satisfactory corrective measures have been taken to preclude further flyrock incidents.

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EXHIBIT 15

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President London Breed
c/o Angela Calvillo, Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place
City Hall, Room 244
San Francisco, CA 94102

Re: Appeal of CEQA Mitigated Negative Declaration
Planning Case No. 2013.1383ENV
Building Permit Application Nos. 2013.12.16.4318 and 2013.12.16.4322
3516 and 3526 Folsom Street ("Project Site")

Dear President Breed and Honorable Members of the Board of Supervisors:

This letter is written on behalf of neighbors of the proposed project at 3516 and 3526 Folsom Street (BPA Nos. 2013.12.16.4318 & 2013.12.16.4322, the "Project"). The appellants – Bernal Heights South Slope Organization, Bernal Safe & Livable, Neighbors Against the Upper Folsom Street Extension, Gail Newman, and Ann Lockett oppose the above-captioned Project, *inter alia*, on the grounds that the Project's Mitigated Negative Declaration ("MND," Exhibit A) violates the California Environmental Quality Act ("CEQA").

Appellants appealed two previous Categorical Exemption determinations for this Project, once in June of 2016, the second in November of 2016, and the Planning Department took the unprecedented step of twice rescinding the Categorical Exemptions prior to the Board's hearings on the appeals. While we appreciate the Planning Department acknowledging the inadequacy of the previous CEQA determinations, this new Mitigated Negative Declaration is still inadequate and legally erroneous for the same reasons. This is a highly unusual situation, with a development proposed for a uniquely dangerous location above a major 26" diameter natural gas transmission pipeline, which is not covered by asphalt, on an extremely steep slope.

Pursuant to San Francisco Administrative Code Section 31.16, Appellants hereby appeal the MND approved by the Planning Commission on June 15, 2017 at a hearing of the Preliminary

MND issued on April 26, 2017[1], amended on June 8, 2017 and appealed to the Planning Commission by the Appellants on May 16, 2017 during the public comment period for filing comments on the Preliminary MND. The appeal is supported by the SF Sierra Club, the Bernal Heights Democratic Club, the Bernal Heights Neighborhood Center, Bernal Heights neighborhood associations, and hundreds of San Francisco residents.

The following documents are attached:

1. A copy of the Final MND and Initial Study dated 6/8/17
2. A copy of the Planning Commission's approval of the MND dated 6/15/17
3. The Application to Request a Board of Supervisors Appeal Fee Waiver
4. A check in the amount of $578 payable to the San Francisco Planning Department
5. Additional supporting documentation

A copy of this letter of appeal will be concurrently submitted to the Environmental Review Officer.

PROJECT DESCRIPTION

On its face, the Project looks innocuous enough: the construction of two single-family homes and an extension of Folsom Street and utilities to service them. However, the street extension would be built on an extraordinarily steep slope (even by San Francisco standards). Moreover, a uniquely dangerous PG&E gas transmission pipeline runs directly underneath.

The Project site is the only High Consequence Area[2] in San Francisco where a 26-inch PG&E Gas Transmission Pipeline is unprotected by asphalt for 125 feet – buried in "variable topography" terrain. It runs up a sharply pitched hillside in a residential area before it re-enters paved street-cover on Bernal Heights Boulevard.[3]

UC Berkeley Professor Emeritus Robert Bea – a pipeline safety expert with UC Berkeley's Center for Catastrophic Management, who testified in PG&E's San Bruno trial – states the concern surrounding this particular Bernal Heights location of an aging transmission pipeline "is

[1] Erroneously dated April 19, 2017.

[2] According to the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration, *"Pipeline safety regulations use the concept of "High Consequence Areas" (HCAs), to identify specific locales and areas where a release could have the most significant adverse consequences. Once identified, operators are required to devote additional focus, efforts, and analysis in HCAs to ensure the integrity of pipelines."*

[3] Pavement protects gas transmission pipelines from accidental rupture and is especially important in urban areas where accidental rupture would be catastrophic. The gas transmission line is unprotected by asphalt at the Project Site.

identical to the list of concerns that summarized causation of the San Bruno Line 132 gas pipeline disaster." To wit, in 1989 the San Francisco Department of Public Works replied to an inquiry about this open space area, stating, "It was too dangerous to ever develop."

Additionally, the Project site's proposed street is located at a blind intersection that serves as the only viable access point for emergency vehicles to reach 28 homes in the neighborhood. The proposed dead-end street is too steep for emergency vehicles to climb, it is too narrow for them to turn around, and its intersection will cause trucks to 'bottom out' and become stuck – blocking access to the neighborhood.

The Planning Department's latest effort to avoid an Environmental Impact Report (EIR) – especially in light of the Millennium Tower and San Bruno PG&E pipeline disaster – is deeply troubling.

DEFICIENT MITIGATION PLAN

The MND violates CEQA, *inter alia*, by failing to reduce the risk of a catastrophic PG&E gas transmission pipeline accident to a level that is "clearly insignificant" and thus continues to have a "significant effect."

Under CEQA Guidelines Section 15070, a mitigated negative declaration is only appropriate where "There is **no** substantial evidence, in light of the whole record before the agency, that the project as revised may have a significant effect on the environment." (Emphasis added.)

> [A]doption of a mitigated negative declaration is proper only where the conditions imposed on the project reduce its adverse environmental impacts **to a level of insignificance**. (§ 21064.5; Guidelines, § 15064, subd. (f)(2).) By statutory definition, a mitigated negative declaration is one in which (1) the proposed conditions "avoid the effects or mitigate the effects to a point where **clearly no significant effect** on the environment would occur, *and* (2) there is **no substantial evidence** in light of the whole record before the public agency that the project, as revised, may have a significant effect on the environment." (§ 21064.5, emphasis added.)

Architectural Heritage Ass'n v. County of Monterey (2004) 122 Cal.App.4th 1095, 1118–19)

In this case, substantial evidence exists to the contrary.

1. <u>A qualified pipeline safety expert has stated on the record that an unacceptably high risk of catastrophic impacts still exists.</u>

Pipeline Safety Expert and Geotechnical Engineer Rune Storesund writes, "the adequacy and feasibility of the proposed mitigation actions are very much in question." Particularly, he says, "there are a number of site-specific factors that make this site unique that do not appear to have been accounted for in the analyses." (Letter from Rune Storesund, attached hereto.)

"The analyses fall short of a rigorous evaluation of pipeline integrity and assurance of public safety," Storesund writes, "given the potential harm as a result of rupture and ignition of natural gas from this transmission pipeline."

He points out the analyses are "unclear," rely on "inference," are not "data-driven," and that "the analyses associated with this negative declaration are indirect." He states that although an assessment of vibration has been completed by acoustical engineering experts, "no direct assessment of pipeline integrity impacts has been evaluated" or proposed. Storesund continues:

> While a discussion was presented by Illingworth & Rodkin, Inc. about anticipated Peak Particle Velocities (PPVs), there was no explicit analysis of actual impact to the pipeline integrity. Illingworth & Rodkin, Inc. infer in their analyses that typical PPV thresholds apply to Line 109. However, there are a number of site-specific factors that make this site unique that do not appear to have been accounted for in the analyses. For example, the pipeline is situated on an incline with a 90-degree bend at the top of the hill. Most conventional pipelines are horizontal in utility trenches on much flatter ground. Ground vibrations will have a different extensional effect on an inclined pipe than a horizontal pipe. The only reliable method to ascertain the impact of these simplifications and generalizations is to calculate pipeline integrity model bias (comparison of predicted value vs actual value). No model bias value for this site was presented.

A mitigation plan based on assumptions runs counter to the recommendations of the American Society of Mechanical Engineers (ASME). According to Storesund, the AMSE presents standard guidance on evaluation of pipeline integrity that includes critical factors affecting pipeline integrity, such as joint factor, bending method, joining method, encroachment, soil cover, depth, etc.

The MND states that "enforcement of the mitigation measure is the responsibility of the Planning Department and the Department of Building Inspection." However, these departments are not in a position to adequately analyze the additional fatigue to be exerted on the pipeline, and a speculative after-the-fact plan which might be developed by PG&E is clearly inadequate. Storesund points out that no "risk validation and process" is identified nor even "referenced" as recommended by ASME B31.5.

Storesund's concerns are even more troubling in light of PG&E's well-publicized history of safety non-compliance and lost record-keeping – especially in terms of weld and installation methods and pipeline location and depth. These safety concerns are validated in a criminal conviction.

It is not inconsequential that SF City Attorney Dennis Herrera has publicly come out critical of PG&E's safety record: "PG&E has demonstrated time and again that outside oversight is needed to protect the public from a company that is driven by profits, not safety," Herrera said in a May 3, 2017 San Francisco Chronicle article.

Storesund is clear about the mitigation plan's failure to safeguard the public: "Based on the facts and new analyses associated with the proposed development, it is my expert opinion that a reasonable possibility of a significant effect still exists...."

As an experienced and practicing pipeline safety expert, Storesund states that site specific assessments may "reveal a lower actual pipeline integrity vs an assumed pipeline integrity." Because of the "uncertainties" surrounding pipeline integrity, Storesund concludes, "strong consideration should be given to replacing the segment of pipeline to ensure maximum integrity and minimal exposure of residents to potential undue injury or death as a result of the anticipated heavy excavation and ground disturbance activities."

There is no doubt this MND fails to meet CEQA requirements to avoid an EIR. It fails to mitigate the effects "down to a point where the effects are clearly insignificant" and there remains "substantial evidence before the agency that the project as revised may have a significant effect." Indeed, the deficiencies in this MND underscore the need for an EIR in order to arrive at a "full understanding of the environmental consequences" and "assure the public that those consequences are taken into account."

2. <u>Although the following mitigation measure has been identified for inclusion in the MND vibration management plan, it has not been incorporated into the project plan.</u>

"Section I, Mitigation Measures, Structures: Permanent structures must be located a minimum distance of 10 feet from the edge of Pipeline 109. A total width of 45 feet shall be maintained for pipeline maintenance. No storage of construction or demolition materials is permitted within the 45 foot zone."

The Project violates these requirements on both counts. First, PG&E considers stairs to be permanent structures. The proposed stairway to access Bernal Heights Boulevard from the end of the Folsom Street extension will be installed less than 10 feet from the edge of Pipeline 109 and remains in the plan. Second, the public right-of-way is only 39.5 feet wide—less than the required 45 feet for pipeline maintenance.

3. The mitigation measures are inadequate and do not provide sufficient accountability and independent oversight of the vibration management and monitoring plan.

In light of PG&E's criminal safety record and the extreme consequence of the worst-case scenario of construction over a major pipeline, it is imperative that construction be safe and that rigorous and transparent oversight be required. The public needs immediate and readily available access to all plans and communications around project safety. The vibration safety standards relied upon for this Project appear to be pulled from thin air, with insufficient data or analysis to justify these standards. (*See* March 17, 2017 letter from PG&E Gas Transmission Pipeline Services – Integrity Management to Joy Navarrete, p. 2: "Specific to this project, please ensure max PPV vibration levels are less than 2in/sec.") There is no data, analysis, or justification for using a PPV vibration standard of 2in/sec.

4. The mitigation measures do not include a safety plan, ensuring adequate emergency response and evacuation as recommended by the US DOT Pipeline and Hazardous Materials Safety Administration.

In assessing and ranking its risks, PG&E acknowledges that the risk of catastrophic pipeline failure may result in "significant environmental damage." [See page 20 of PG&E 2016 Gas Safety Plan.] In other words, the risk is not zero; there is a possibility of significant environmental damage. The possibility of such a risk is more compelling given PG&E's recent track record. See Exhibit C of our letter dated and submitted on January 24, 2017 for the Board of Supervisors 1/24/17 hearing, File #161278, see Post-Packet Materials 012417 (available at https://sfgov.legistar.com/View.ashx?M=F&ID=4939382&GUID=DE320C6C-1C98-457E-8BCF-89FC65DDA523).

The Mitigated Negative Declaration (MND) fails to consider significant, unmitigated environmental impacts regulated by CEQA. We urge that a more rigorous evaluation of the entire project be conducted through a full Environmental Impact Report.

ENVIRONMENTAL IMPACTS

CUMULATIVE IMPACTS

There is substantial evidence supporting a fair argument that the project may have a significant, adverse, unmitigated effect on the environment. The Initial Study and the MND are deficient, failing to adequately address several issues, which include but are not limited to the following:

1. Although the Project Description acknowledges the Folsom Street extension of the "paper street," it does not assess its environmental impact. The same is true of the cumulative impacts of the four additional houses for which utilities will be installed under this Project.

According to the Planning Department Environmental Review Process Summary, dated March17, 2011:

"Projects subject to CEQA are those actions that have the potential for resulting in a physical change of some magnitude on the environment and that require a discretionary decision by the City, such as public works construction and related activities, developments requiring permits (which in San Francisco are discretionary and thus not exempt from CEQA), use permits, activities supported by assistance from public agencies, ... No action to issue permits, allocate funds, or otherwise implement a discretionary project may be taken until environmental review is complete."

Violating SF's Environmental Review Guidelines, the MND errs in not individually listing "past, present, and probable future projects that might result in related impacts" (Environmental Review Guidelines, San Francisco Planning Department, p. 3-13, available at http://sfmea.sfplanning.org/EP%20Environmental%20Review%20Guidelines%2010-5-12.pdf), despite acknowledging that "improvements proposed by the development would facilitate future development" of four lots – and "would require further environmental review." The new road is not listed as a separate cumulative impact, although it is a part of the project and poses a significant impact on the stability on the pipeline. Likewise for the various impacts related to development of the four additional vacant lots.

"For a phased development project, even if details about future phases are not known, future phases must be included in the project description if they are a reasonably foreseeable consequence of the initial phase and will significantly change the initial project or its impacts." *Laurel Heights Improvement Association v Regents of University of California* (1988) 47 Cal. 3d 376.

The MND errs in proposing a mitigation that does not take into account the cumulative impacts of a proposed street and four "probable future" homes for which utilities will now be installed, thus violating CEQA's cumulative impact requirement. Appellants have filed a declaration that confirms future development of at least two of the additional lots.

2. <u>If the Folsom Street extension and the six remaining vacant lots along the "paper street" were subdivided today, they would automatically be subject to an environmental impact analysis.</u>

The six remaining vacant lots along the Folsom "paper street" were created in 1861, predating the first Map Act in 1893, the creation of Chapman Street intersecting the Folsom "paper street" in 1957, the installation of the PG&E gas transmission pipeline in 1932, CEQA in 1970 and the California Subdivision Map Act in 2008.

3. The MND errs in describing the "relevant area affected" by using a misleading "reasonable explanation" of the geographic area.

The MND limits the project area to a thumbnail description that involves two houses and a "paper street" with four additional utility extensions, thus violating CEQA by not describing the "whole" of a project. There is no mention of the unusual geographic and geotechnical conditions of this hillside area that were made uniquely dangerous in 1932 when PG&E laid a 26-inch Gas Transmission Pipeline in this steep, once rural Bernal hillside, rendering the land dangerous.

It consistently downplays the introduction of a new road into a radically steep hillside – under which the pipeline is buried – with euphemisms such as "street improvements" or "vehicular access." It will be a new 150-foot road constituting an entirely new block in Bernal Heights on Folsom Street, a major cross-town thoroughfare.

INCOMPLETE GEOTECHNICAL REPORT

The geotechnical report dated August 3, 2013 focuses solely on the footprint sites of the two proposed houses, with no acknowledgement of the "revised" Project scope. Thus, it is incomplete and fails to address the entire scope of the Project.

The Project Site is unusual and of special concern because the aging 26-inch PG&E gas transmission pipeline is in a rare location where it is unprotected by asphalt on steep terrain. The pipeline's presence on this unimproved steep terrain presents unusual grading and excavation challenges not addressed in the geotechnical report. The Project Site is in a residential High Consequence Area, a designation that denotes catastrophic results in the event of accidental gas pipeline rupture.

The current "incomplete" geotechnical report raises the following concerns:

• UNCERTAINTIES REGARDING SOIL STABILITY: The report acknowledges the uncertainty of the depth of soil to bedrock, which "can vary across the site," and that due to this uncertainty, assumptions about "soil stability, site settlements, and foundations" could change. Given the expanded site scope with excavation activity and grading next to, over, and under the gas transmission pipeline, more thorough review is needed.

• NO MENTION OF BACKFILL SOIL OVER PIPELINE: The transmission pipeline is covered with loose backfill soil, which is different from the other soil on this site. The conditions surrounding the pipeline substantially differ from the soil borings of this report yet are not a part of the report.

• SIGNIFICANT RISK: Lateral and overhead earth movement from excavation activities on this steep hillside pose a significant risk of accidental pipeline rupture. The pipeline will be located under the driveways of the proposed houses, adjacent to excavation activity of 10 feet deep or more. The report affirms, "Excavations extending deeper into bedrock may require extra effort, such as heavy ripping, hoe-jams or jack-hammering." *Federal pipeline safety guidelines point out that most pipeline accidents happen during construction/excavation activities.*

• DISCREPANCIES: The Project Site is located on an extreme slope. Serious inconsistencies exist in the MND regarding the Project site's slope percentage. The MND's representation of the grade (28%) substantially differs from the geotechnical report (32%). The Project Sponsors' own figures have varied from between 34% to 37%, due to the uncertainties regarding the depth of the transmission pipeline.

• EARTHQUAKES AND LANDSLIDES: The Initial Study violates Section 101.1 of the Planning Code, which establishes eight Priority Policies, including "*maximization of earthquake preparedness*" by not requiring earthquake hazard mitigation for this project. The project site borders on and is below a Seismic Hazard Zone prone to landslides. "Guidelines for Evaluating and Mitigating Seismic Hazards in California" state:

> "The fact that a site lies outside a mapped zone of required investigation does not necessarily mean that the site is free from seismic or other geologic hazards, nor does it preclude lead agencies from adopting regulations or procedures that require site-specific soil and/or geologic investigations and mitigation of seismic or other geologic hazards. It is possible that development proposals may involve alterations (for example, cuts, fills, and/or modifications...) that could cause a site outside the zone to become susceptible to earthquake-induced ground failure."

Given that a steep hillside will be graded and a new street introduced – and that retaining walls will not be allowed over a gas transmission pipeline which runs under the project site – the City must evaluate the landslide risks involved and how they will be mitigated. This winter a landslide occurred on Bernal Hillside in close proximity to the proposed project site. "The EIR's function is to ensure that government officials who decide to build or approve a project do so with a full understanding of the environmental consequences and, equally important, that the public is assured those consequences have been taken into account." (*Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 449, citing *Laurel Heights I* (1988) 47 Cal.3d at pp. 391–392, 253.)

• SITE DRAINAGE: The report addresses the importance of site drainage issues, but no mention is made of the water and fertilizer drainage from the adjacent Community Garden, which abuts the revised Project Site. Importantly, years of fertilizer runoff from the adjacent community garden may have eroded the gas transmission line's protective coating.

DANGEROUSLY STEEP STREET, LIABILITY ISSUES, GARAGE ACCESS

The proposed steep street presents a significant threat to residents and drivers. It will be among the steepest streets in SF. There will be no turn-around at the top, and it will be too narrow to turn around within the proposed street.

• Existing steep streets are substandard but grandfathered in. It is irresponsible governance to create a new one. According to an October 26, 2016 letter from DPW, a Major Encroachment permit would be required for this proposed street but there is no certainty it would be granted. This unclear situation casts doubts on the entire proposed Project Site, which includes garages, sidewalks, and driveways.

• The proposed street plans contain dangerous break-over angles and unclear plans for garage access to current residents.

TRAFFIC AND NEIGHBORHOOD IMPACTS

• The Folsom/Chapman intersection at the Project Site is the primary access point to the 28 existing homes along and above Chapman Street. The other two access points are dangerous: Prentiss Street is the third steepest street in SF at 37% grade that curves, where large vehicles and fire trucks get stuck, and Nevada Street is an unimproved roadway at 35% grade that connects to a rutted dirt trail.

• Due to the usage of the Folsom/Chapman intersection by most drivers and emergency and delivery vehicles, the additional traffic to and from two additional residences potentially increases existing traffic volumes significantly. For six additional residences, it will dramatically increase traffic volumes.

PUBLIC VIEWS

The Planning Department uses inaccurate and misleading data to dismiss the significant impacts on the public vista from Bernal Heights Park and Bernal Heights Blvd.

• The largest intact panorama of the Bay and valley below on the south side of Bernal Heights Park is impacted by this site. This vista is created by a unique stretch of undeveloped DPW and Recreation and Park land that abuts the Project Site. The vista has significant importance to Park visitors and residents. Hundreds of park visitors walk around the Park daily, and enjoy this vista from the sidewalk on Bernal Heights Blvd. directly above the Project Site.

ADDITIONAL IMPACTS

Cumulative Impacts

1) There is a more than insignificant Impact of many hundreds of trips of heavy equipment, including cement trucks driving over speed bumps within a few feet of the pipeline. The area on the uphill side of Bernal Heights Boulevard has already suffered from landslides due to soil instability. Cement trucks and other heavy equipment driving over the speed bumps every day on a street that is designated "No Trucks" presents a hazard that has not been investigated or considered in any reports. These vibrations may cause further instability in the surrounding soil and on the pipeline that runs under that area.

2) We question the accuracy of the soils report and are concerned it does not include the street in its survey. Since developing the street right-of-way is an essential part of the project, the cumulative impact would also include soils impacts in areas affected by street construction.

3) The Bernal Heights East Slope Guidelines were not followed for this project.

4) There is a conflict in whether or not the Folsom Street right-of-way or the proposed 'subdivision' is included in the Slope Protection Act. Maps have conflicting information.

5) If the Folsom Street extension were properly included in the project description, the total square footage of the whole project would trigger the requirement that a stormwater management plan be completed before the environmental review is completed.

Transportation and Circulation

1) The project would cause a significant danger to residents who will not be accessible for Fire trucks or other Emergency vehicles during street construction. The only access to homes off Chapman Street is to come up Folsom and continue onto Chapman. There is no room to park vehicles at this corner, though the MND states that the staging for street construction will be located there. There is also a construction project planned for the near future at that same corner on a currently vacant undersized lot.

2) Pedestrians will lose access to the only sidewalk along Bernal Heights Boulevard during construction, and hundreds of people use it every week.

Construction

Since the local residents' lives will be at risk, how will the community have input into the construction plan with regards to street blockage and pedestrian access, as well as equipment loads and vibration levels? Many questions regarding construction have not been addressed and could cause substantial harm to the environment. Who will monitor this plan? What is the recourse if the plan is altered or not followed? How will staging occur away from the 45' PG&E safety area?

Emergency Access

Emergency access will not be available at all times during construction. If the corner of Chapman and Folsom is blocked, there is no access for emergency vehicles to residences on or north of Chapman Street. Some emergency vehicles are unable to navigate Prentiss Street between Powhattan and Chapman, which is the only other access. Additionally, emergency vehicles will not be able to access the new Folsom Street extension due to its steep slope and narrow width.

Structures

We question the feasibility of staging the project construction in a way that follows the requirement that "A total width of 45 feet shall be maintained for pipeline maintenance. No storage of construction or demolition materials is permitted within the 45 foot zone."

Impact WS-2

How does the addition of the fence/railing on the roof deck affect the shadow on the nearby Community Garden or other property?

Impact C-UT-1

Sunset Scavenger provides a service for the City picking up garbage and recycling. The current staging area is at the corner of Chapman and Powhattan, There is now a home being constructed at that corner, which means there is no place for the extra garbage, recycling, and compost containers at that corner, or anywhere within 2 blocks. No plan has been put forth to adequately accommodate garbage, compost, and recycling needs.

Impact PS-2

The construction phase of the street right-of-way will cause congestion at the corner of Chapman and Folsom, prohibiting access by fire vehicles, especially the hook and ladder, which can only access homes on and north of Chapman street through this corner.

Because of the extra vulnerability of construction over a PG&E pipeline, the likelihood of an explosion is increased, making emergency access even more important.

If a family has a special education student at a local public school, the bus will need to pick up that child in front of the house. At these homes a bus would not be able to turn around at the top of the hill, and backing up a hill so steep is exceedingly dangerous.

Impact GE-1

Because of the proximity to the Gas Line, this area becomes a higher-risk location in the event of an earthquake. When the project is in-process and excavation is occurring near the pipeline, the adjacent homes are even more at risk due to pipeline damage or fire.

There is no evacuation plan the public is aware of.

There is a question as to the validity of the Seismic Hazards Map indication that the site is not located in an area subject to landslide, since a significant landslide occurred on the hill just a few feet away from the construction site and PG&E pipeline.

Impact GE-5

28% is not the accurate slope of the project site. The street is estimated to be 32 - 37% slope.

The stormwater management plan does not comply with the PG&E requirements.

Impact HY-3

Stormwater is currently absorbed into the hillside. Once the street is installed, stormwater will flow down the street, causing a significant change in drainage.

Impact HZ-4

There is not an adequate plan for evacuation in the event of a pipeline accident.

CONCLUSION

The Mitigated Negative Declaration (MND) fails to consider the substantial evidence demonstrating significant, unmitigated environmental impacts regulated by CEQA. We strongly urge that a more rigorous evaluation of the entire project be conducted through a full Environmental Impact Report.

Appellants reserve the right to submit additional written and oral comments, bases, and evidence in support of this appeal to the City up to and including the final hearing on this appeal and any and all subsequent permitting proceedings or approvals for the Project. Appellants request that this letter and exhibits be placed in and incorporated into the administrative record for Case No. 2013.1383ENV.

Appellants respectfully request that the Board of Supervisors reject the Mitigated Negative Declaration and require a full Environmental Impact Report pursuant to CEQA. If the Mitigated Negative Declaration is upheld, Appellants are prepared to file suit to enforce their and the public's rights.

Very truly yours,

ZACKS, FREEDMAN & PATTERSON, PC

Ryan J. Patterson
Attorneys for Herb Felsenfeld and Gail Newman

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Enclosures

EXHIBIT 16

H. ALLEN GRUEN

Geotechnical Engineer

360 Grand Avenue, # 262
Oakland, CA 94610
Phone (510) 839-0765
H.Allen.Gruen@gmail.com

April 14, 2017
Project Number: 13-4060d

Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

Subject: Geotechnical Consultation
3516 and 3526 Folsom Street
San Francisco, California

Dear Ladies and Gentlemen:

This letter presents my geotechnical consultation for the proposed residences at 3516 and 3526 Folsom Street in San Francisco, California. H. Allen Gruen, Geotechnical Engineer performed a geotechnical investigation for the project and presented results in the report dated August 3, 2013.

- The house foundations will require about 298 cubic yards of excavation for 3516 Folsom and 253 cubic yards for 3526 Folsom. I would estimate about 50 cubic yards of top soil, with the rest being chert. The deepest excavation (15'-0" maximum at rear of proposed foundation) will happen in chert.

- The chert bedrock at the subject site is firm and friable (with the definitions provided on Plate 5 of the geotechnical report.)

I appreciate the opportunity to be of continued service to you on this project. If you have any questions, please call me at (510) 839-0765.

Sincerely,

H. Allen Gruen, C.E., G.E.
Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
H. ALLEN GRUEN
GE2147
EXP. 12-31-2017
GEOTECHNICAL
STATE OF CALIFORNIA

REPORT
GEOTECHNICAL INVESTIGATION
Planned Residence At
3516 Folsom Street
San Francisco, California

Prepared for:

Mr. Fabien Lannoye
Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

Prepared by:

H. Allen Gruen
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360 Grand Avenue, # 262
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(510) 839-0765

Project Number: 13-4060

REGISTERED PROFESSIONAL ENGINEER
H ALLEN GRUEN
GE. 2147
Exp. 12/31/2013
GEOTECHNICAL
STATE OF CALIFORNIA

H. Allen Gruen

H. Allen Gruen, C.E., G.E.
Registered Geotechnical Engineer No. 2147

August 3, 2013

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INTRODUCTION

Purpose

A geotechnical investigation has been completed for the proposed residence at 3516 Folsom Street in San Francisco, California. The purposes of this study have been to gather information on the nature, distribution, and characteristics of the earth materials at the site, assess geologic hazards, and to provide geotechnical design criteria for the planned improvements.

Scope

The scope of our services was outlined in our Proposal and Professional Service Agreement dated June 16, 2013. Our investigation included a reconnaissance of the site and surrounding vicinity; sampling and logging two test borings to practical refusal at a maximum depth of 5 feet below the ground surface; laboratory testing conducted on selected samples of the earth materials recovered from the borings; a review of published geotechnical and geologic data pertinent to the project area; geotechnical interpretation and engineering analyses; and preparation of this report.

This report contains the results of our investigation, including findings regarding site, soil, geologic, and groundwater conditions; conclusions pertaining to geotechnical considerations such as weak soils, settlement, and construction considerations; conclusions regarding exposure to geologic hazards, including faulting, ground shaking, liquefaction, lateral spreading, and slope stability; and geotechnical recommendations for design of the proposed project including site preparation and grading, foundations, retaining walls, slabs on grade, and geotechnical drainage.

Pertinent exhibits appear in Appendix A. The locations of the test borings are depicted relative to site features on Plate 1, Boring Location Map. The logs of the test borings are displayed on Plates 2 and 3. Explanations of the symbols and other codes used on the logs are presented on Plate 4, Soil Classification Chart and Key to Test Data. Bedrock is described in accordance with the engineering geology rock terms presented on Plate 5.

References consulted during the course of this investigation are listed in Appendix B. Details regarding the field exploration program appear in Appendix C.

Proposed Development

It is our understanding that the project will consist of the design and construction of a new residence on an undeveloped lot. No other project details are known at this time.

FINDINGS

Site Description

As shown on the Boring Location Map, Plate 1, the project site is located northwest of the intersection of Folsom and Chapman Streets in San Francisco, California. The topography in the vicinity of the site slopes downward toward the south at an average inclination of about 3-½:1 (horizontal:vertical). At the time of our investigation, the subject site was undeveloped.

Geologic Conditions

The site is within the Coast Ranges Geomorphic Province, which includes the San Francisco Bay and the northwest-trending mountains that parallel the coast of California. Tectonic forces resulting in extensive folding and faulting of the area formed these features. The oldest rocks in the area include sedimentary, volcanic, and metamorphic rocks of the Franciscan Complex. This unit is Jurassic to Cretaceous in age and forms the basement rocks in the region.

Locally, the site is in the San Francisco South Quadrangle (1993). A published geologic map of the area (Bonilla, 1998) shows the area southwest of the site is underlain by colluvial deposits (slope debris and ravine fill) consisting of stony silty to sandy clay and the area northeast of the site is underlain by chert bedrock.

Earth Materials

Our borings at the subject site encountered about 3 to 4 feet of soil overlying chert bedrock. Boring 1 encountered about 4 feet of very stiff, lean clay with varying amounts of sand overlying the chert bedrock. Boring 2 penetrated about 2 feet of very stiff, silty clayey sand overlying hard, sandy lean clay that was underlain at a depth of about 3 feet by chert bedrock. Detailed descriptions of the materials encountered as well as test results are shown on the Boring Logs, Plates 2 and 3.

Groundwater

Free groundwater was not encountered in our borings to the maximum depth explored of 5 feet. It is our opinion that the free groundwater table will be below the planned site excavations. We anticipate that the depth to the free water table will vary with time and that zones of seepage may be encountered near the ground surface following rain or irrigation upslope of the subject site.

CONCLUSIONS

General

On the basis of our site reconnaissance and data review, we conclude that the site is suitable for support of the proposed improvements. The primary geotechnical concerns are founding improvements in competent earth materials and seismic shaking and related effects during earthquakes. These items are addressed below.

Foundation Support

It is our opinion that the planned improvements may be supported on a conventional spread footing foundation bearing in competent earth materials. If the spread footings would cover a substantial portion of the building area, a mat foundation may be used as an alternative to reduce forming and steel bending costs. The Structural Engineer may also choose to use drilled piers to support improvements, or for shoring and underpinning, if required. Detailed foundation design criteria are presented later in this report.

We estimate that improvements supported on foundations designed and constructed in accordance with our recommendations will experience post-construction total settlements from static loading of less than 1 inch with differential settlements of less than ½ inch over a 50-foot span.

Geologic Hazards

Faulting

The property does not lie within an Alquist-Priolo Earthquake Fault Zone as defined by the California Division of Mines and Geology. The closest mapped active fault in the vicinity of the site is the San Andreas Fault, located about 6 miles southwest of the site (CDMG, 1998). No active faults are shown crossing the site on reviewed published maps, nor did we observe evidence of active faulting during our investigation. Therefore we conclude that the potential risk for damage to improvements at the site due to surface rupture from faults to be low.

Earthquake Shaking

Earthquake shaking results from the sudden release of seismic energy during displacement along a fault. During an earthquake, the intensity of ground shaking at a particular location will depend on a number of factors including the earthquake magnitude, the distance to the zone of energy release, and local geologic conditions. We expect that the site will be exposed to strong earthquake shaking during the life of the improvements. The recommendations contained in the applicable Building Code should be followed for reducing potential damage to the improvements from earthquake shaking.

Liquefaction

Liquefaction results in a loss of shear strength and potential volume reduction in saturated granular soils below the groundwater level from earthquake shaking. The occurrence of this phenomenon is dependent on many factors, including the intensity and duration of ground shaking, soil density and particle size distribution, and position of the groundwater table (Seed and Idriss, 1982). The site does not lie within a liquefaction potential zone as mapped by the California Division of Mines and Geology for the City and County of San Francisco (CDMG, 2000). In addition, the earth materials encountered on our borings have a low potential for liquefaction. Therefore, it is our opinion that there is a low potential for damage to the planned improvements from liquefaction.

Lateral Spreading

Lateral spreading or lurching is generally caused by liquefaction of marginally stable soils underlying gentle slopes. In these cases, the surficial soils move toward an unsupported face, such as an incised channel, river, or body of water. Because the site has a low potential for liquefaction, we judge that there is a low risk for damage of the improvements from seismically-induced lateral spreading.

Densification

Densification can occur in clean, loose granular soils during earthquake shaking, resulting in seismic settlement and differential compaction. It is our opinion that earth materials subject to seismic densification do not exist beneath the site in sufficient thickness to adversely impact the planned improvements.

Landsliding

The geologic maps of the site vicinity reviewed for this study did not show landslides at the subject site. In addition, a map prepared by the California Division of Mines and Geology for the City and County of San Francisco (CDMG, 2000) does not indicate that the subject site lies within an area of potential earthquake-induced landsliding. During our site reconnaissance, we did not observe evidence of active slope instability at the site. Therefore, it is our opinion that the potential for damage to the improvements from slope instability at the site is low provided the recommendations presented in this report are incorporated into the design and construction of the project.

RECOMMENDATIONS

Site Preparation and Grading

General

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for foundations and retaining walls in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if during construction, soil is observed more than 4 feet below the ground surface at foundation levels, the foundations will need to be deepened to bear in rock, or the foundations will need to be redesigned using the soil values. Likewise, if more than 2 feet of soil than what was anticipated from the borings is being retaining by subsurface walls, the portions of walls supporting the additional soil will need to be designed using the lateral earth pressures for soil conditions.

We assume that the planned improvements will be constructed at or below existing site grades. If site grades are raised by filling more than about 1 foot, we should be retained to calculate the impact of filling on slope stability, site settlements, and foundations.

Clearing

Areas to be graded should be cleared of debris, deleterious materials, and vegetation, and then stripped of the upper soils containing root growth and organic matter. We anticipate that the required depth of stripping will generally be less than 2 inches. Deeper stripping may be required to remove localized concentrations of organic matter, such as tree roots. The cleared materials should be removed from the site; strippings may be stockpiled for reuse as topsoil in landscaping areas or should be hauled off site.

Excavations

Bedrock was encountered in our borings at a depth of about 3 to 4 feet below the ground surface. We anticipate that excavations in the upper portions of bedrock at the site can be conducted with conventional equipment, although localized ripping may be required. Excavations extending deeper into the bedrock may require extra effort, such as heavy ripping, hoe-rams, or jack-hammering. We anticipate that the bedrock will become harder and more massive with increasing depth.

Overexcavation

Loose, porous soils and topsoil, if encountered, should be overexcavated in areas designated for placement of future engineered fill or support of improvements. Difficulty in achieving the recommended minimum degree of compaction described below should be used as a field criterion by the geotechnical engineer to identify areas of weak soils that should be removed and replaced as engineered fill. The depth and extent of excavation should be approved in the field by the geotechnical engineer prior to placement of fill or improvements.

Subgrade Preparation

Exposed soils designated to receive engineered fill should be cut to form a level bench, scarified to a minimum depth of 6 inches, brought to at least optimum moisture content, and compacted to at least 90 percent relative compaction, in accordance with ASTM test designation D 1557.

Material for Fill

It is anticipated that the on-site soil will be suitable for reuse as fill provided that lumps greater than 6 inches in largest dimension and perishable materials are removed, and that the fill materials are approved by the geotechnical engineer prior to use.

Fill materials brought onto the site should be free of vegetative mater and deleterious debris, and should be primarily granular. The geotechnical engineer should approve fill material prior to trucking it to the site.

Compaction of Fill

Fill should be placed in level lifts not exceeding 8 inches in loose thickness. Each lift should be brought to at least the optimum moisture content and compacted to at least 90 percent relative compaction, in accordance with ASTM test designation D 1557.

Underpinning

During excavations adjacent to existing structures or footings, care should be taken to adequately support the existing structures. When excavating below the level of foundations supporting existing structures, some form of underpinning may be required where excavations extend below an imaginary plane sloping at 1:1 downward and outward from the edge of the existing footings. All temporary underpinning design and construction are the responsibility of the contractor. Earth Mechanics is available to provide consultation regarding underpinning adjacent improvements.

Temporary Slopes

Temporary slopes will be necessary during the planned site excavations. In order to safely develop the site, temporary slopes will need to be laid back in conformance with OSHA standards at safe inclinations, or temporary shoring will have to be installed. All temporary slopes and shoring design are the responsibility of the contractor. Earth Mechanics is available to provide consultation regarding stability and support of temporary slopes during construction. The contractor may choose to excavate test pits to evaluate site earth materials and the need for temporary shoring.

Finished Slopes

In general, finished cut and fill slopes in soil should be constructed at an inclination not exceeding 2:1 (horizontal:vertical). Routine maintenance of slopes should be anticipated. The tops of cut slopes should be rounded and compacted to reduce the risk of erosion. Fill and cut slopes should be planted with vegetation to resist erosion, or protected from erosion by other measures, upon completion of grading. Surface water runoff should be intercepted and diverted away from the tops and toes of cut and fill slopes by using berms or ditches.

Seismic Design

The following seismic design parameters apply:

Site Class C
$S_s = 1.520$, $S_1 = 0.693$
$Fa = 1.0$, $Fv = 1.3$
$SM_s = 1.520$, $SM_1 = 0.901$
$SD_s = 1.013$, $SD_1 = 0.601$

Foundations

General

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for foundations in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if during construction, soil is observed more than 4 feet below the ground surface at foundation levels, the foundations will need to be deepened to bear in rock, or the foundations will need to be redesigned using the soil values.

It is our opinion that the planned improvements may be supported on a conventional spread footing foundation bearing in competent earth materials. If the spread footings would cover a substantial portion of the building area, a mat foundation may be used as an alternative to reduce forming and steel bending costs. The Structural Engineer may also choose to use drilled piers to support improvements, or for shoring and underpinning, if required. Design criteria for each foundation type are presented below.

Spread Footings

Spread footings should extend at least 24 inches below lowest adjacent exterior grade, or 18 inches below lowest adjacent interior grade, whichever is lower. If soft or unstable soil areas are encountered at the bottom of the footings, localized deepening of the footing excavation will be necessary. Footing depths may be reduced if competent bedrock is exposed in footing excavations. Footings should be stepped to produce level tops and bottoms and should be deepened as necessary to provide at least 7 feet of horizontal clearance between the portions of footings designed to impose passive pressures and the face of the nearest slope or retaining wall.

Spread footings bottomed in soil can be designed to impose dead plus code live load bearing pressures and total design load bearing pressures of 2,000 and 3,000 psf, respectively. If foundations are bottomed in bedrock, the footings may be designed for maximum allowable rock contact pressures of 3,500 pounds per square foot (psf) for dead plus sustained live loads, and 5,000 psf for total loads, including wind or seismic forces.

There should be no isolated footing pads. We recommend that all new footings be interconnected and the foundation system should have upslope-downslope elements spaced no more than 20 feet apart. Resistance to lateral pressures can be obtained from passive earth pressures against the face of the footing and soil friction along the base of footings. A passive pressure equivalent to that obtained using a fluid weight of 250 pounds per cubic foot (pcf) and a friction factor of 0.3 may be used to resist lateral forces and sliding in soil. In bedrock, a uniform pressure of 3000 psf and a friction factor of 0.4 times the net vertical dead load may be used for design to resist lateral forces and sliding. These values include a safety factor of 1.5 and may be used in combination without reduction. Passive pressures should be disregarded in areas with less than 7 feet of horizontal soil confinement and for the uppermost 1-foot of foundation depth unless confined by concrete slabs or pavements.

Drilled Piers

Drilled, cast-in-place, reinforced concrete piers should be at least 14 inches in diameter and extend at least 10 feet below grade, or to practical drilling refusal in bedrock. Piers should be designed for a maximum allowable skin friction of 500 psf for combined dead plus sustained live loads in soil. In bedrock, piers should be designed for a maximum allowable skin friction of 1,000 psf for combined dead plus sustained live loads. The above values may be increased by one-third for total loads, including the effect of seismic or wind forces. The weight of the foundation concrete extending below grade may be disregarded. We recommend that all piers be interconnected with grade or tie beams and the foundation system should have upslope-downslope elements spaced no more than 20 feet apart.

Resistance to lateral displacement of individual piers will be generated primarily by passive earth pressures acting on the pier. Passive pressures in soil should be assumed equivalent to those generated by a fluid weighing 250 pcf acting on 2 pier diameters. In bedrock, a passive pressure equivalent to that generated by a uniform pressure of 3000 psf acting on 1.5 pier diameters may be used. Passive pressures should be neglected within 12 inches of the ground surface in areas not confined by slabs or pavements and in areas with less than 7 feet of horizontal confinement. Piers designed to resist lateral loads from retaining walls will reach their maximum lateral load carrying capacity at a depth of 8 times the pier diameter. A practical limit on the pier depth of twice the height of the retaining wall can be used, if less than 8 times the pier diameter.

Where groundwater is encountered during pier shaft drilling, it should be removed by pumping, or the concrete must be placed by the tremie method. If the pier shafts will not stand open, temporary casing may be necessary to support the sides of the pier shafts until concrete is placed. Concrete should not be allowed to free fall more than 5 feet to avoid segregation of the aggregate.

Mat Foundation

A mat foundation may be used to support the planned improvements. The mat can be designed for an average allowable bearing pressure in soil over the entire mat of 2,000 psf for combined dead plus sustained live loads, and 3,000 psf for total loads including wind or seismic forces. The weight of the mat extending below current site grade may be neglected in computing bearing loads. Localized increases in bearing pressures of up to 4,000 psf may be utilized. If the mat is bottomed in bedrock, the mat may be designed for maximum allowable rock contact pressures of 3,500 pounds per square foot (psf) for dead plus sustained live loads, and 5,000 psf for total loads, including wind or seismic forces, with localized increases up to 8,000 psf. For elastic design, a modulus of subgrade reaction for soil of 50 kips per cubic foot and for rock of 200 kips per cubic foot may be used.

Resistance to lateral pressures can be obtained from passive earth pressures against the face of the mat and soil friction along the base of the mat foundation. We recommend that an allowable passive equivalent fluid pressure in soil of 250 pcf and a friction factor of 0.3 times the net vertical dead load be used for design. In bedrock, a uniform pressure of 3000 psf and a friction factor of 0.4 times the net vertical dead load may be used for design to resist lateral forces and sliding. Passive pressures should be disregarded in areas with less than 7 feet of horizontal soil confinement and for the uppermost 1-foot of foundation depth unless confined by concrete slabs or pavements.

Retaining Walls

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for retaining walls in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if more than 2 feet of soil than what was anticipated from the borings is being retaining by subsurface walls, the portions of walls supporting the additional soil will need to be designed using the lateral earth pressures for soil conditions.

Retaining walls should be fully backdrained. The backdrains should consist of at least a 3-inch-diameter, rigid perforated pipe, or equivalent such as a "high profile drain", surrounded by a drainage blanket. The pipe should be sloped to drain by gravity to appropriate outlets. Accessible subdrain cleanouts should be provided and maintained on a routine basis. The drainage blanket should consist of clean, free-draining crushed rock or gravel, wrapped in a filter fabric such as Mirafi 140N. The aggregate drainage blanket should be at least 1 foot in width and extend to within 1 foot of the surface. The uppermost 1-foot should be backfilled with compacted native soil to exclude surface water. Alternatively, the drainage blanket could consist of Caltrans Class 2 "Permeable Material" or a prefabricated drainage structure such as Mirafi Miradrain. The backdrain should extend down at least 8 inches below lowest adjacent grade.

Vertical retaining walls that are free to rotate at the top should be designed to resist active lateral soil pressures equivalent to those exerted by a fluid weighing 40 pcf where the backslope is level, and 60 pcf for backfill at a 2:1 (horizontal:vertical) slope. In areas where bedrock is exposed and backfill is placed behind the wall, the structural engineer may use active lateral earth pressures equivalent to those exerted by a fluid weighing 30 pcf where the backslope is level, and 45 pcf for backfill at a 2:1 (horizontal:vertical) slope. If the retaining wall is constructed directly against the bedrock with no backfill, the structural engineer may use active lateral earth pressures equivalent to those exerted by a fluid weighing 20 pcf where the backslope is level, and 26 pcf for backfill at a 2:1 (horizontal:vertical) slope. For intermediate slopes, interpolate between these values. We should be consulted to calculate lateral pressures on retaining walls that are tied-back or braced.

In addition to lateral earth pressures, retaining walls must be designed to resist horizontal pressures that may be generated by surcharge foundation loads applied at or near the ground surface. If a footing surcharge is located above a retaining wall within a horizontal distance of 0.4H, where H is the height of soil retained by the wall, then a horizontal lateral resultant force equal to 0.55 Q_L should be applied to the retaining wall at a height above the base of the wall equal to 0.6H. Q_L equals the equivalent resultant footing line load. This footing surcharge load applies equally to walls that are fixed or free to rotate. As an example, a retaining wall supporting 10 feet of soil has a footing 2 feet away from the top of the wall carrying a line load of 1,000 pounds per lineal foot. This footing is within 0.4H=4 feet of the retaining wall. The resultant horizontal force on the retaining wall from the footing surcharge load would be 0.55x1,000=550 pounds acting 0.6H=6 feet above the base of the retaining wall.

In addition to lateral earth pressures and adjacent footing loads, retaining walls must be designed to resist horizontal pressures that may be generated by surcharge loads applied at or near the ground surface. Where an imaginary 1:1 (H:V) plane projected downward from the outermost edge of a surcharge load intersects a retaining wall, that portion of the wall below the intersection should be designed for an additional horizontal thrust from a uniform pressure equivalent to one-third the maximum anticipated surcharge pressure in soil and one-fourth the maximum anticipated surcharge pressure in rock. In some cases, this value yields a conservative estimate of the actual lateral pressure imposed. We should be contacted if a more precise estimate of lateral loading on the retaining wall from surcharge pressures is desired.

Rigid retaining walls constrained against such movement could be subjected to "at-rest" lateral earth pressures equivalent to those exerted by the fluid pressures listed above plus a uniform load of 6•H pounds per square foot in soil and of 4•H pounds per square foot in rock, where H is the height of the backfill above footing level. Where an imaginary 1:1 (H:V) plane projected downward from the outermost edge of a surcharge load intersects a lower retaining wall, that portion of the constrained wall below the intersection should be designed for an additional horizontal thrust from a uniform pressure equivalent to one-half the maximum anticipated surcharge pressure in soil and one-third the maximum anticipated surcharge pressure in rock. In some cases, this value yields a conservative estimate of the actual lateral pressure imposed. We should be contacted if a more precise estimate of lateral loading on the retaining wall from surcharge pressures is desired.

A seismic pressure increment equivalent to a rectangular pressure distribution of 5H in psf may be used, where H is the height of the soil retained in feet.

Wall backfill should consist of soil that is spread in level lifts not exceeding 8 inches in thickness. Each lift should be brought to at least optimum moisture content and compacted to not less than 90 percent relative compaction, per ASTM test designation D 1557. Retaining walls may yield slightly during backfilling. Therefore, walls should be properly braced during the backfilling operations.

Where migration of moisture through retaining walls would be detrimental or undesirable, retaining walls should be waterproofed as specified by the project architect or structural engineer.

Retaining walls should be supported on footings designed in accordance with the recommendations presented above. A minimum factor of safety of 1.5 against overturning and sliding should be used in the design of retaining walls.

Slab-on-Grade Floors

The subgrade soil in slab and flatwork areas should be proof rolled to provide a firm, non-yielding surface. If moisture penetration through the slab would be objectionable, slabs should be underlain by a capillary moisture break consisting of at least 4 inches of clean, free-draining crushed rock or gravel graded such that 100 percent will pass the 1-inch sieve and none will pass the No. 4 sieve. Further protection against slab moisture penetration can be provided by means of a moisture vapor barrier membrane, placed between the drain rock and the slab. The membrane may be covered with 2 inches of damp, clean sand to protect it during construction.

Additional protection against moisture seepage into subsurface levels may be provided by installing a slab underdrain system. If selected, the slab underdrain system would consist of trenches, which are at least 12 inches deep and 6 inches wide, spaced no further than 10 feet apart beneath the floor slab. The bottoms of the trenches should slope to drain to a low-point by gravity. A 3-inch diameter, rigid perforated pipe should be placed near the bottom of the trench which is fully encapsulated in drain rock. The drainrock should be fully encapsulated in an approved filter fabric. The perforated pipes should be tied to closed conduits which outlet at appropriate discharge points.

Site Drainage

Positive drainage should be provided away from the improvements. Roof downspouts should discharge into closed conduits that drain into the site storm drain system. Surface drainage facilities (roof downspouts and drainage inlets) should be maintained entirely separate from subsurface drains (retaining wall backdrains and underslab drains). Drains should be checked periodically, and cleaned and maintained as necessary to provide unimpeded flow.

Supplemental Services

Earth Mechanics recommend that we be retained to review the project plans and specifications to determine if they are consistent with our recommendations. In addition, we should be retained to observe geotechnical construction, particularly site excavations, placement of retaining wall backdrains, fill compaction, and excavation of foundations, as well as to perform appropriate field observations and laboratory tests.

If, during construction, subsurface conditions different from those described in this report are observed, or appear to be present beneath excavations, we should be advised at once so that these conditions may be reviewed and our recommendations reconsidered. The recommendations made in this report are contingent upon our notification and review of the changed conditions.

If more than 18 months have elapsed between the submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at or adjacent to the site, the recommendations of this report may no longer be valid or appropriate. In such case, we recommend that we review this report to determine the applicability of the conclusions and recommendations considering the time elapsed or changed conditions. The recommendations made in this report are contingent upon such a review.

These services are performed on an as-requested basis and are in addition to this geotechnical investigation. We cannot accept responsibility for conditions, situations or stages of construction that we are not notified to observe.

LIMITATIONS

This report has been prepared for the exclusive use of Bluorange Designs and their consultants for the proposed project described in this report.

Our services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. We provide no other warranty, either expressed or implied. Our conclusions and recommendations are based on the information provided us regarding the proposed construction, the results of our field exploration and laboratory testing programs, and professional judgment. Verification of our conclusions and recommendations is subject to our review of the project plans and specifications, and our observation of construction.

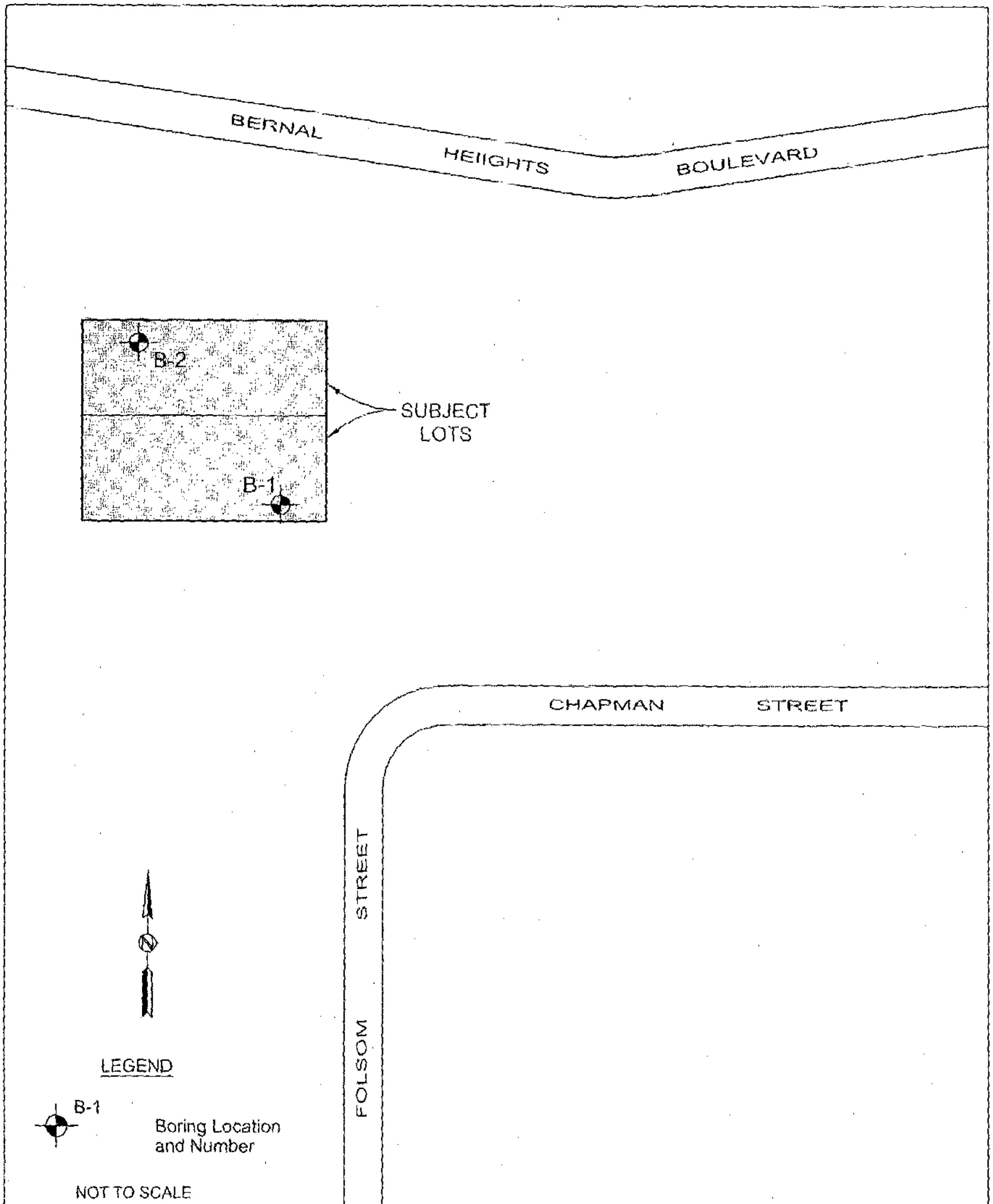
The test boring logs represent subsurface conditions at the locations and on the date indicated. It is not warranted that they are representative of such conditions elsewhere or at other times. Site conditions and cultural features described in the text of this report are those existing at the time of our field exploration, conducted on June 28, 2013, and may not necessarily be the same or comparable at other times.

The locations of the test borings were established in the field by reference to existing features and should be considered approximate only.

The scope of our services did not include an environmental assessment or an investigation of the presence or absence of hazardous, toxic, or corrosive materials in the soil, surface water, groundwater or air, on or below, or around the site, nor did it include an evaluation or investigation of the presence or absence of wetlands.

APPENDIX A

List of Plates



Earth Mechanics Consulting Engineers	Job. No: 13-4060 Appr: Drwn: LPDD Date: 7/1/13	BORING LOCATION MAP 3516 & 3526 Folsom Street San Francisco, California	PLATE 1

EQUIPMENT: Continuous Sampling ELEVATION: *

LOGGED BY: A.K. START DATE: 6-28-13

FINISH DATE: 6-28-13

Other Laboratory Tests	Pocket Penetrometer (ksf)	Moisture Content (%)	Dry Density (pcf)	% Passing #200 sieve	Blows/Foot	Sample	DEPTH (FEET)	Description
					79		0	Brown Sandy Lean Clay (CL), moist, very stiff
							1	
		6.6		57				
					83		2	Mottled Orangish-Brown Lean Clay with Sand (CL), moist, very stiff
							3	
		25.1		81				
					82		4	Mottled Orangish-Brown Chert, firm, friable, moderately weathered
							5	Bottom of Boring = 5' No Free Water Encountered

* Existing ground surface.

Earth Mechanics
Consulting Engineers

Job No: 13-4060

Appr:

Drwn: LPDD

Date: JUL 2013

LOG OF BORING 1

3516 & 3526 Folsom Street

San Francisco, California

PLATE

2

EQUIPMENT: **Continuous Sampling** ELEVATION: *

LOGGED BY: A.K. START DATE: 6-28-13

FINISH DATE: 6-28-13

Other Laboratory Tests	Pocket Penetrometer (ksf)	Moisture Content (%)	Dry Density (pcf)	% Passing #200 sieve	Blows/Foot	Sample	DEPTH (FEET)	Description
					58		0	Brown Silty Clayey Sand (CL-ML), moist, very stiff, with roots
							1	
		18.3		73				
					86		2	Light Mottled Brown Sandy Lean Clay (CL), moist, hard
		20.9		63				
		2.7		27	50/6"		3	Reddish-Brown Chert, firm, friable, moderately weathered

Bottom of Boring = 3.5'
No Free Water Encountered

* Existing ground surface.

Earth Mechanics
Consulting Engineers

Job No: 13-4060

Appr:

Drwn: LPDD

Date: JUL 2013

LOG OF BORING 2

3516 & 3526 Folsom Street

San Francisco, California

PLATE

3

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

Shear Strength, psf
Confining Pressure, psf

Consol	Consolidation	Tx	2630 (240)	Unconsolidated Undrained Triaxial
LL	Liquid Limit (in %)	Tx sat	2100 (575)	Unconsolidated Undrained Triaxial, saturated prior to test
PL	Plastic Limit (in %)	DS	3740 (960)	Unconsolidated Undrained Direct Shear
PI	Plasticity Index	TV	1320	Torvane Shear
Gs	Specific Gravity	UC	4200	Unconfined Compression
SA	Sieve Analysis	LVS	500	Laboratory Vane Shear
■	Undisturbed Sample (2.5-inch ID)	FS	Free Swell	
◪	2-inch-ID Sample	EI	Expansion Index	
◩	Standard Penetration Test	Perm	Permeability	
☒	Bulk Sample	SE	Sand Equivalent	

KEY TO TEST DATA

Earth Mechanics Consulting Engineers	Job No: 13-4060 Appr: Drwn: LPDD Date: JUL 2013	**SOIL CLASSIFICATION CHART AND KEY TO TEST DATA** 3516 & 3526 Folsom Street San Francisco, California	PLATE 4

ROCK SYMBOLS

SHALE OR CLAYSTONE	CHERT	SERPENTINITE
SILTSTONE	PYROCLASTIC	METAMORPHIC ROCKS
SANDSTONE	VOLCANIC	DIATOMITE
CONGLOMERATE	PLUTONIC	SHEARED ROCKS

LAYERING

MASSIVE	Greater than 6 feet
THICKLY BEDDED	2 to 6 feet
MEDIUM BEDDED	8 to 24 inches
THINNLY BEDDED	2-1/2 to 8 inches
VERY THINNLY BEDDED	3/4 to 2-1/2 inches
CLOSELY LAMINATED	1/4 to 3/4 inches
VERY CLOSELY LAMINATED	Less than 1/4 inch

JOINT, FRACTURE, OR SHEAR SPACING

VERY WIDELY SPACED	Greater than 6 feet
WIDELY SPACED	2 to 6 feet
MODERATELY SPACED	8 to 24 inches
CLOSELY SPACED	2-1/2 to 8 inches
VERY CLOSELY SPACED	3/4 to 2-1/2 inches
EXTREMELY CLOSELY SPACED	Less than 3/4 inch

HARDNESS

SOFT - Pliable; can be dug by hand

FIRM - Can be gouged deeply or carved with a pocket knife

MODERATELY HARD - Can be readily scrached by a knife blade; scratch leaves heavy trace of dust and is readily visable after the powder has been blown away

HARD - Can be scratched with difficulty; scratch produces little powder and is often faintly visable

VERY HARD - Cannot be scratched with pocket knife; leaves a metallic streak

STRENGTH

PLASTIC - Capable of being molded by hand

FRIABLE - Crumbles by rubbing with fingers

WEAK - An unfractured specimen of such material will crumble under light hammer blows

MODERATELY STRONG - Specimen will withstand a few heavy hammer blows before breaking

STRONG - Specimem will withstand a few heavy ringing hammer blows and usually yields large fragments

VERY STRONG - Rock will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments

DEGREE OF WEATHERING

HIGHLY WEATHERED - Abundant fractures coated with oxides, carbonates, sulphates, mud, etc., thourough discoloration, rock disintegration, mineral decomposition

MODERATELY WEATHERED - Some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition

SLIGHTLY WEATHERED - A few stained fractures, slight discoloration, little or no effect on cementation, no mineral decomposition

FRESH - Unaffected by weathering agents, no appreciable change with depth

Earth Mechanics Consulting Engineers	Job No: 13-4060 Appr. Drwn: LPDD Date: JUL 2013	**ENGINEERING GEOLOGY ROCK TERMS** 3516 & 3526 Folsom Street San Francisco, California	PLATE **5**

APPENDIX B

List of References

1. Bonilla, M. G., 1998, *Preliminary Geologic Map of the San Francisco South 7.5' Quadrangle and Part of the Hunters Point 7.5' Quadrangle, San Francisco Bay Area, California*, United States Geological Survey Open-File Report OF-98-354, Scale 1:24,000.

2. California Department of Conservation, Division of Mines and Geology, 1998, *Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada.*

3. CDMG, 2000, State of California Seismic Hazards Zones, City and County of San Francisco, California Division of Mines and Geology.

4. Seed, H. B., and Idriss, E., 1982, *Ground Motion and Soil Liquefaction During Earthquakes*, Earthquake Engineering Research Institute Monograph.

5. United States Geological Survey, 1993, San Francisco South Quadrangle, 7.5 Minute Series, Scale 1:24,000.

APPENDIX C

Field Exploration

Our field exploration consisted of a geologic reconnaissance and subsurface exploration by means of two test borings logged by our Engineer on June 28, 2013. The test borings were drilled with a hand carried, portable drill rig utilizing continuous flight, 4-inch-diameter augers. The borings were drilled at the approximate locations shown on Plate 1.

The logs of the test borings are displayed on Plates 2 and 3. Representative undisturbed samples of the earth materials were obtained from the test borings at selected depth intervals with a 1.4-inch inside diameter, split-barrel Standard Penetration Test (SPT) sampler, a 2-inch inside diameter, split-barrel sampler, and a 2.5-inch inside diameter, modified California sampler.

Penetration resistance blow counts were obtained by dropping a 70-pound hammer through a 30-inch free fall. The sampler was driven 24 inches or less and the number of blows was recorded for each 6 inches of penetration. The blows per foot recorded on the Boring Logs represent the accumulated number of blows that were required to drive the sampler the last 12 inches or fraction thereof.

The soil classifications are shown on the Boring Logs and referenced on Plate 4. Bedrock is described in accordance with the engineering geology rock terms presented on Plate 5.

Laboratory Testing

Natural water contents and percentages of gravel, sand, and fines were determined on selected soil samples recovered from the test borings. The data are recorded at the appropriate sample depths on the Boring Logs.

APPENDIX D

Distribution

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(4 wet signed and stamped originals)

REPORT
GEOTECHNICAL INVESTIGATION
Planned Residence At
3526 Folsom Street
San Francisco, California

Prepared for:

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Project Number: 13-4060a

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Exp. 12/31/2013
GEOTECHNICAL
STATE OF CALIFORNIA

H. Allen Gruen

H. Allen Gruen, C.E., G.E.
Registered Geotechnical Engineer No. 2147

August 3, 2013

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INTRODUCTION

Purpose

A geotechnical investigation has been completed for the proposed residence at 3526 Folsom Street in San Francisco, California. The purposes of this study have been to gather information on the nature, distribution, and characteristics of the earth materials at the site, assess geologic hazards, and to provide geotechnical design criteria for the planned improvements.

Scope

The scope of our services was outlined in our Proposal and Professional Service Agreement dated June 16, 2013. Our investigation included a reconnaissance of the site and surrounding vicinity; sampling and logging two test borings to practical refusal at a maximum depth of 5 feet below the ground surface; laboratory testing conducted on selected samples of the earth materials recovered from the borings; a review of published geotechnical and geologic data pertinent to the project area; geotechnical interpretation and engineering analyses; and preparation of this report.

This report contains the results of our investigation, including findings regarding site, soil, geologic, and groundwater conditions; conclusions pertaining to geotechnical considerations such as weak soils, settlement, and construction considerations; conclusions regarding exposure to geologic hazards, including faulting, ground shaking, liquefaction, lateral spreading, and slope stability; and geotechnical recommendations for design of the proposed project including site preparation and grading, foundations, retaining walls, slabs on grade, and geotechnical drainage.

Pertinent exhibits appear in Appendix A. The locations of the test borings are depicted relative to site features on Plate 1, Boring Location Map. The logs of the test borings are displayed on Plates 2 and 3. Explanations of the symbols and other codes used on the logs are presented on Plate 4, Soil Classification Chart and Key to Test Data. Bedrock is described in accordance with the engineering geology rock terms presented on Plate 5.

References consulted during the course of this investigation are listed in Appendix B. Details regarding the field exploration program appear in Appendix C.

Proposed Development

It is our understanding that the project will consist of the design and construction of a new residence on an undeveloped lot. No other project details are known at this time.

FINDINGS

Site Description

As shown on the Boring Location Map, Plate 1, the project site is located northwest of the intersection of Folsom and Chapman Streets in San Francisco, California. The topography in the vicinity of the site slopes downward toward the south at an average inclination of about 3-½:1 (horizontal:vertical). At the time of our investigation, the subject site was undeveloped.

Geologic Conditions

The site is within the Coast Ranges Geomorphic Province, which includes the San Francisco Bay and the northwest-trending mountains that parallel the coast of California. Tectonic forces resulting in extensive folding and faulting of the area formed these features. The oldest rocks in the area include sedimentary, volcanic, and metamorphic rocks of the Franciscan Complex. This unit is Jurassic to Cretaceous in age and forms the basement rocks in the region.

Locally, the site is in the San Francisco South Quadrangle (1993). A published geologic map of the area (Bonilla, 1998) shows the area southwest of the site is underlain by colluvial deposits (slope debris and ravine fill) consisting of stony silty to sandy clay and the area northeast of the site is underlain by chert bedrock.

Earth Materials

Our borings at the subject site encountered about 3 to 4 feet of soil overlying chert bedrock. Boring 1 encountered about 4 feet of very stiff, lean clay with varying amounts of sand overlying the chert bedrock. Boring 2 penetrated about 2 feet of very stiff, silty clayey sand overlying hard, sandy lean clay that was underlain at a depth of about 3 feet by chert bedrock. Detailed descriptions of the materials encountered as well as test results are shown on the Boring Logs, Plates 2 and 3.

Groundwater

Free groundwater was not encountered in our borings to the maximum depth explored of 5 feet. It is our opinion that the free groundwater table will be below the planned site excavations. We anticipate that the depth to the free water table will vary with time and that zones of seepage may be encountered near the ground surface following rain or irrigation upslope of the subject site.

CONCLUSIONS

General

On the basis of our site reconnaissance and data review, we conclude that the site is suitable for support of the proposed improvements. The primary geotechnical concerns are founding improvements in competent earth materials and seismic shaking and related effects during earthquakes. These items are addressed below.

Foundation Support

It is our opinion that the planned improvements may be supported on a conventional spread footing foundation bearing in competent earth materials. If the spread footings would cover a substantial portion of the building area, a mat foundation may be used as an alternative to reduce forming and steel bending costs. The Structural Engineer may also choose to use drilled piers to support improvements, or for shoring and underpinning, if required. Detailed foundation design criteria are presented later in this report.

We estimate that improvements supported on foundations designed and constructed in accordance with our recommendations will experience post-construction total settlements from static loading of less than 1 inch with differential settlements of less than ½ inch over a 50-foot span.

Geologic Hazards

Faulting

The property does not lie within an Alquist-Priolo Earthquake Fault Zone as defined by the California Division of Mines and Geology. The closest mapped active fault in the vicinity of the site is the San Andreas Fault, located about 6 miles southwest of the site (CDMG, 1998). No active faults are shown crossing the site on reviewed published maps, nor did we observe evidence of active faulting during our investigation. Therefore we conclude that the potential risk for damage to improvements at the site due to surface rupture from faults to be low.

Earthquake Shaking

Earthquake shaking results from the sudden release of seismic energy during displacement along a fault. During an earthquake, the intensity of ground shaking at a particular location will depend on a number of factors including the earthquake magnitude, the distance to the zone of energy release, and local geologic conditions. We expect that the site will be exposed to strong earthquake shaking during the life of the improvements. The recommendations contained in the applicable Building Code should be followed for reducing potential damage to the improvements from earthquake shaking.

Liquefaction

Liquefaction results in a loss of shear strength and potential volume reduction in saturated granular soils below the groundwater level from earthquake shaking. The occurrence of this phenomenon is dependent on many factors, including the intensity and duration of ground shaking, soil density and particle size distribution, and position of the groundwater table (Seed and Idriss, 1982). The site does not lie within a liquefaction potential zone as mapped by the California Division of Mines and Geology for the City and County of San Francisco (CDMG, 2000). In addition, the earth materials encountered on our borings have a low potential for liquefaction. Therefore, it is our opinion that there is a low potential for damage to the planned improvements from liquefaction.

Lateral Spreading

Lateral spreading or lurching is generally caused by liquefaction of marginally stable soils underlying gentle slopes. In these cases, the surficial soils move toward an unsupported face, such as an incised channel, river, or body of water. Because the site has a low potential for liquefaction, we judge that there is a low risk for damage of the improvements from seismically-induced lateral spreading.

Densification

Densification can occur in clean, loose granular soils during earthquake shaking, resulting in seismic settlement and differential compaction. It is our opinion that earth materials subject to seismic densification do not exist beneath the site in sufficient thickness to adversely impact the planned improvements.

Landsliding

The geologic maps of the site vicinity reviewed for this study did not show landslides at the subject site. In addition, a map prepared by the California Division of Mines and Geology for the City and County of San Francisco (CDMG, 2000) does not indicate that the subject site lies within an area of potential earthquake-induced landsliding. During our site reconnaissance, we did not observe evidence of active slope instability at the site. Therefore, it is our opinion that the potential for damage to the improvements from slope instability at the site is low provided the recommendations presented in this report are incorporated into the design and construction of the project.

RECOMMENDATIONS

Site Preparation and Grading

General

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for foundations and retaining walls in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if during construction, soil is observed more than 4 feet below the ground surface at foundation levels, the foundations will need to be deepened to bear in rock, or the foundations will need to be redesigned using the soil values. Likewise, if more than 2 feet of soil than what was anticipated from the borings is being retaining by subsurface walls, the portions of walls supporting the additional soil will need to be designed using the lateral earth pressures for soil conditions.

We assume that the planned improvements will be constructed at or below existing site grades. If site grades are raised by filling more than about 1 foot, we should be retained to calculate the impact of filling on slope stability, site settlements, and foundations.

Clearing

Areas to be graded should be cleared of debris, deleterious materials, and vegetation, and then stripped of the upper soils containing root growth and organic matter. We anticipate that the required depth of stripping will generally be less than 2 inches. Deeper stripping may be required to remove localized concentrations of organic matter, such as tree roots. The cleared materials should be removed from the site; strippings may be stockpiled for reuse as topsoil in landscaping areas or should be hauled off site.

Excavations

Bedrock was encountered in our borings at a depth of about 3 to 4 feet below the ground surface. We anticipate that excavations in the upper portions of bedrock at the site can be conducted with conventional equipment, although localized ripping may be required. Excavations extending deeper into the bedrock may require extra effort, such as heavy ripping, hoe-rams, or jack-hammering. We anticipate that the bedrock will become harder and more massive with increasing depth.

Overexcavation

Loose, porous soils and topsoil, if encountered, should be overexcavated in areas designated for placement of future engineered fill or support of improvements. Difficulty in achieving the recommended minimum degree of compaction described below should be used as a field criterion by the geotechnical engineer to identify areas of weak soils that should be removed and replaced as engineered fill. The depth and extent of excavation should be approved in the field by the geotechnical engineer prior to placement of fill or improvements.

Subgrade Preparation

Exposed soils designated to receive engineered fill should be cut to form a level bench, scarified to a minimum depth of 6 inches, brought to at least optimum moisture content, and compacted to at least 90 percent relative compaction, in accordance with ASTM test designation D 1557.

Material for Fill

It is anticipated that the on-site soil will be suitable for reuse as fill provided that lumps greater than 6 inches in largest dimension and perishable materials are removed, and that the fill materials are approved by the geotechnical engineer prior to use.

Fill materials brought onto the site should be free of vegetative mater and deleterious debris, and should be primarily granular. The geotechnical engineer should approve fill material prior to trucking it to the site.

Compaction of Fill

Fill should be placed in level lifts not exceeding 8 inches in loose thickness. Each lift should be brought to at least the optimum moisture content and compacted to at least 90 percent relative compaction, in accordance with ASTM test designation D 1557.

Underpinning

During excavations adjacent to existing structures or footings, care should be taken to adequately support the existing structures. When excavating below the level of foundations supporting existing structures, some form of underpinning may be required where excavations extend below an imaginary plane sloping at 1:1 downward and outward from the edge of the existing footings. All temporary underpinning design and construction are the responsibility of the contractor. Earth Mechanics is available to provide consultation regarding underpinning adjacent improvements.

Temporary Slopes

Temporary slopes will be necessary during the planned site excavations. In order to safely develop the site, temporary slopes will need to be laid back in conformance with OSHA standards at safe inclinations, or temporary shoring will have to be installed. All temporary slopes and shoring design are the responsibility of the contractor. Earth Mechanics is available to provide consultation regarding stability and support of temporary slopes during construction. The contractor may choose to excavate test pits to evaluate site earth materials and the need for temporary shoring.

Finished Slopes

In general, finished cut and fill slopes in soil should be constructed at an inclination not exceeding 2:1 (horizontal:vertical). Routine maintenance of slopes should be anticipated. The tops of cut slopes should be rounded and compacted to reduce the risk of erosion. Fill and cut slopes should be planted with vegetation to resist erosion, or protected from erosion by other measures, upon completion of grading. Surface water runoff should be intercepted and diverted away from the tops and toes of cut and fill slopes by using berms or ditches.

Seismic Design

The following seismic design parameters apply:

Site Class C
$S_s = 1.520$, $S_1 = 0.693$
$Fa = 1.0$, $Fv = 1.3$
$SM_s = 1.520$, $SM_1 = 0.901$
$SD_s = 1.013$, $SD_1 = 0.601$

Foundations

General

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for foundations in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if during construction, soil is observed more than 4 feet below the ground surface at foundation levels, the foundations will need to be deepened to bear in rock, or the foundations will need to be redesigned using the soil values.

It is our opinion that the planned improvements may be supported on a conventional spread footing foundation bearing in competent earth materials. If the spread footings would cover a substantial portion of the building area, a mat foundation may be used as an alternative to reduce forming and steel bending costs. The Structural Engineer may also choose to use drilled piers to support improvements, or for shoring and underpinning, if required. Design criteria for each foundation type are presented below.

Spread Footings

Spread footings should extend at least 24 inches below lowest adjacent exterior grade, or 18 inches below lowest adjacent interior grade, whichever is lower. If soft or unstable soil areas are encountered at the bottom of the footings, localized deepening of the footing excavation will be necessary. Footing depths may be reduced if competent bedrock is exposed in footing excavations. Footings should be stepped to produce level tops and bottoms and should be deepened as necessary to provide at least 7 feet of horizontal clearance between the portions of footings designed to impose passive pressures and the face of the nearest slope or retaining wall.

Spread footings bottomed in soil can be designed to impose dead plus code live load bearing pressures and total design load bearing pressures of 2,000 and 3,000 psf, respectively. If foundations are bottomed in bedrock, the footings may be designed for maximum allowable rock contact pressures of 3,500 pounds per square foot (psf) for dead plus sustained live loads, and 5,000 psf for total loads, including wind or seismic forces.

There should be no isolated footing pads. We recommend that all new footings be interconnected and the foundation system should have upslope-downslope elements spaced no more than 20 feet apart. Resistance to lateral pressures can be obtained from passive earth pressures against the face of the footing and soil friction along the base of footings. A passive pressure equivalent to that obtained using a fluid weight of 250 pounds per cubic foot (pcf) and a friction factor of 0.3 may be used to resist lateral forces and sliding in soil. In bedrock, a uniform pressure of 3000 psf and a friction factor of 0.4 times the net vertical dead load may be used for design to resist lateral forces and sliding. These values include a safety factor of 1.5 and may be used in combination without reduction. Passive pressures should be disregarded in areas with less than 7 feet of horizontal soil confinement and for the uppermost 1-foot of foundation depth unless confined by concrete slabs or pavements.

Drilled Piers

Drilled, cast-in-place, reinforced concrete piers should be at least 14 inches in diameter and extend at least 10 feet below grade, or to practical drilling refusal in bedrock. Piers should be designed for a maximum allowable skin friction of 500 psf for combined dead plus sustained live loads in soil. In bedrock, piers should be designed for a maximum allowable skin friction of 1,000 psf for combined dead plus sustained live loads. The above values may be increased by one-third for total loads, including the effect of seismic or wind forces. The weight of the foundation concrete extending below grade may be disregarded. We recommend that all piers be interconnected with grade or tie beams and the foundation system should have upslope-downslope elements spaced no more than 20 feet apart.

Resistance to lateral displacement of individual piers will be generated primarily by passive earth pressures acting on the pier. Passive pressures in soil should be assumed equivalent to those generated by a fluid weighing 250 pcf acting on 2 pier diameters. In bedrock, a passive pressure equivalent to that generated by a uniform pressure of 3000 psf acting on 1.5 pier diameters may be used. Passive pressures should be neglected within 12 inches of the ground surface in areas not confined by slabs or pavements and in areas with less than 7 feet of horizontal confinement. Piers designed to resist lateral loads from retaining walls will reach their maximum lateral load carrying capacity at a depth of 8 times the pier diameter. A practical limit on the pier depth of twice the height of the retaining wall can be used, if less than 8 times the pier diameter.

Where groundwater is encountered during pier shaft drilling, it should be removed by pumping, or the concrete must be placed by the tremie method. If the pier shafts will not stand open, temporary casing may be necessary to support the sides of the pier shafts until concrete is placed. Concrete should not be allowed to free fall more than 5 feet to avoid segregation of the aggregate.

Mat Foundation

A mat foundation may be used to support the planned improvements. The mat can be designed for an average allowable bearing pressure in soil over the entire mat of 2,000 psf for combined dead plus sustained live loads, and 3,000 psf for total loads including wind or seismic forces. The weight of the mat extending below current site grade may be neglected in computing bearing loads. Localized increases in bearing pressures of up to 4,000 psf may be utilized. If the mat is bottomed in bedrock, the mat may be designed for maximum allowable rock contact pressures of 3,500 pounds per square foot (psf) for dead plus sustained live loads, and 5,000 psf for total loads, including wind or seismic forces, with localized increases up to 8,000 psf. For elastic design, a modulus of subgrade reaction for soil of 50 kips per cubic foot and for rock of 200 kips per cubic foot may be used.

Resistance to lateral pressures can be obtained from passive earth pressures against the face of the mat and soil friction along the base of the mat foundation. We recommend that an allowable passive equivalent fluid pressure in soil of 250 pcf and a friction factor of 0.3 times the net vertical dead load be used for design. In bedrock, a uniform pressure of 3000 psf and a friction factor of 0.4 times the net vertical dead load may be used for design to resist lateral forces and sliding. Passive pressures should be disregarded in areas with less than 7 feet of horizontal soil confinement and for the uppermost 1-foot of foundation depth unless confined by concrete slabs or pavements.

Retaining Walls

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for retaining walls in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if more than 2 feet of soil than what was anticipated from the borings is being retaining by subsurface walls, the portions of walls supporting the additional soil will need to be designed using the lateral earth pressures for soil conditions.

Retaining walls should be fully backdrained. The backdrains should consist of at least a 3-inch-diameter, rigid perforated pipe, or equivalent such as a "high profile drain", surrounded by a drainage blanket. The pipe should be sloped to drain by gravity to appropriate outlets. Accessible subdrain cleanouts should be provided and maintained on a routine basis. The drainage blanket should consist of clean, free-draining crushed rock or gravel, wrapped in a filter fabric such as Mirafi 140N. The aggregate drainage blanket should be at least 1 foot in width and extend to within 1 foot of the surface. The uppermost 1-foot should be backfilled with compacted native soil to exclude surface water. Alternatively, the drainage blanket could consist of Caltrans Class 2 "Permeable Material" or a prefabricated drainage structure such as Mirafi Miradrain. The backdrain should extend down at least 8 inches below lowest adjacent grade.

Vertical retaining walls that are free to rotate at the top should be designed to resist active lateral soil pressures equivalent to those exerted by a fluid weighing 40 pcf where the backslope is level, and 60 pcf for backfill at a 2:1 (horizontal:vertical) slope. In areas where bedrock is exposed and backfill is placed behind the wall, the structural engineer may use active lateral earth pressures equivalent to those exerted by a fluid weighing 30 pcf where the backslope is level, and 45 pcf for backfill at a 2:1 (horizontal:vertical) slope. If the retaining wall is constructed directly against the bedrock with no backfill, the structural engineer may use active lateral earth pressures equivalent to those exerted by a fluid weighing 20 pcf where the backslope is level, and 26 pcf for backfill at a 2:1 (horizontal:vertical) slope. For intermediate slopes, interpolate between these values. We should be consulted to calculate lateral pressures on retaining walls that are tied-back or braced.

In addition to lateral earth pressures, retaining walls must be designed to resist horizontal pressures that may be generated by surcharge foundation loads applied at or near the ground surface. If a footing surcharge is located above a retaining wall within a horizontal distance of 0.4H, where H is the height of soil retained by the wall, then a horizontal lateral resultant force equal to 0.55 Q_L should be applied to the retaining wall at a height above the base of the wall equal to 0.6H. Q_L equals the equivalent resultant footing line load. This footing surcharge load applies equally to walls that are fixed or free to rotate. As an example, a retaining wall supporting 10 feet of soil has a footing 2 feet away from the top of the wall carrying a line load of 1,000 pounds per lineal foot. This footing is within 0.4H=4 feet of the retaining wall. The resultant horizontal force on the retaining wall from the footing surcharge load would be 0.55x1,000=550 pounds acting 0.6H=6 feet above the base of the retaining wall.

In addition to lateral earth pressures and adjacent footing loads, retaining walls must be designed to resist horizontal pressures that may be generated by surcharge loads applied at or near the ground surface. Where an imaginary 1:1 (H:V) plane projected downward from the outermost edge of a surcharge load intersects a retaining wall, that portion of the wall below the intersection should be designed for an additional horizontal thrust from a uniform pressure equivalent to one-third the maximum anticipated surcharge pressure in soil and one-fourth the maximum anticipated surcharge pressure in rock. In some cases, this value yields a conservative estimate of the actual lateral pressure imposed. We should be contacted if a more precise estimate of lateral loading on the retaining wall from surcharge pressures is desired.

Rigid retaining walls constrained against such movement could be subjected to "at-rest" lateral earth pressures equivalent to those exerted by the fluid pressures listed above plus a uniform load of 6•H pounds per square foot in soil and of 4•H pounds per square foot in rock, where H is the height of the backfill above footing level. Where an imaginary 1:1 (H:V) plane projected downward from the outermost edge of a surcharge load intersects a lower retaining wall, that portion of the constrained wall below the intersection should be designed for an additional horizontal thrust from a uniform pressure equivalent to one-half the maximum anticipated surcharge pressure in soil and one-third the maximum anticipated surcharge pressure in rock. In some cases, this value yields a conservative estimate of the actual lateral pressure imposed. We should be contacted if a more precise estimate of lateral loading on the retaining wall from surcharge pressures is desired.

A seismic pressure increment equivalent to a rectangular pressure distribution of 5H in psf may be used, where H is the height of the soil retained in feet.

Wall backfill should consist of soil that is spread in level lifts not exceeding 8 inches in thickness. Each lift should be brought to at least optimum moisture content and compacted to not less than 90 percent relative compaction, per ASTM test designation D 1557. Retaining walls may yield slightly during backfilling. Therefore, walls should be properly braced during the backfilling operations.

Where migration of moisture through retaining walls would be detrimental or undesirable, retaining walls should be waterproofed as specified by the project architect or structural engineer.

Retaining walls should be supported on footings designed in accordance with the recommendations presented above. A minimum factor of safety of 1.5 against overturning and sliding should be used in the design of retaining walls.

Slab-on-Grade Floors

The subgrade soil in slab and flatwork areas should be proof rolled to provide a firm, non-yielding surface. If moisture penetration through the slab would be objectionable, slabs should be underlain by a capillary moisture break consisting of at least 4 inches of clean, free-draining crushed rock or gravel graded such that 100 percent will pass the 1-inch sieve and none will pass the No. 4 sieve. Further protection against slab moisture penetration can be provided by means of a moisture vapor barrier membrane, placed between the drain rock and the slab. The membrane may be covered with 2 inches of damp, clean sand to protect it during construction.

Additional protection against moisture seepage into subsurface levels may be provided by installing a slab underdrain system. If selected, the slab underdrain system would consist of trenches, which are at least 12 inches deep and 6 inches wide, spaced no further than 10 feet apart beneath the floor slab. The bottoms of the trenches should slope to drain to a low-point by gravity. A 3-inch diameter, rigid perforated pipe should be placed near the bottom of the trench which is fully encapsulated in drain rock. The drainrock should be fully encapsulated in an approved filter fabric. The perforated pipes should be tied to closed conduits which outlet at appropriate discharge points.

Site Drainage

Positive drainage should be provided away from the improvements. Roof downspouts should discharge into closed conduits that drain into the site storm drain system. Surface drainage facilities (roof downspouts and drainage inlets) should be maintained entirely separate from subsurface drains (retaining wall backdrains and underslab drains). Drains should be checked periodically, and cleaned and maintained as necessary to provide unimpeded flow.

Supplemental Services

Earth Mechanics recommend that we be retained to review the project plans and specifications to determine if they are consistent with our recommendations. In addition, we should be retained to observe geotechnical construction, particularly site excavations, placement of retaining wall backdrains, fill compaction, and excavation of foundations, as well as to perform appropriate field observations and laboratory tests.

If, during construction, subsurface conditions different from those described in this report are observed, or appear to be present beneath excavations, we should be advised at once so that these conditions may be reviewed and our recommendations reconsidered. The recommendations made in this report are contingent upon our notification and review of the changed conditions.

If more than 18 months have elapsed between the submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at or adjacent to the site, the recommendations of this report may no longer be valid or appropriate. In such case, we recommend that we review this report to determine the applicability of the conclusions and recommendations considering the time elapsed or changed conditions. The recommendations made in this report are contingent upon such a review.

These services are performed on an as-requested basis and are in addition to this geotechnical investigation. We cannot accept responsibility for conditions, situations or stages of construction that we are not notified to observe.

LIMITATIONS

This report has been prepared for the exclusive use of Bluorange Designs and their consultants for the proposed project described in this report.

Our services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. We provide no other warranty, either expressed or implied. Our conclusions and recommendations are based on the information provided us regarding the proposed construction, the results of our field exploration and laboratory testing programs, and professional judgment. Verification of our conclusions and recommendations is subject to our review of the project plans and specifications, and our observation of construction.

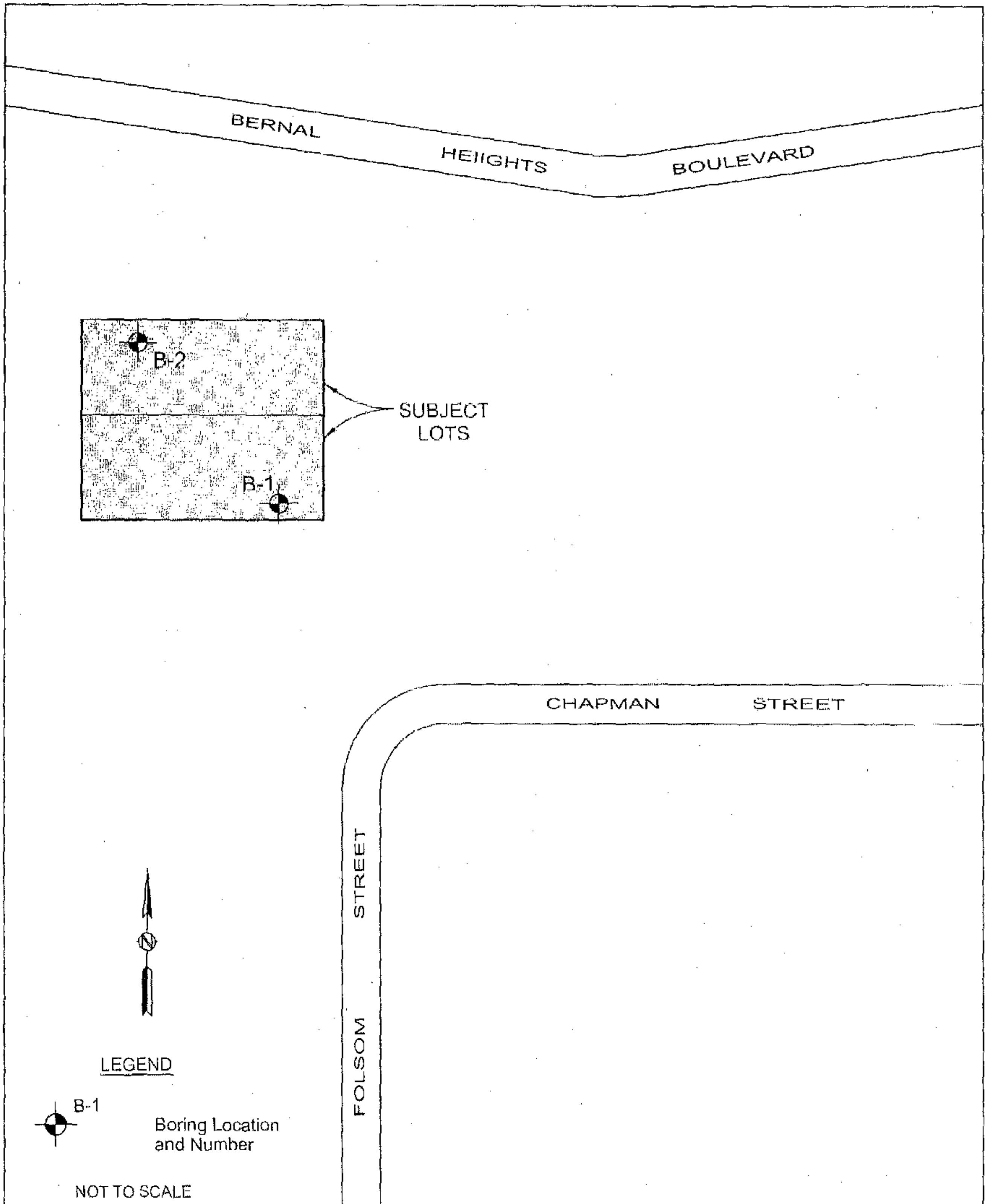
The test boring logs represent subsurface conditions at the locations and on the date indicated. It is not warranted that they are representative of such conditions elsewhere or at other times. Site conditions and cultural features described in the text of this report are those existing at the time of our field exploration, conducted on June 28, 2013, and may not necessarily be the same or comparable at other times.

The locations of the test borings were established in the field by reference to existing features and should be considered approximate only.

The scope of our services did not include an environmental assessment or an investigation of the presence or absence of hazardous, toxic, or corrosive materials in the soil, surface water, groundwater or air, on or below, or around the site, nor did it include an evaluation or investigation of the presence or absence of wetlands.

APPENDIX A

List of Plates



Earth Mechanics
Consulting Engineers

Job. No: 13-4060
Appr:
Drwn: LPDD
Date. 7/1/13

BORING LOCATION MAP
3516 & 3526 Folsom Street
San Francisco, California

PLATE 1

EQUIPMENT: **Continuous Sampling** ELEVATION: *

LOGGED BY: **A.K.**

START DATE: **6-28-13**

FINISH DATE: **6-28-13**

Other Laboratory Tests	Pocket Penetrometer (ksf)	Moisture Content (%)	Dry Density (pcf)	% Passing #200 sieve	Blows/Foot	Sample	DEPTH (FEET)	Description
					79		0	Brown Sandy Lean Clay (CL), moist, very stiff
							1	
		6.6		57				
					83		2	Mottled Orangish-Brown Lean Clay with Sand (CL), moist, very stiff
							3	
		25.1		81				
					82		4	Mottled Orangish-Brown Chert, firm, friable, moderately weathered
							5	Bottom of Boring = 5' No Free Water Encountered

* Existing ground surface.

Earth Mechanics Consulting Engineers	Job No: 13-4060 Appr: Drwn: LPDD Date: JUL 2013	**LOG OF BORING 1** 3516 & 3526 Folsom Street San Francisco, California	PLATE **2**

EQUIPMENT: **Continuous Sampling** ELEVATION: *

LOGGED BY: **A.K.** START DATE: **6-28-13**

FINISH DATE: **6-28-13**

Other Laboratory Tests	Pocket Penetrometer (ksf)	Moisture Content (%)	Dry Density (pcf)	% Passing #200 sieve	Blows/Foot	DEPTH (FEET)	Description
					58	0	Brown Silty Clayey Sand (CL-ML), moist, very stiff, with roots
		18.3		73			
					86	2	Light Mottled Brown Sandy Lean Clay (CL), moist, hard
		20.9		63			
		2.7		27	50/6"	3	Reddish-Brown Chert, firm, friable, moderately weathered

Bottom of Boring = 3.5'
No Free Water Encountered

* Existing ground surface.

Earth Mechanics
Consulting Engineers

Job No: 13-4060
Appr:
Drwn: LPDD
Date: JUL 2013

LOG OF BORING 2

3516 & 3526 Folsom Street

San Francisco, California

PLATE 3

MAJOR DIVISIONS					TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS, GRAVEL-SAND
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS
			SP		POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM		SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC		CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL		ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

			Shear Strength, psf (Confining Pressure, psf)	
Consol	Consolidation	Tx	2630 (240)	Unconsolidated Undrained Triaxial
LL	Liquid Limit (in %)	Tx sat	2100 (575)	Unconsolidated Undrained Triaxial, saturated prior to test
PL	Plastic Limit (in %)	DS	3740 (960)	Unconsolidated Undrained Direct Shear
PI	Plasticity Index	TV	1320	Torvane Shear
Gs	Specific Gravity	UC	4200	Unconfined Compression
SA	Sieve Analysis	LVS	500	Laboratory Vane Shear
■	Undisturbed Sample (2.5-inch ID)	FS	Free Swell	
◪	2-inch-ID Sample	EI	Expansion Index	
◣	Standard Penetration Test	Perm	Permeability	
⊠	Bulk Sample	SE	Sand Equivalent	

KEY TO TEST DATA

Earth Mechanics Consulting Engineers	Job No: 13-4060 Appr: Drwn: LPDD Date: JUL 2013	**SOIL CLASSIFICATION CHART AND KEY TO TEST DATA** 3516 & 3526 Folsom Street San Francisco, California	PLATE 4

ROCK SYMBOLS

SHALE OR CLAYSTONE	CHERT	SERPENTINITE
SILTSTONE	PYROCLASTIC	METAMORPHIC ROCKS
SANDSTONE	VOLCANIC	DIATOMITE
CONGLOMERATE	PLUTONIC	SHEARED ROCKS

LAYERING

MASSIVE	Greater than 6 feet
THICKLY BEDDED	2 to 6 feet
MEDIUM BEDDED	8 to 24 inches
THINNLY BEDDED	2-1/2 to 8 inches
VERY THINNLY BEDDED	3/4 to 2-1/2 inches
CLOSELY LAMINATED	1/4 to 3/4 inches
VERY CLOSELY LAMINATED	Less than 1/4 inch

JOINT, FRACTURE, OR SHEAR SPACING

VERY WIDELY SPACED	Greater than 6 feet
WIDELY SPACED	2 to 6 feet
MODERATELY SPACED	8 to 24 inches
CLOSELY SPACED	2-1/2 to 8 inches
VERY CLOSELY SPACED	3/4 to 2-1/2 inches
EXTREMELY CLOSELY SPACED	Less than 3/4 inch

HARDNESS

SOFT - Pliable; can be dug by hand

FIRM - Can be gouged deeply or carved with a pocket knife

MODERATELY HARD - Can be readily scrached by a knife blade; scratch leaves heavy trace of dust and is readily visable after the powder has been blown away

HARD - Can be scratched with difficulty; scratch produces little powder and is often faintly visable

VERY HARD - Cannot be scratched with pocket knife; leaves a metallic streak

STRENGTH

PLASTIC - Capable of being molded by hand

FRIABLE - Crumbles by rubbing with fingers

WEAK - An unfractured specimen of such material will crumble under light hammer blows

MODERATELY STRONG - Specimen will withstand a few heavy hammer blows before breaking

STRONG - Specimem will withstand a few heavy ringing hammer blows and usually yields large fragments

VERY STRONG - Rock will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments

DEGREE OF WEATHERING

HIGHLY WEATHERED - Abundant fractures coated with oxides, carbonates, sulphates, mud, etc., thourough discoloration, rock disintegration, mineral decomposition

MODERATELY WEATHERED - Some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition

SLIGHTLY WEATHERED - A few stained fractures, slight discoloration, little or no effect on cementation, no mineral decomposition

FRESH - Unaffected by weathering agents, no appreciable change with depth

Earth Mechanics Consulting Engineers	Job No: 13-4060 Appr: Drwn: LPDD Date: JUL 2013	**ENGINEERING GEOLOGY ROCK TERMS** 3516 & 3526 Folsom Street San Francisco, California	PLATE 5

APPENDIX B

List of References

1. Bonilla, M. G., 1998, *Preliminary Geologic Map of the San Francisco South 7.5' Quadrangle and Part of the Hunters Point 7.5' Quadrangle, San Francisco Bay Area, California*, United States Geological Survey Open-File Report OF-98-354, Scale 1:24,000.

2. California Department of Conservation, Division of Mines and Geology, 1998, *Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada.*

3. CDMG, 2000, State of California Seismic Hazards Zones, City and County of San Francisco, California Division of Mines and Geology.

4. Seed, H. B., and Idriss, E., 1982, *Ground Motion and Soil Liquefaction During Earthquakes*, Earthquake Engineering Research Institute Monograph.

5. United States Geological Survey, 1993, San Francisco South Quadrangle, 7.5 Minute Series, Scale 1:24,000.

APPENDIX C

Field Exploration

Our field exploration consisted of a geologic reconnaissance and subsurface exploration by means of two test borings logged by our Engineer on June 28, 2013. The test borings were drilled with a hand carried, portable drill rig utilizing continuous flight, 4-inch-diameter augers. The borings were drilled at the approximate locations shown on Plate 1.

The logs of the test borings are displayed on Plates 2 and 3. Representative undisturbed samples of the earth materials were obtained from the test borings at selected depth intervals with a 1.4-inch inside diameter, split barrel Standard Penetration Test (SPT) sampler, a 2-inch inside diameter, split-barrel sampler, and a 2.5-inch inside diameter, modified California sampler.

Penetration resistance blow counts were obtained by dropping a 70-pound hammer through a 30-inch free fall. The sampler was driven 24 inches or less and the number of blows was recorded for each 6 inches of penetration. The blows per foot recorded on the Boring Logs represent the accumulated number of blows that were required to drive the sampler the last 12 inches or fraction thereof.

The soil classifications are shown on the Boring Logs and referenced on Plate 4. Bedrock is described in accordance with the engineering geology rock terms presented on Plate 5.

Laboratory Testing

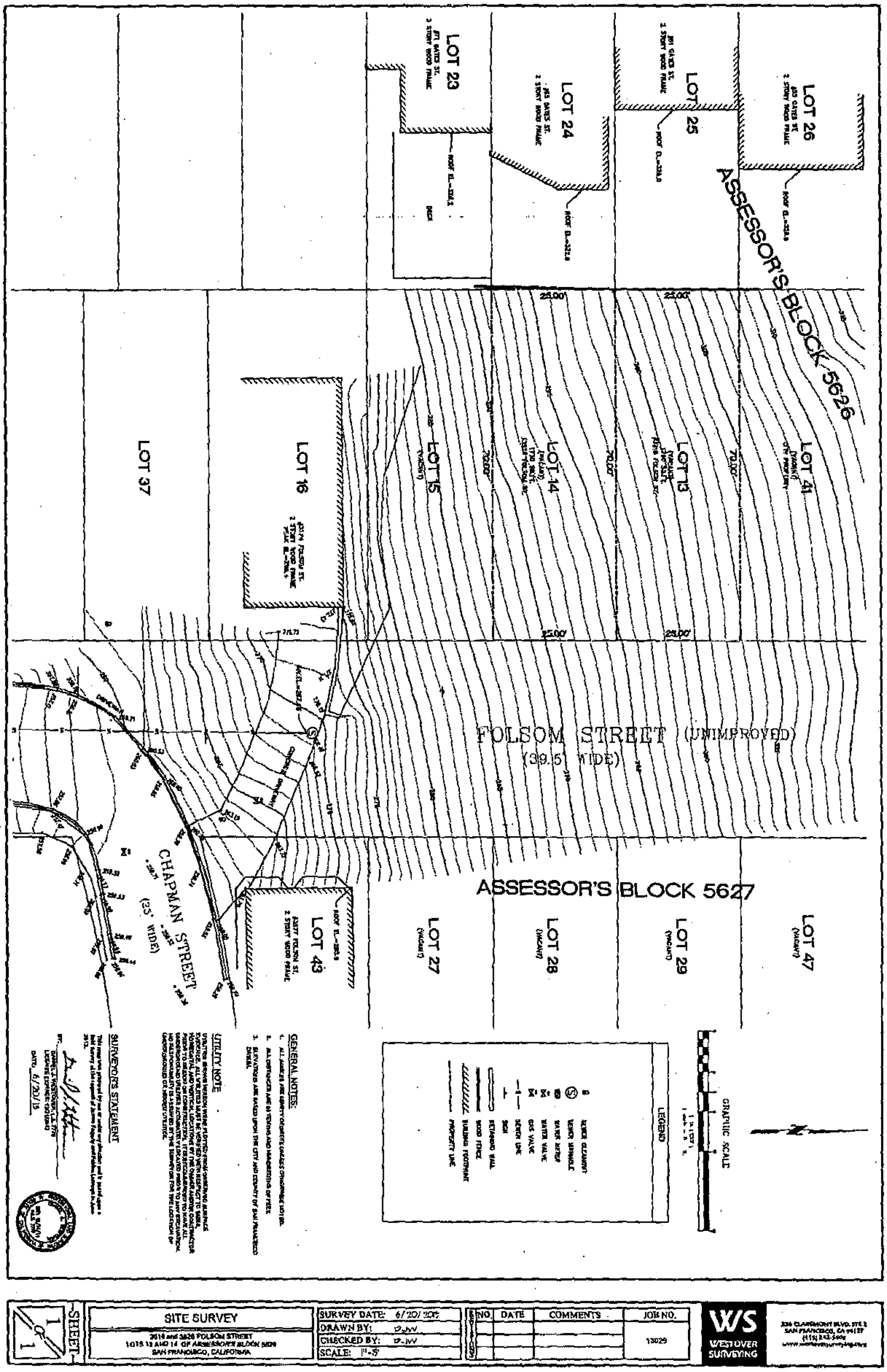
Natural water contents and percentages of gravel, sand, and fines were determined on selected soil samples recovered from the test borings. The data are recorded at the appropriate sample depths on the Boring Logs.

APPENDIX D

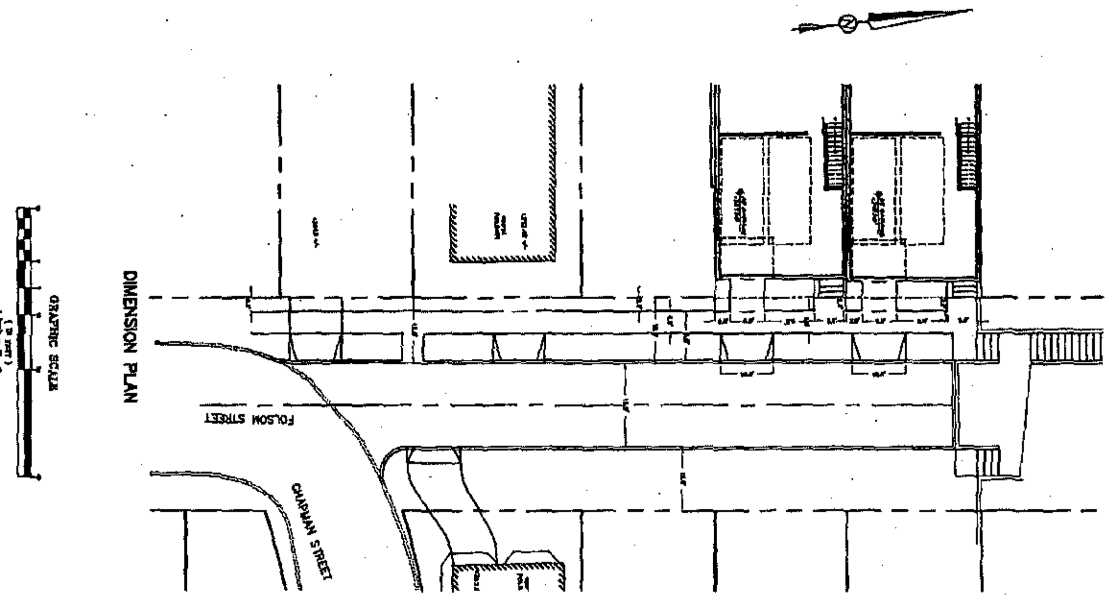
Distribution

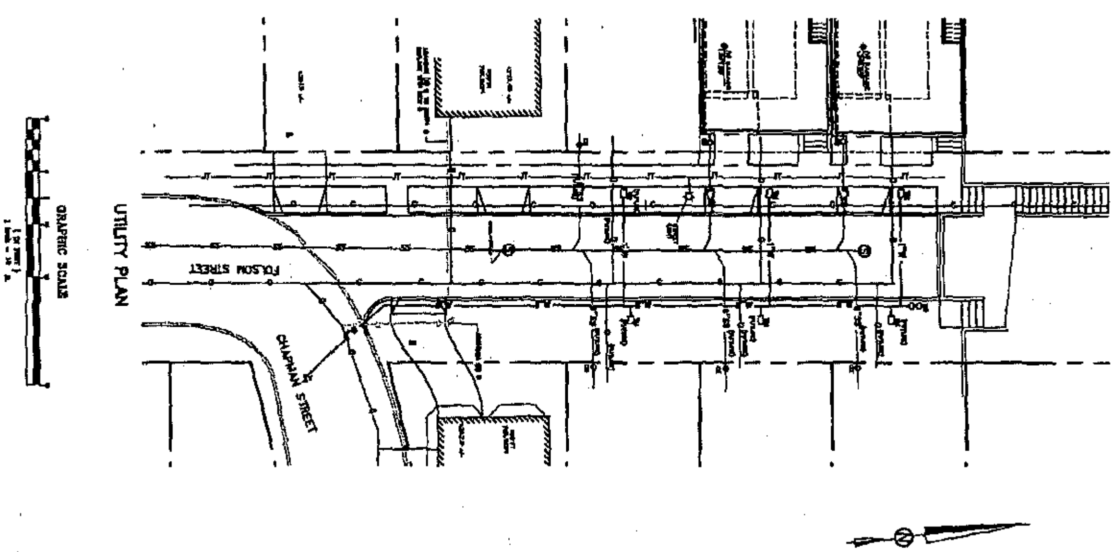
Mr. James Fogarty
Bluorange Designs
241 Amber Drive
San Francisco, CA 94131
jfogarty@sonic.net
Fabien@novadesignsbuilds.com
Fabien@bluorange.com

(4 wet signed and stamped originals)



LOT 23
LOT 24
LOT 25
LOT 26
ASSESSOR'S BLOCK 5626
LOT 37
LOT 16
LOT 15
LOT 14
LOT 13
LOT 41
25.00'
70.00'
FOLSOM STREET (UNIMPROVED)
(39.5' WIDE)
CHAPMAN STREET
(25' WIDE)
ASSESSOR'S BLOCK 5627
LOT 43
LOT 27
LOT 28
LOT 29
LOT 47
GRAPHIC SCALE
LEGEND
GENERAL NOTES:
UTILITY NOTE
SURVEYOR'S STATEMENT
SHEET
1
OF
1
SITE SURVEY
SURVEY DATE:
DRAWN BY:
CHECKED BY:
SCALE:
NO.
DATE
COMMENTS
JOB NO.
13029
WS
WESTOVER SURVEYING





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3516 & 3526 FOLSOM STREET
STREET AND UTILITY IMPROVEMENT PLAN
SAN FRANCISCO, CALIFORNIA

UTILITY & DIMENSION PLAN

SCALE 1" = 10'

C2.0

EXHIBIT 17

EARTH MECHANICS CONSULTING ENGINEERS

Geotechnical Engineering

360 Grand Avenue • Suite 262
Oakland, CA 94610
Phone (510) 839-0765
Fax (510) 839-0716

November 29, 2016
Project Number: 13-4060

Mr. James Fogarty
Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

Subject: Geotechnical Report Update
Proposed Residence at
3516 & 3526 Folsom Street
San Francisco, California

Dear Mr. Fogarty:

This letter presents an update of my geotechnical investigation report for the proposed residence at 3516 and 3526 Folsom Street in San Francisco, California. H. Allen Gruen, Geotechnical Engineer performed a geotechnical investigation for the project and presented results in the report dated August 3, 2013.

Proposed Project

It is my understanding that the project will consist of the design and construction of a new residence on an undeveloped lot. No other project details are known at this time.

Report Update

It is my opinion that, the findings, conclusions, and recommendations presented in our geotechnical investigation report dated August 3, 2013, are still valid and applicable for the proposed development.

I appreciate the opportunity to be of continued service to you on this project. If you have any questions, please call me at (510) 839-0765.

Sincerely,

H. Allen Gruen

H. Allen Gruen, C.E., G.E.
Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
H. ALLEN GRUEN
GE2147
EXP. 12-31-2017
GEOTECHNICAL
STATE OF CALIFORNIA

Mr. James Fogarty
Bluorange Designs
241 Amber Drive
San Francisco. CA 94131

EXHIBIT 18

H. ALLEN GRUEN

Geotechnical Engineer

360 Grand Avenue, # 262
Oakland, CA 94610
Phone (510) 839-0765
H.Allen.Gruen@gmail.com

January 24, 2017
Project Number: 13-4060c

Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

Subject: Geotechnical Responses to Project Review Letter
3516 and 3526 Folsom Street
San Francisco, California

Dear Ladies and Gentlemen:

This letter presents my geotechnical responses to the project review letter by Storesund Consulting, dated December 1, 2016, for the proposed residences at 3516 and 3526 Folsom Street in San Francisco, California. H. Allen Gruen, Geotechnical Engineer performed a geotechnical investigation for the project and presented results in the report dated August 3, 2013.

- The reviewer notes that geotechnical borings do not extend to the proposed depth of excavations (about 6 feet deep). Our borings encountered chert bedrock at depths about 2 to 4 feet. Practical drilling refusal was encountered at the maximum depth explored of 5 feet. We anticipate that bedrock will extend for a significant depth below the subject site.

- Estimating induced ground vibrations caused by rock excavations causing potential degradation of the transmission line integrity was beyond our scope of work for the residential development.

- Determining negative impacts of construction traffic to the transmission line integrity was beyond our scope of work for the residential development.

- The construction operations for the subject residential development adjacent to the transmission pipeline are not expected to have a significant detrimental impact to the transmission pipeline.

I appreciate the opportunity to be of continued service to you on this project. If you have any questions, please call me at (510) 839-0765.

Sincerely,

H. Allen Gruen, C.E., G.E.
Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
H. ALLEN GRUEN
GE2147
EXP. 12-31-2017
GEOTECHNICAL
STATE OF CALIFORNIA

EXHIBIT 19

Storesund Consulting
154 Lawson Road, Kensington, CA 94707
510-225-5389 (cell) email: rune@storesundconsulting.com

June 14, 2017

SF Board of Supervisors
San Francisco City Hall
1 Dr Carlton B Goodlett Pl #244
San Francisco, CA 94102

Subject: Review of Proposed Pipeline Impacts
3516 & 3526 Folsom Street
San Francisco, California

Dear President Breed and Honorable Members of the Board of Supervisors,

I have reviewed the analyses upon which the proposed mitigation options[1] relative to PG&E's natural gas Line 109 (the "Transmission Line") have been generated. In my opinion, the analyses are inadequate, incomplete, and fall short of a rigorous evaluation of pipeline integrity and assurance of public safety given the potential harm as a result of rupture and ignition of natural gas from this transmission pipeline. As a result, a reasonable possibility of a significant effect still exists with respect to degradation of the Transmission Line integrity and the adequacy and feasibility of the proposed mitigation actions are very much in question.

While an assessment of a potential suite of ground velocities has been completed, no direct assessment of pipeline integrity impacts have been evaluated. The analyses presented associated with this negative declaration are indirect. The current analysis infers that peak particle velocities (PPV) below a certain threshold will not degrade pipeline integrity. Inference is not equivalent to a data-driven validated relationship by PG&E that explicitly establishes a direct correlation between peak particle velocity and degradation of pipeline integrity.

The American Society of Mechanical Engineers (ASME) has a standard (ASME B31.8S) that presents guidance on evaluation of gas pipeline integrity[2]. A multitude of factors that impact pipeline integrity are presented in this document. These factors include: pipe wall thickness, diameter, seam type and joint factor, year of installation, bending method, joining method and process of inspection, depth of cover, field coating methods, soil backfill, cathodic protection, coating type, nominal maximum and minimum operating pressures, leak/failure history, pipe wall temperature, OD/ID corrosion monitoring, pressure fluctuations, encroachments, vandalism, and external forces. It is unclear that all of these factors are fully accounted for in the PPV-Integrity relationship proposed by PG&E.

Further, ASME B31.8S recommends that validation of any assessment process is vital. "Validation of risk analysis results is one of the most important steps in any assessment process. This shall be done to assure that the methods used have produced results that are usable and are consistent with the operator's and industry's experience...A risk validation and process shall be identified and documented in the integrity and management program. Risk result validations can be

[1] San Francisco Planning Department, Mitigated Negative Declaration (April 19, 2017; amended June 8, 2017)
[2] ASME B31.8S-2004 "Managing System Integrity of Gas Pipelines"

successfully performed by conducting inspections, examinations, and evaluations at locations that are indicated as either high risk or low risk to determine if methods are correctly characterizing the risks." No such validation has been provided or referenced.

Based on the facts and new analyses associated with the proposed development, it is my expert opinion that a reasonable possibility of a significant effect still exists with respect to degradation of the Transmission Line integrity.

Given the uncertainties of actual pipe integrity, strong consideration should be given to replacing the segment of pipeline to ensure maximum integrity and minimal exposure of residents to potential undue injury or death as a result of the anticipated heavy excavation and ground disturbance activities.

No payments for services have been received and no future promises of compensation have been offered.

I reserve the right to update my independent review based on new information.

Please contact me with any questions or comments by phone at (510) 225-5389 or via email at rune@storesundconsulting.com.

REGISTERED PROFESSIONAL ENGINEER
RUNE STORESUND
GE 2855
6/30/17
GEOTECHNICAL
STATE OF CALIFORNIA

Sincerely,

STORESUND CONSULTING

Rune Storesund, D.Eng., P.E., G.E.
Consulting Engineer

UC Berkeley Center for Catastrophic Risk Management
Executive Director

GENERAL NOTES

1. ELEVATIONS ARE BASED ON CITY OF SAN FRANCISCO DATUM AND THE TOPOGRAPHIC SURVEY PERFORMED BY WESTOVER SURVEYING, DATED JUNE 20, 2013.

2. CONTRACTOR SHALL COMPLY WITH ALL CITY AND COUNTY OF SAN FRANCISCO LAWS AND ORDINANCES; REGULATIONS OF THE DEPARTMENT OF INDUSTRIAL RELATIONS, O.S.H.A. AND INDUSTRIAL ACCIDENT COMMISSION RELATIONS TO THE SAFETY AND CHARACTER OF THE WORK, EQUIPMENT AND PERSONNEL.

3. STREET IMPROVEMENTS SHALL BE CONSTRUCTED IN ACCORDANCE WITH CITY AND COUNTY OF SAN FRANCISCO STANDARD SPECIFICATIONS AND STANDARD PLANS.

4. THE OWNER SHALL BE RESPONSIBLE FOR OBTAINING ALL EASEMENTS, RIGHTS OF ENTRY, ETC. NECESSARY TO CONSTRUCT ANY WORK SHOWN HEREON.

5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL ENCROACHMENT, EXCAVATION, CONCRETE, ELECTRICAL, IRRIGATION, PLUMBING, ETC. PERMITS NECESSARY PRIOR TO BEGINNING CONSTRUCT FOR ANY WORK SHOWN HEREON.

6. CONTRACTOR SHALL POST EMERGENCY TELEPHONE NUMBERS FOR PUBLIC WORKS, AMBULANCE, POLICE AND FIRE DEPARTMENTS, AND THE CONTRACTOR.

7. CONTRACTOR SHALL HAVE A SUPERINTENDENT OR REPRESENTATIVE ON SITE AT ALL TIMES DURING CONSTRUCTION.

8. THE LOCATION AND PROTECTION OF ALL UTILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR. CONTACT U.S.A. UNDERGROUND SERVICE ALERT 48 HOURS PRIOR TO ANY EXCAVATION (800-422-4133).

9. THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITIES, PIPELINES OR STRUCTURES SHOWN ON THESE PLANS WERE OBTAINED BY A SURVEY OR BY REVIEW OF EXISTING PLANS. APPROVAL OF THESE PLANS BY FRANCO CIVIL ENGINEERING OR REVIEW BY CITY ENGINEER DOES NOT CONSTITUTE A REPRESENTATION AS TO THE ACCURACY OR COMPLETENESS OF THE LOCATION OR EXISTENCE OR NON-EXISTENCE OF ANY UNDERGROUND UTILITIES, PIPELINES OR STRUCTURES WITHIN THE LIMITS OF WORK. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THE LOCATION OF ALL EXISTING UTILITIES PRIOR TO BEGINNING WORK.

10. THE CONTRACTOR AND SUBCONTRACTORS AGREE THAT THEY ASSUME SOLE RESPONSIBILITY AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE OWNER, FRANCO CIVIL ENGINEERING, FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OR WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE OWNER OR THE ENGINEER.

11. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE CONSTRUCTION WITH THE UTILITY AGENCIES AND THE SUBCONTRACTORS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY FRANCO CIVIL ENGINEERING OF ANY DIFFERENCES OF LOCATION OF EXISTING UTILITIES FROM THAT SHOWN, OR ANY CONFLICTS WITH THE DESIGN BEFORE CONTINUING WORK IN THAT AREA.

12. A SURVEYOR LICENSED IN THE STATE OF CALIFORNIA SHALL SET ALL STAKES AND PROVIDE CUT SHEETS FOR THIS PROJECT. THE CONTRACTOR SHALL REQUEST STAKES 48 HOURS IN ADVANCE. THE CONTRACTOR SHALL CAREFULLY PRESERVE STAKES AND MARKERS. IN CASE SUCH STAKES AND MARKERS ARE DESTROYED OR DAMAGED THEY WILL BE REPLACED AT THE ENGINEER'S EARLIEST CONVENIENCE. THE CONTRACTOR WILL BE CHARGED FOR THE COST OF NECESSARY REPLACEMENT OR RESTORATION OF STAKES AND MARKERS WHICH IN THE JUDGMENT OF THE ENGINEER WERE CARELESSLY OR FULLY DESTROYED OR DAMAGED BY THE CONTRACTOR'S OPERATIONS.

13. PRIOR TO PLACING CURB, SIDEWALK, ASPHALT CONCRETE, SUBBASE OR BASE MATERIAL, ALL UNDERGROUND UTILITIES SHALL BE INSTALLED, BACKFILL COMPLETED.

14. THE CONTRACTOR SHALL EXPOSE (I.E. BY POTHOLING) AND CHECK INVERTS ON EXISTING SEWERS, STORM DRAINS, AND CLEARANCES OF KNOWN CROSSINGS OF OTHER UTILITIES BEFORE CONSTRUCTING NEW PIPELINES. IF THE CONTRACTOR DETERMINES THE EXISTING INVERTS ARE NOT IN CONFORMANCE WITH THE PLANS, OR CROSSING CONFLICTS ARISE, HE SHALL NOTIFY THE ENGINEER BEFORE PERFORMING ANY WORK.

15. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING HIS WORK TO AVOID CONFLICTS BETWEEN MAINS AND LATERALS (I.E., STORM DRAINS, SANITARY SEWERS AND WATER MAINS).

16. SHOULD IT APPEAR THAT THE WORK TO BE DONE, OR ANY MATTER RELATIVE THERETO, IS NOT SUFFICIENTLY DETAILED OR EXPLAINED ON THESE PLANS THE CONTRACTOR SHALL CONTACT FRANCO CIVIL ENGINEERING FOR SUCH FURTHER EXPLANATION AS MAY BE NECESSARY.

17. IT IS THE DEVELOPER'S AND/OR CONTRACTOR'S RESPONSIBILITY TO NOTIFY FRANCO CIVIL ENGINEERING UPON FINDING CONDITIONS IN THE FIELD WHICH ARE AT VARIANCE WITH THE PLANS AND/OR WHICH MAY REQUIRE ALTERING OF THE PLANS PRIOR TO COMMENCEMENT OF WORK.

18. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY FIELD CHANGES MADE WITHOUT WRITTEN AUTHORIZATION FROM FRANCO CIVIL ENGINEERING.

19. COMPACTION TESTS WILL BE PERFORMED ON ALL TRENCHES AND STREET WORK INCLUDING BUT NOT LIMITED TO SUB-GRADE SOILS, AGGREGATE SUBBASE AND BASE COURSE MATERIALS TO VERIFY THAT COMPACTION CONFORMS TO THE PLANS. TESTING SERVICES SHALL BE PERFORMED BY A CERTIFIED TESTING LABORATORY IN CONFORMANCE WITH THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS). SOIL SAMPLING AND TESTING FREQUENCY SHALL CONFORM TO CHAPTER 8 OF THE CALTRANS CONSTRUCTION MANUAL. ALL TESTING WILL BE AT THE CONTRACTOR'S EXPENSE.

20. ANY EXISTING IMPROVEMENTS DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED AND/OR REPLACED BY THE CONTRACTOR AT HIS EXPENSE.

21. CONTRACTOR SHALL BE RESPONSIBLE FOR RESPONDING TO ANY LOCAL COMPLAINTS ABOUT CONSTRUCTION NOISE.

22. CONSTRUCTION EQUIPMENT, TOOLS, ETC. SHALL NOT BE CLEANED OR RINSED INTO A STREET, GUTTER, STORM DRAIN OR STREAM. SHOVEL OR VACUUM SAW-CUT SLURRY AND REMOVE FROM SITE.

23. A CONTAINED AND COVERED AREA ON-SITE SHALL BE USED FOR STORAGE OF CEMENT BAGS, PAINTS, FLAMMABLES, OILS, FERTILIZERS, PESTICIDES, OR ANY OTHER MATERIALS THAT HAVE POTENTIAL FOR BEING DISCHARGED TO THE STORM DRAIN SYSTEM BY WIND OR IN THE EVENT OF A MATERIAL SPILL.

24. ALL CONSTRUCTION DEBRIS SHALL BE GATHERED ON A REGULAR BASIS AND PLACED IN A DUMPSTER WHICH IS EMPTIED OR REMOVED WEEKLY. WHEN FEASIBLE, TARPS SHALL BE USED ON THE GROUND TO COLLECT FALLEN DEBRIS OR SPLATTERS THAT COULD CONTRIBUTE TO STORMWATER POLLUTION. ANY TEMPORARY ON-SITE CONSTRUCTION PILES SHALL BE SECURELY COVERED WITH A TARP OR OTHER DEVICE TO CONTAIN DEBRIS.

25. CONCRETE/GUNITE TRUCKS AND CONCRETE/PLASTER FINISHING OPERATIONS SHALL NOT DISCHARGE WASH WATER INTO THE STREET GUTTERS OR DRAINS.

26. TRASH AND DEBRIS SHALL BE CLEANED UP DAILY IN THE PROJECT VICINITY AND ALONG HAUL ROUTES. SWEEP AS NEEDED.

GRADING AND PAVING NOTES

1. ALL GRADING SHALL BE PERFORMED IN ACCORDANCE THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS) STANDARD SPECIFICATIONS, LATEST EDITION.

2. ALL MANHOLE FRAMES AND COVERS, MONUMENT BOXES AND VALVE BOXES SHALL BE SET TO GRADE AFTER FINAL PAVING. THE CONTRACTOR SHALL NOTIFY UTILITY COMPANIES, GIVING THEM ADEQUATE NOTICE TO ALLOW THEM TO ADJUST THEIR FACILITIES TO GRADE.

3. ASPHALT CONCRETE - SURFACE COURSE SHALL BE 3 / 4 INCH (30MM) MAXIMUM AGGREGATE SIZE ASPHALT CONCRETE AND SHALL MEET THE REQUIREMENTS OF SECTION 39 OF THE CALTRANS STANDARD SPECIFICATIONS. ASPHALT CONCRETE SHALL BE TYPE 'A'. COMPACTING EQUIPMENT SHALL CONFORM TO SECTION 39-5.02, "COMPACTING EQUIPMENT", OF THE STANDARD SPECIFICATIONS.

4. AGGREGATE BASE SHALL BE FURNISHED AS REQUIRED TO CONSTRUCT STREET BASE AND SHALL CONFORM TO SECTION 26, ARTICLES,26-1.01, 26-1.02, 26-1.02A, 26-1.035, 26-1.04 AND 26-1.05 OF THE CALTRANS STANDARD SPECIFICATIONS. MAXIMUM AGGREGATE SIZE SHALL BE 1-1/2 INCHES (60MM).

5. ALL PAVEMENT CONFORMS SHALL BE MADE WITH A SMOOTH BUTT JOINT.

6. PAVEMENT RESTORATION SHALL EXTEND TO A MAXIMUM 18" BEYOND THE STANDARD PLAN LIMITS WHERE EXISTING ADJACENT PAVEMENT IS RAVELED OR ALLIGATORED. PAVEMENT RESTORATION SHALL INCLUDE SAWCUT, REMOVAL OF ASPHALT CONCRETE, AND REPLACEMENT IN KIND IN CONJUNCTION WITH TRENCH RESTORATION PAVING OR STREET PAVING.

7. THE CONTRACTOR IS RESPONSIBLE FOR MATCHING EXISTING STREETS, SURROUNDING LANDSCAPE AND OTHER IMPROVEMENTS WITH A SMOOTH TRANSITION IN PAVING, CURBS, GUTTER, SIDEWALKS, GRADING, ETC., AND TO AVOID ANY ABRUPT OR APPARENT CHANGES IN GRADES OR CROSS SLOPES, LOW SPOTS OR HAZARDOUS CONDITIONS.

8. SURFACE DRAINAGE MUST SLOPE AWAY FROM ALL BUILDINGS. THE MINIMUM ACCEPTABLE GRADE FOR SURFACE FLOW, EXCEPT PAVED AREAS, AFTER SUBSIDENCE IS 1%.

9. GRADING ALONG THE EXTERIOR BOUNDARIES SHALL NOT INTERFERE WITH THE NATURAL DRAINAGE OF THE SURROUNDING AREA.

CONCRETE IMPROVEMENTS NOTES

1. ALL CONCRETE SHALL BE CLASS 'B' UNLESS OTHERWISE SPECIFIED AND SHALL MEET THE REQUIREMENTS OF SECTION 90 OF THE CALTRANS STANDARD SPECIFICATIONS. ALL CONCRETE IMPROVEMENTS SHALL CONFORM TO SECTION 73 OF THE CALTRANS STANDARD SPECIFICATIONS.

2. AGGREGATE BASE SHALL BE PROPERLY WATERED AND ROLLED WITH A FULL SIZE ROLLER IN CONFORMANCE WITH THE APPLICABLE PORTIONS OF SECTION 26 OF THE CALTRANS STANDARD SPECIFICATIONS.

LEGEND

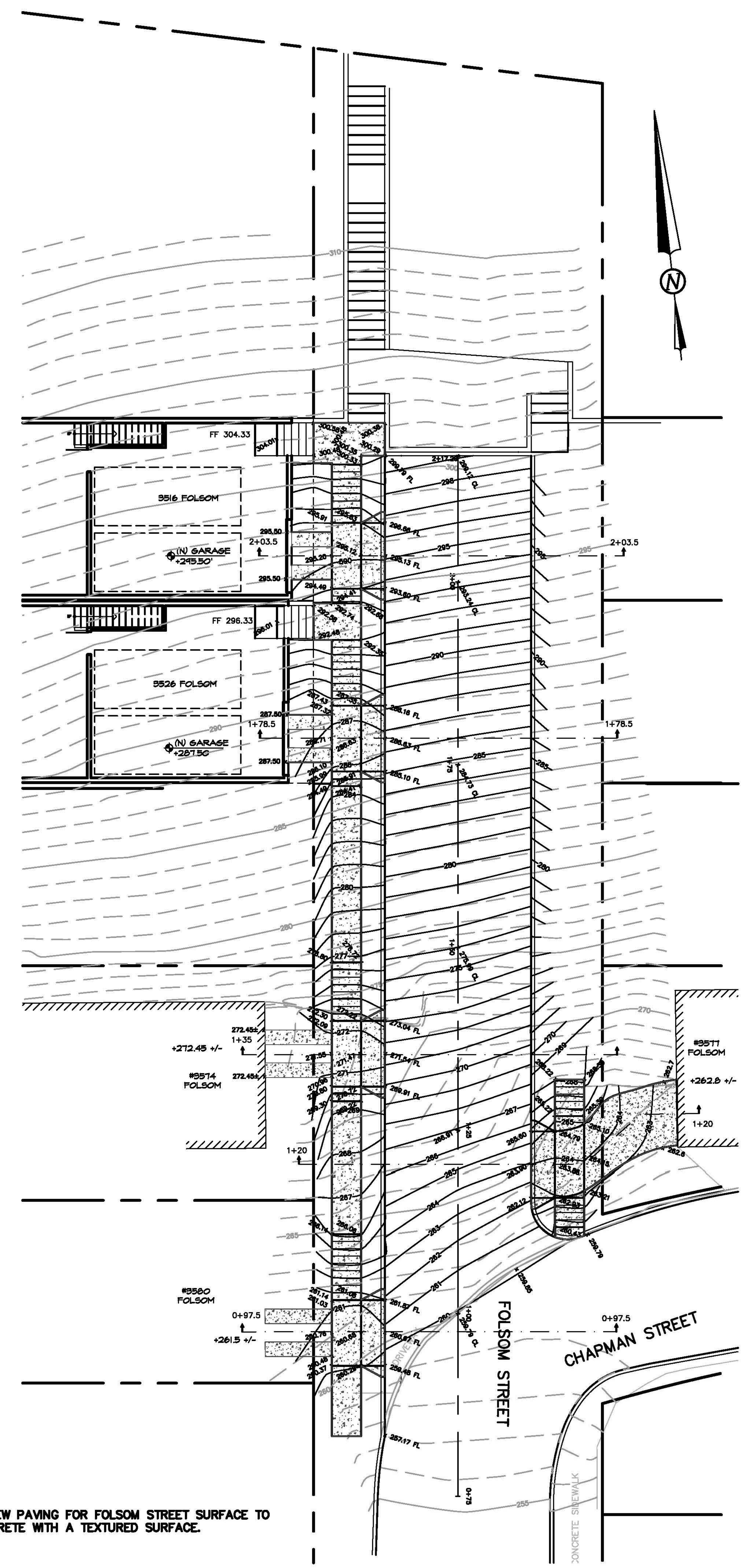
BO	BLOW OFF
BVC	BEGIN VERTICAL CURVE
CL	CENTER LINE
CO	CLEAN OUT
ELEV	ELEVATION
EVC	END VERTICAL CURVE
FL	FLOW LINE
G	GAS
GV	GAS VALVE
INV	INVERT
JT	JOINT SERVICE TRENCH
MH	MAN HOLE
PL	PROPERTY LINE
STA	STATION
SS	SEWER SANITARY & STORM
TC	TOP OF CURB
VC	VERTICAL CURVE
W	WATER
WM	WATER METER
WV	WATER VALVE

REGISTERED PROFESSIONAL ENGINEER DAVID J. FRANCO No. 34652 CIVIL STATE OF CALIFORNIA

GRAPHIC SCALE

10 0 5 10 20 40

(IN FEET)
1 inch = 10 ft.



NOTE: NEW PAVING FOR FOLSOM STREET SURFACE TO BE CONCRETE WITH A TEXTURED SURFACE.

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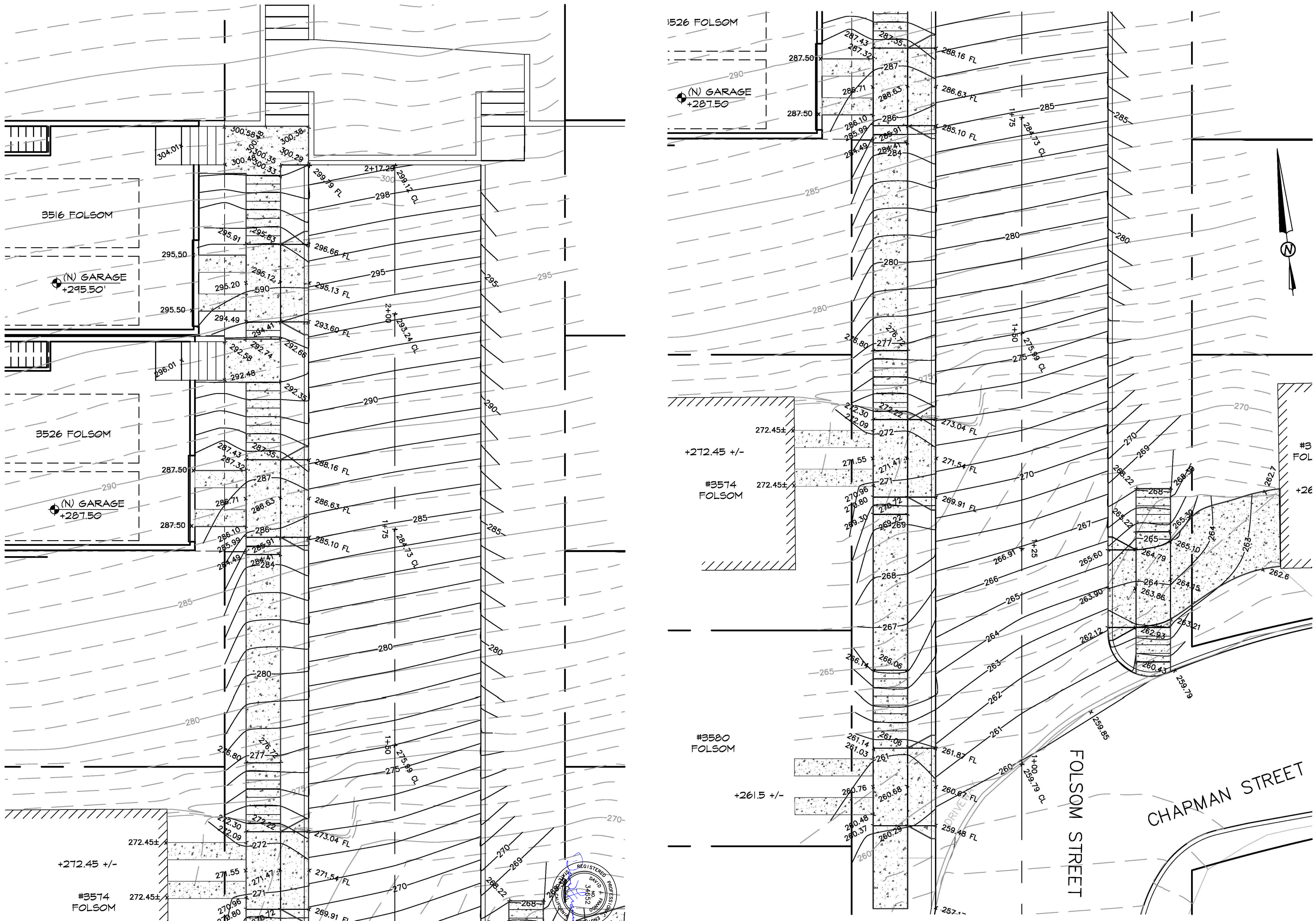
3516 & 3526 FOLSOM STREET
STREET AND UTILITY IMPROVEMENT PLAN
SAN FRANCISCO, CALIFORNIA

GRADING PLAN

DRAWING FOLSOMCIVIL
F.B. NO. NA
SCALE 1" = 10'
DATE AUGUST 2016
REVISIONS
SHEET NO. 1 OF 4
JOB NO. F14-373

C1.0



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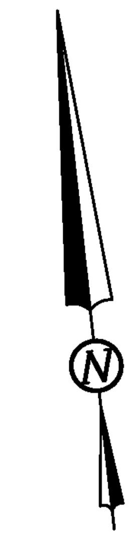
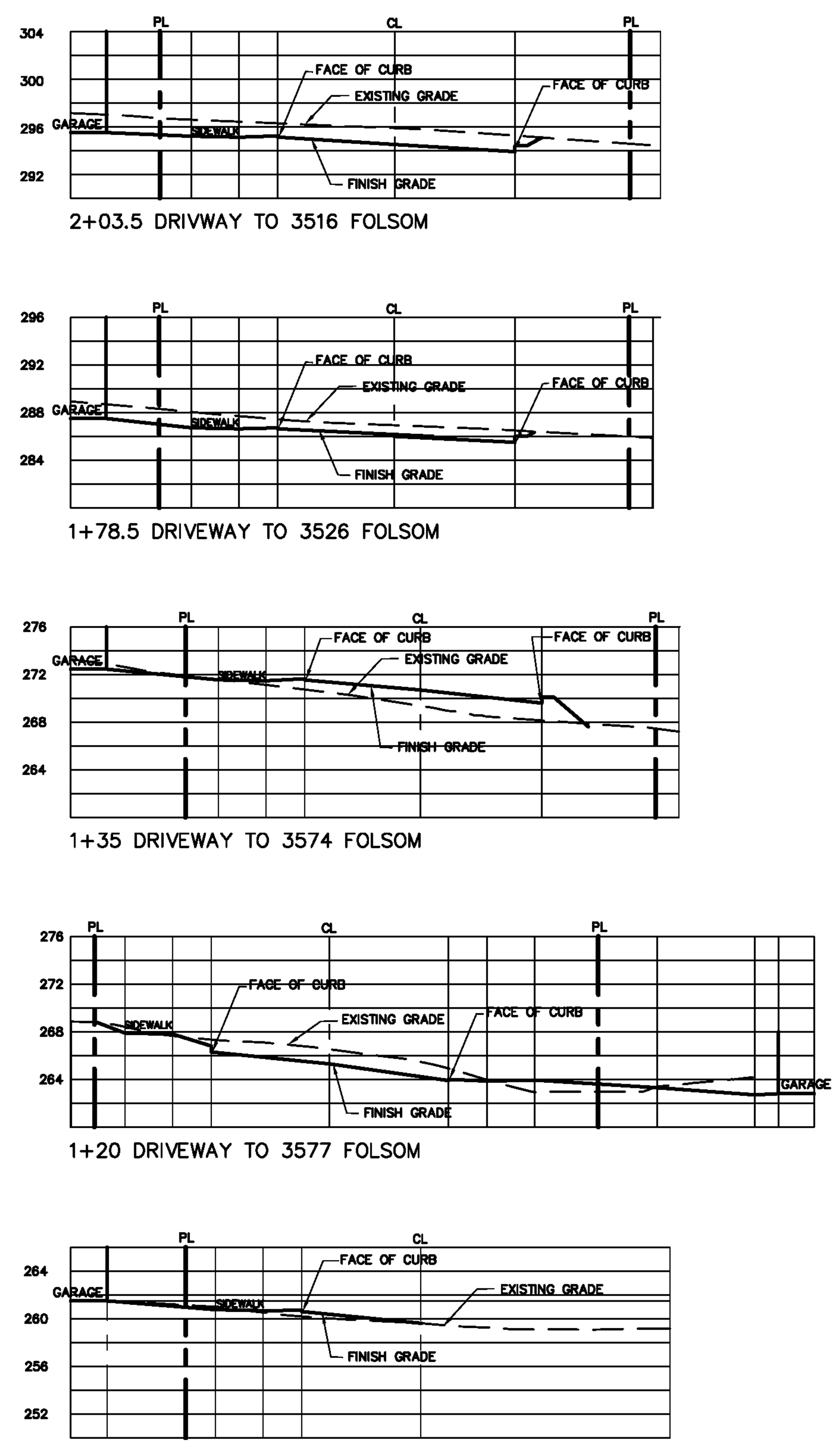
3516 & 3526 FOLSOM STREET
STREET AND UTILITY IMPROVEMENT PLAN
SAN FRANCISCO, CALIFORNIA

ENLARGED GRADING PLAN

DRAWING	FOLSOMCIVIL
F.B. NO.	NA
SCALE	1" = 5'
DATE	AUGUST 2016
REVISIONS	
SHEET NO.	2 OF 4
JOB NO.	F14-373

C2.0

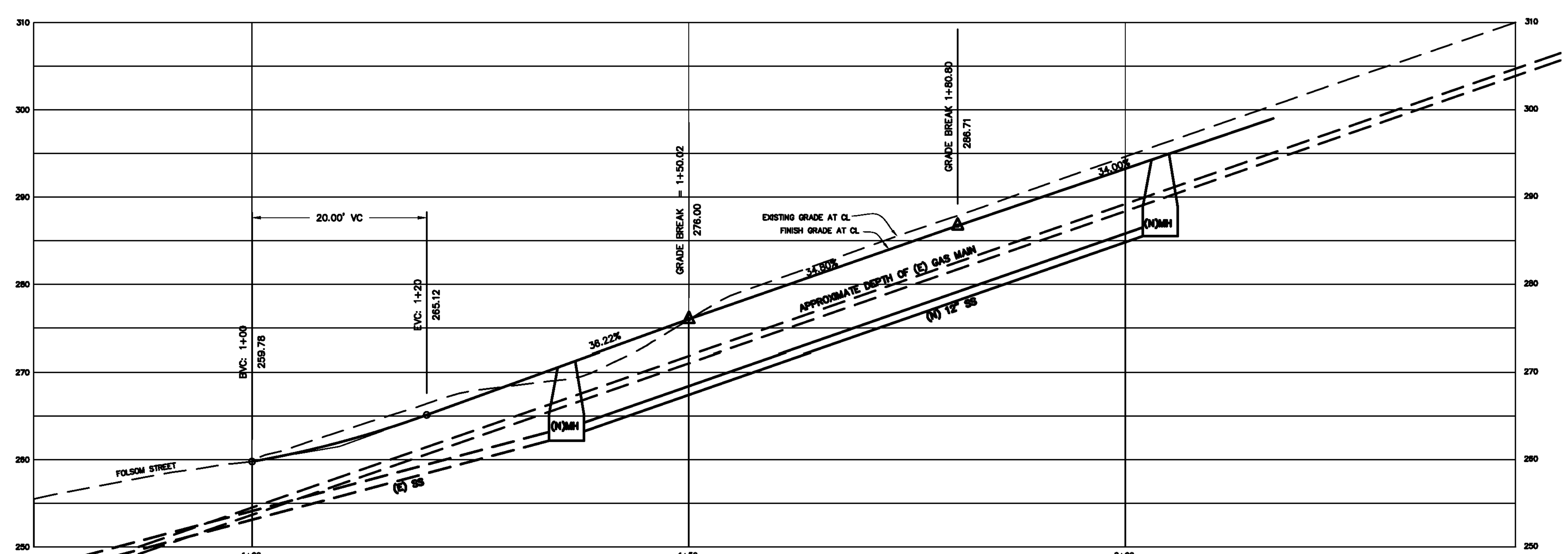




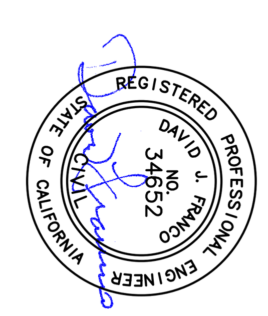
STREET CROSS SECTION
THROUGH EXISTING & PROPOSED DRIVEWAYS

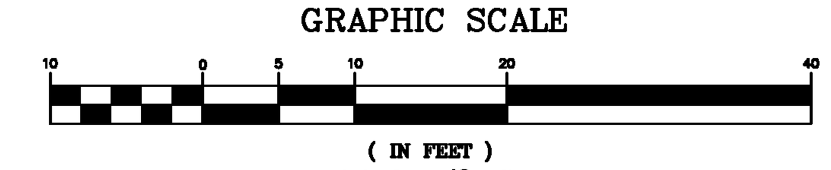
LEGEND

BO	BLOW OFF
BVC	BEGIN VERTICAL CURVE
CL	CENTER LINE
CO	CLEAN OUT
ELEV	ELEVATION
EVC	END VERTICAL CURVE
FL	FLOW LINE
G	GAS
GV	GAS VALVE
INV	INVERT
JT	JOINT SERVICE TRENCH
MH	MAN HOLE
PL	PROPERTY LINE
STA	STATION
SS	SEWER SANITARY & STORM
TC	TOP OF CURB
VC	VERTICAL CURVE
W	WATER
WM	WATER METER
WV	WATER VALVE



CENTER LINE PROFILE





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STREET AND UTILITY IMPROVEMENT PLAN
SAN FRANCISCO, CALIFORNIA

PROFLIE & CROSS SECTIONS PLAN

DRAWING FOLSOMCIVIL

F.B. NO. NA

SCALE 1" = 10'

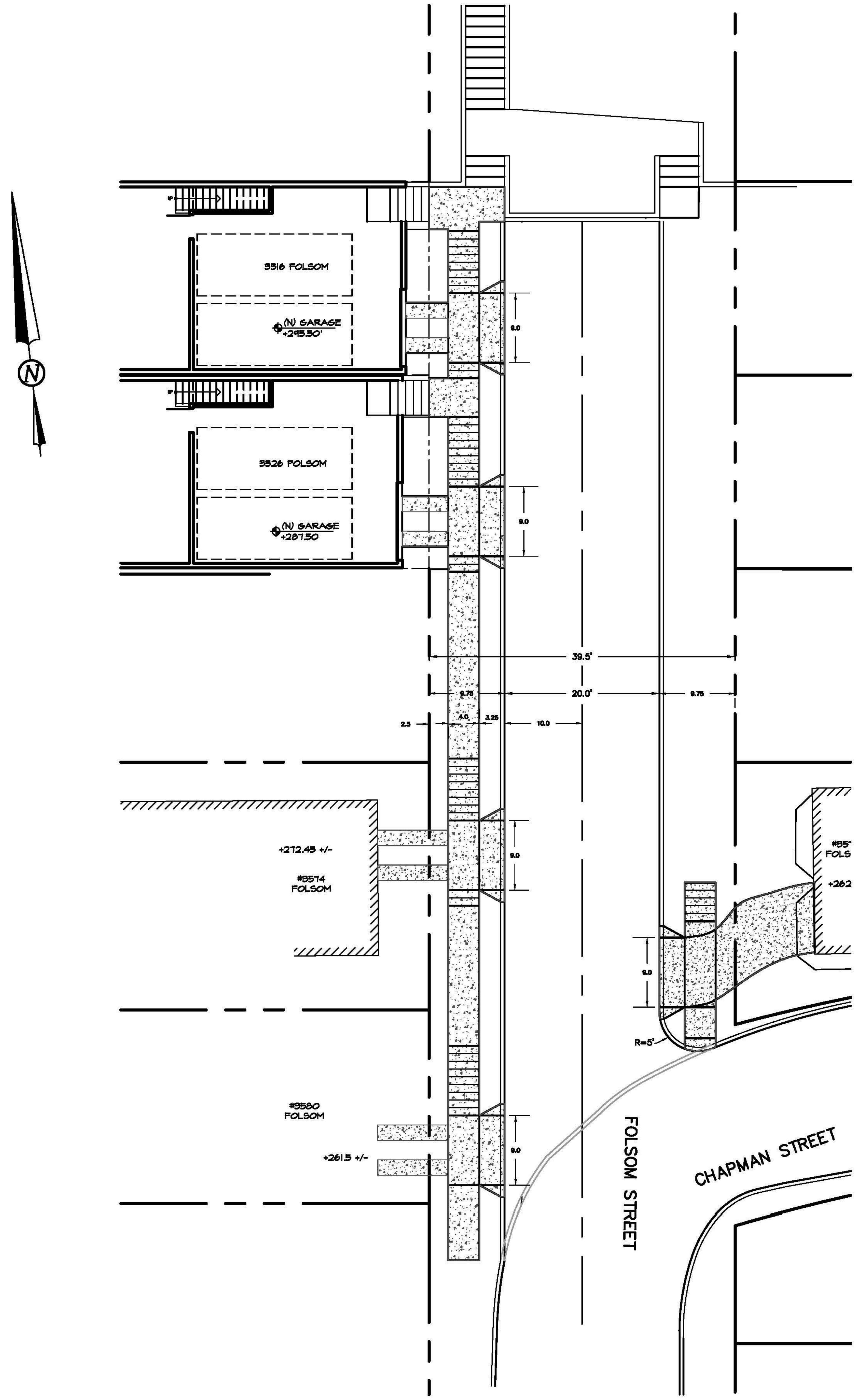
DATE AUGUST 2016

REVISIONS

SHEET NO. 3 OF 4

JOB NO. F14-373

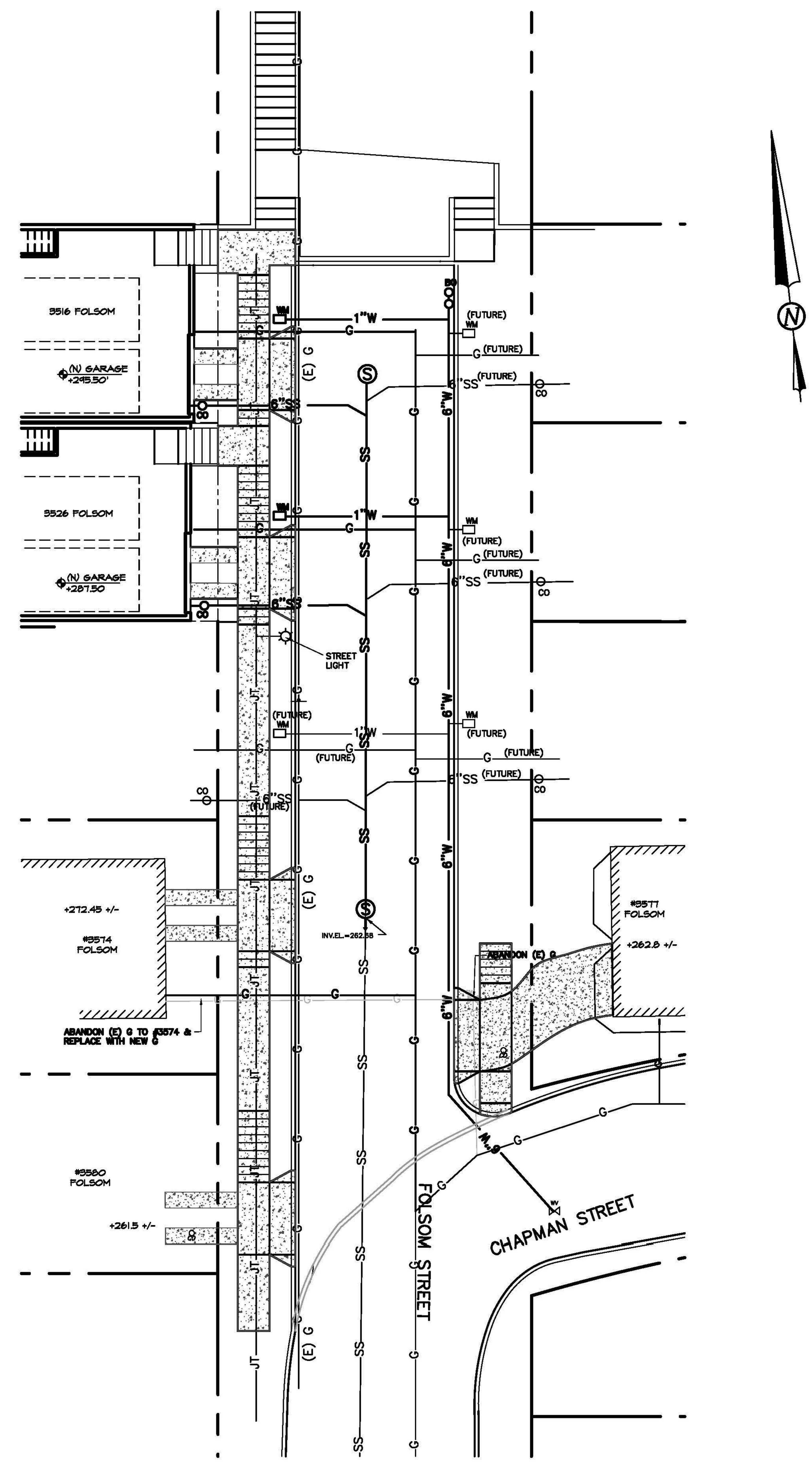
C1.0



DIMENSION PLAN

GRAPHIC SCALE

(IN FEET)
1 inch = 10 ft.



UTILITY PLAN

GRAPHIC SCALE

(IN FEET)
1 inch = 10 ft.

DAVID J. FRANCO
CIVIL ENGINEER
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BERKELEY, CALIFORNIA 94704
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3516 & 3526 FOLSOM STREET
STREET AND UTILITY IMPROVEMENT PLAN
SAN FRANCISCO, CALIFORNIA

UTILITY & DIMENSION PLAN

DRAWING	FOLSOMCIVIL
F.B. NO.	NA
SCALE	1" = 10'
DATE	AUGUST 2016
REVISIONS	
SHEET NO.	4 OF 4
JOB NO.	F14-373

C2.0

EXHIBIT 21

REPORT
GEOTECHNICAL INVESTIGATION
Planned Street and Utility Improvements At 3516 and 3526 Folsom Street San Francisco, California

Prepared for:

Mr. Fabien Lannoye
241 Amber Drive
San Francisco, CA 94131

Prepared by:

H. Allen Gruen
Geotechnical Engineer
360 Grand Avenue, # 262
Oakland, California 94610
(510) 839-0765

Project Number: 17-4702

REGISTERED PROFESSIONAL ENGINEER
H. ALLEN GRUEN
GE2147
EXP. 12-31-2017
GEOTECHNICAL
STATE OF CALIFORNIA

H. Allen Gruen

H. Allen Gruen, C.E., G.E.
Registered Geotechnical Engineer No. 2147

July 6, 2017

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INTRODUCTION

Purpose

A geotechnical investigation has been completed for the proposed street and utility improvements at 3516 and 3526 Folsom Street in San Francisco, California. The purposes of this study have been to gather information on the nature, distribution, and characteristics of the earth materials at the site, assess geologic hazards, and to provide geotechnical design criteria for the planned improvements.

Scope

The scope of my services was outlined in the Proposal and Professional Service Agreement dated April 6, 2017. My investigation included a reconnaissance of the site and surrounding vicinity; sampling and logging one test boring to practical refusal at a depth of 6-½ feet below the ground surface; laboratory testing conducted on selected samples of the earth materials recovered from the boring; a review of published geotechnical and geologic data pertinent to the project area; geotechnical interpretation and engineering analyses; and preparation of this report.

This report contains the results of my investigation, including findings regarding site, soil, geologic, and groundwater conditions; conclusions pertaining to geotechnical considerations such as weak soils, settlement, and construction considerations; conclusions regarding exposure to geologic hazards, including faulting, ground shaking, liquefaction, lateral spreading, and slope stability; and geotechnical recommendations for design of the proposed project including site preparation and grading, foundations, retaining walls, slabs on grade, and geotechnical drainage.

Pertinent exhibits appear in Appendix A. The location of the test boring is depicted relative to site features on Plate 1, Boring Location Map. The log of the test boring is displayed on Plate 2. Explanations of the symbols and other codes used on the log is presented on Plate 3, Soil Classification Chart and Key to Test Data.

References consulted during the course of this investigation are listed in Appendix B. Details regarding the field exploration program appear in Appendix C.

Proposed Street and Utility Improvements

It is my understanding that the project will consist of the design and construction of an extension of Folsom Street and associated utilities. I have reviewed the civil plans, dated August 2016, by David J. Franco Civil Engineer. No other project details are known at this time.

FINDINGS

Site Description

As shown on the Boring Location Map, Plate 1, the project site is located north of the intersection of Folsom and Chapman Streets in San Francisco, California. The topography in the vicinity of the site slopes downward toward the south at an average inclination of about 3-½:1 (horizontal:vertical). At the time of my investigation, the subject site was undeveloped.

Geologic Conditions

The site is within the Coast Ranges Geomorphic Province, which includes the San Francisco Bay and the northwest-trending mountains that parallel the coast of California. Tectonic forces resulting in extensive folding and faulting of the area formed these features. The oldest rocks in the area include sedimentary, volcanic, and metamorphic rocks of the Franciscan Complex. This unit is Jurassic to Cretaceous in age and forms the basement rocks in the region.

Locally, the site is in the San Francisco South Quadrangle (1993). A published geologic map of the area (Bonilla, 1998) shows the area southwest of the site is underlain by colluvial deposits (slope debris and ravine fill) consisting of stony silty to sandy clay and the area northeast of the site is underlain by chert bedrock.

Earth Materials

My boring at the subject site encountered sandy lean clay with gravel from the ground surface to practical refusal at a depth of 6-½ feet. The clay was firm near the ground surface and became stiff to hard with increasing depth. Detailed descriptions of the materials encountered as well as test results are shown on the Boring Log, Plate 2.

Groundwater

Free groundwater was not encountered in my boring to the maximum depth explored of 6-½ feet. It is my opinion that the free groundwater table will be below the planned site excavations. I anticipate that the depth to the free water table will vary with time and that zones of seepage may be encountered near the ground surface following rain or irrigation upslope of the subject site.

CONCLUSIONS

General

On the basis of my site reconnaissance and data review, I conclude that the site is suitable for support of the proposed improvements. The primary geotechnical concerns are founding improvements in competent earth materials and seismic shaking and related effects during earthquakes. These items are addressed below.

Foundation Support

It is my opinion that the planned improvements may be supported on a conventional spread footing foundation bearing in competent earth materials. If the spread footings would cover a substantial portion of the building area, a mat foundation may be used as an alternative to reduce forming and steel bending costs. The Structural Engineer may also choose to use drilled piers to support improvements, or for shoring and underpinning, if required. Detailed foundation design criteria are presented later in this report.

I estimate that improvements supported on foundations designed and constructed in accordance with my recommendations will experience post-construction total settlements from static loading of less than 1 inch with differential settlements of less than ½ inch over a 50-foot span.

Geologic Hazards

Faulting

The property does not lie within an Alquist-Priolo Earthquake Fault Zone as defined by the California Division of Mines and Geology. The closest mapped active fault in the vicinity of the site is the San Andreas Fault, located about 6 miles southwest of the site (CDMG, 1998). No active faults are shown crossing the site on reviewed published maps, nor did I observe evidence of active faulting during my investigation. Therefore I conclude that the potential risk for damage to improvements at the site due to surface rupture from faults to be low.

Earthquake Shaking

Earthquake shaking results from the sudden release of seismic energy during displacement along a fault. During an earthquake, the intensity of ground shaking at a particular location will depend on a number of factors including the earthquake magnitude, the distance to the zone of energy release, and local geologic conditions. I expect that the site will be exposed to strong earthquake shaking during the life of the improvements. The recommendations contained in the applicable Building Code should be followed for reducing potential damage to the improvements from earthquake shaking.

Liquefaction

Liquefaction results in a loss of shear strength and potential volume reduction in saturated granular soils below the groundwater level from earthquake shaking. The occurrence of this phenomenon is dependent on many factors, including the intensity and duration of ground shaking, soil density and particle size distribution, and position of the groundwater table (Seed and Idriss, 1982). The site does not lie within a liquefaction potential zone as mapped by the California Division of Mines and Geology for the City and County of San Francisco (CDMG, 2000). In addition, the earth materials encountered in my boring have a low potential for liquefaction. Therefore, it is my opinion that there is a low potential for damage to the planned improvements from liquefaction.

Lateral Spreading

Lateral spreading or lurching is generally caused by liquefaction of marginally stable soils underlying gentle slopes. In these cases, the surficial soils move toward an unsupported face, such as an incised channel, river, or body of water. Because the site has a low potential for liquefaction, I judge that there is a low risk for damage of the improvements from seismically-induced lateral spreading.

Densification

Densification can occur in clean, loose granular soils during earthquake shaking, resulting in seismic settlement and differential compaction. It is my opinion that earth materials subject to seismic densification do not exist beneath the site in sufficient thickness to adversely impact the planned improvements.

Landsliding

The site is mapped within an area of potential landslide hazard by URS/John A. Blume & Associates (1974). Qualifying projects may be subject to the Slope Protection Act (San Francisco Building Code 106A.4.1.4). The San Francisco Building Code (106A.4.1.4.3) states construction work that is subject to these requirements includes the construction of new buildings or structures having over 1000 square feet of new projected roof area and horizontal or vertical additions having over 1000 square feet of new projected roof area. In addition, these requirements apply to the following activity or activities, if, in the opinion of the Director, the proposed work may have a substantial impact on the slope stability of any property: shoring, underpinning, excavation or retaining wall work; grading, including excavation or fill, of over 50 cubic yards of earth materials; or any other construction activity.

The geologic map of the site vicinity reviewed for this study (Bonilla, 1998) did not show landslides at the subject site. In addition, a map prepared by the California Division of Mines and Geology for the City and County of San Francisco (CDMG, 2000) indicates that the subject site does not lie within an area of potential earthquake-induced landsliding. During his site reconnaissance, my field engineer did not observe evidence of active slope instability at the subject site. Therefore, it is my opinion that the potential for damage to the improvements from slope instability at the site is low provided the recommendations presented in this report are incorporated into the design and construction of the project.

RECOMMENDATIONS

Site Preparation and Grading

General

I drilled boring adjacent to the proposed road extension which encountered bedrock at depths of about 3 to 4 feet. The thickness of soil blanketing the subject site and the depth to bedrock can vary across the site. Design criteria are provided for foundations and retaining walls in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if during construction, soil is observed more than 4 feet below the ground surface at foundation levels, the foundations will need to be deepened to bear in rock, or the foundations will need to be redesigned using the soil values. Likewise, if more than 2 feet of soil than what was anticipated from the boring is being retaining by subsurface walls, the portions of walls supporting the additional soil will need to be designed using the lateral earth pressures for soil conditions.

I assume that the planned improvements will be constructed at or below existing site grades. If site grades are raised by filling more than about 1 foot, I should be retained to calculate the impact of filling on slope stability, site settlements, and foundations.

Clearing

Areas to be graded should be cleared of debris, deleterious materials, and vegetation, and then stripped of the upper soils containing root growth and organic matter. I anticipate that the required depth of stripping will generally be less than 2 inches. Deeper stripping may be required to remove localized concentrations of organic matter, such as tree roots. The cleared materials should be removed from the site; strippings may be stockpiled for reuse as topsoil in landscaping areas or should be hauled off site.

Excavations

Bedrock was encountered in boring drilled adjacent to the subject site at depths of about 3 to 4 feet below the ground surface. I anticipate that excavations in the upper portions of bedrock at the site can be conducted with conventional equipment, although localized ripping may be required. Excavations extending deeper into the bedrock may require extra effort, such as heavy ripping, hoe-rams, or jack-hammering. I anticipate that the bedrock will become harder and more massive with increasing depth.

Overexcavation

Loose, porous soils and topsoil, if encountered, should be overexcavated in areas designated for placement of future engineered fill or support of improvements. Difficulty in achieving the recommended minimum degree of compaction described below should be used as a field criterion by the geotechnical engineer to identify areas of weak soils that should be removed and replaced as engineered fill. The depth and extent of excavation should be approved in the field by the geotechnical engineer prior to placement of fill or improvements.

Subgrade Preparation

Exposed soils designated to receive engineered fill should be cut to form a level bench, scarified to a minimum depth of 6 inches, brought to at least optimum moisture content, and compacted to at least 90 percent relative compaction, in accordance with ASTM test designation D 1557.

Material for Fill

It is anticipated that the on-site soil will be suitable for reuse as fill provided that lumps greater than 6 inches in largest dimension and perishable materials are removed, and that the fill materials are approved by the geotechnical engineer prior to use.

Fill materials brought onto the site should be free of vegetative mater and deleterious debris, and should be primarily granular. The geotechnical engineer should approve fill material prior to trucking it to the site.

Compaction of Fill

Fill should be placed in level lifts not exceeding 8 inches in loose thickness. Each lift should be brought to at least the optimum moisture content and compacted to at least 90 percent relative compaction, in accordance with ASTM test designation D 1557.

Underpinning

During excavations adjacent to existing structures or footings, care should be taken to adequately support the existing structures. When excavating below the level of foundations supporting existing structures, some form of underpinning may be required where excavations extend below an imaginary plane sloping at 1:1 downward and outward from the edge of the existing footings. All temporary underpinning design and construction are the responsibility of the contractor. Earth Mechanics is available to provide consultation regarding underpinning adjacent improvements.

Temporary Slopes

Temporary slopes will be necessary during the planned site excavations. In order to safely develop the site, temporary slopes will need to be laid back in conformance with OSHA standards at safe inclinations, or temporary shoring will have to be installed. All temporary slopes and shoring design are the responsibility of the contractor. Earth Mechanics is available to provide consultation regarding stability and support of temporary slopes during construction. The contractor may choose to excavate test pits to evaluate site earth materials and the need for temporary shoring.

Finished Slopes

In general, finished cut and fill slopes in soil should be constructed at an inclination not exceeding 2:1 (horizontal:vertical). Routine maintenance of slopes should be anticipated. The tops of cut slopes should be rounded and compacted to reduce the risk of erosion. Fill and cut slopes should be planted with vegetation to resist erosion, or protected from erosion by other measures, upon completion of grading. Surface water runoff should be intercepted and diverted away from the tops and toes of cut and fill slopes by using berms or ditches.

Seismic Design

The following seismic design parameters apply:

Site Class C
$S_s = 1.520$, $S_1 = 0.693$
$Fa = 1.0$, $Fv = 1.3$
$SM_s = 1.520$, $SM_1 = 0.901$
$SD_s = 1.013$, $SD_1 = 0.601$

Foundations

General

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for foundations in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if during construction, soil is observed more than 4 feet below the ground surface at foundation levels, the foundations will need to be deepened to bear in rock, or the foundations will need to be redesigned using the soil values.

It is my opinion that the planned improvements may be supported on a conventional spread footing foundation bearing in competent earth materials. If the spread footings would cover a substantial portion of the building area, a mat foundation may be used as an alternative to reduce forming and steel bending costs. The Structural Engineer may also choose to use drilled piers to support improvements, or for shoring and underpinning, if required. Design criteria for each foundation type are presented below.

Spread Footings

Spread footings should extend at least 24 inches below lowest adjacent exterior grade, or 18 inches below lowest adjacent interior grade, whichever is lower. If soft or unstable soil areas are encountered at the bottom of the footings, localized deepening of the footing excavation will be necessary. Footing depths may be reduced if competent bedrock is exposed in footing excavations. Footings should be stepped to produce level tops and bottoms and should be deepened as necessary to provide at least 7 feet of horizontal clearance between the portions of footings designed to impose passive pressures and the face of the nearest slope or retaining wall.

Spread footings bottomed in soil can be designed to impose dead plus code live load bearing pressures and total design load bearing pressures of 2,000 and 3,000 psf, respectively. If foundations are bottomed in bedrock, the footings may be designed for maximum allowable rock contact pressures of 3,500 pounds per square foot (psf) for dead plus sustained live loads, and 5,000 psf for total loads, including wind or seismic forces.

There should be no isolated footing pads. I recommend that all new footings be interconnected and the foundation system should have upslope-downslope elements spaced no more than 20 feet apart. Resistance to lateral pressures can be obtained from passive earth pressures against the face of the footing and soil friction along the base of footings. A passive pressure equivalent to that obtained using a fluid weight of 250 pounds per cubic foot (pcf) and a friction factor of 0.3 may be used to resist lateral forces and sliding in soil. In bedrock, a uniform pressure of 3000 psf and a friction factor of 0.4 times the net vertical dead load may be used for design to resist lateral forces and sliding. These values include a safety factor of 1.5 and may be used in combination without reduction. Passive pressures should be disregarded in areas with less than 7 feet of horizontal soil confinement and for the uppermost 1-foot of foundation depth unless confined by concrete slabs or pavements.

Drilled Piers

Drilled, cast-in-place, reinforced concrete piers should be at least 14 inches in diameter and extend at least 10 feet below grade, or to practical drilling refusal in bedrock. Piers should be designed for a maximum allowable skin friction of 500 psf for combined dead plus sustained live loads in soil. In bedrock, piers should be designed for a maximum allowable skin friction of 1,000 psf for combined dead plus sustained live loads. The above values may be increased by one-third for total loads, including the effect of seismic or wind forces. The weight of the foundation concrete extending below grade may be disregarded. I recommend that all piers be interconnected with grade or tie beams and the foundation system should have upslope-downslope elements spaced no more than 20 feet apart.

Resistance to lateral displacement of individual piers will be generated primarily by passive earth pressures acting on the pier. Passive pressures in soil should be assumed equivalent to those generated by a fluid weighing 250 pcf acting on 2 pier diameters. In bedrock, a passive pressure equivalent to that generated by a uniform pressure of 3000 psf acting on 1.5 pier diameters may be used. Passive pressures should be neglected within 12 inches of the ground surface in areas not confined by slabs or pavements and in areas with less than 7 feet of horizontal confinement. Piers designed to resist lateral loads from retaining walls will reach their maximum lateral load carrying capacity at a depth of 8 times the pier diameter. A practical limit on the pier depth of twice the height of the retaining wall can be used, if less than 8 times the pier diameter.

Where groundwater is encountered during pier shaft drilling, it should be removed by pumping, or the concrete must be placed by the tremie method. If the pier shafts will not stand open, temporary casing may be necessary to support the sides of the pier shafts until concrete is placed. Concrete should not be allowed to free fall more than 5 feet to avoid segregation of the aggregate.

Mat Foundation

A mat foundation may be used to support the planned improvements. The mat can be designed for an average allowable bearing pressure in soil over the entire mat of 2,000 psf for combined dead plus sustained live loads, and 3,000 psf for total loads including wind or seismic forces. The weight of the mat extending below current site grade may be neglected in computing bearing loads. Localized increases in bearing pressures of up to 4,000 psf may be utilized. If the mat is bottomed in bedrock, the mat may be designed for maximum allowable rock contact pressures of 3,500 pounds per square foot (psf) for dead plus sustained live loads, and 5,000 psf for total loads, including wind or seismic forces, with localized increases up to 8,000 psf. For elastic design, a modulus of subgrade reaction for soil of 50 kips per cubic foot and for rock of 200 kips per cubic foot may be used.

Resistance to lateral pressures can be obtained from passive earth pressures against the face of the mat and soil friction along the base of the mat foundation. I recommend that an allowable passive equivalent fluid pressure in soil of 250 pcf and a friction factor of 0.3 times the net vertical dead load be used for design. In bedrock, a uniform pressure of 3000 psf and a friction factor of 0.4 times the net vertical dead load may be used for design to resist lateral forces and sliding. Passive pressures should be disregarded in areas with less than 7 feet of horizontal soil confinement and for the uppermost 1-foot of foundation depth unless confined by concrete slabs or pavements.

Retaining Walls

The thickness of soil blanketing the site and the depth to bedrock can vary across the site. Design criteria are provided for retaining walls in soil and rock. Soil design criteria may be assumed within 4 feet of the current ground surface and rock design criteria may be assumed more than 4 feet below the current ground surface. However, if more than 2 feet of soil than what was anticipated from the boring is being retaining by subsurface walls, the portions of walls supporting the additional soil will need to be designed using the lateral earth pressures for soil conditions.

Retaining walls should be fully backdrained. The backdrains should consist of at least a 3-inch-diameter, rigid perforated pipe, or equivalent such as a "high profile drain", surrounded by a drainage blanket. The pipe should be sloped to drain by gravity to appropriate outlets. Accessible subdrain cleanouts should be provided and maintained on a routine basis. The drainage blanket should consist of clean, free-draining crushed rock or gravel, wrapped in a filter fabric such as Mirafi 140N. The aggregate drainage blanket should be at least 1 foot in width and extend to within 1 foot of the surface. The uppermost 1-foot should be backfilled with compacted native soil to exclude surface water. Alternatively, the drainage blanket could consist of Caltrans Class 2 "Permeable Material" or a prefabricated drainage structure such as Mirafi Miradrain. The backdrain should extend down at least 8 inches below lowest adjacent grade.

Vertical retaining walls that are free to rotate at the top should be designed to resist active lateral soil pressures equivalent to those exerted by a fluid weighing 40 pcf where the backslope is level, and 60 pcf for backfill at a 2:1 (horizontal:vertical) slope. In areas where bedrock is exposed and backfill is placed behind the wall, the structural engineer may use active lateral earth pressures equivalent to those exerted by a fluid weighing 30 pcf where the backslope is level, and 45 pcf for backfill at a 2:1 (horizontal:vertical) slope. If the retaining wall is constructed directly against the bedrock with no backfill, the structural engineer may use active lateral earth pressures equivalent to those exerted by a fluid weighing 20 pcf where the backslope is level, and 26 pcf for backfill at a 2:1 (horizontal:vertical) slope. For intermediate slopes, interpolate between these values. I should be consulted to calculate lateral pressures on retaining walls that are tied-back or braced.

In addition to lateral earth pressures, retaining walls must be designed to resist horizontal pressures that may be generated by surcharge foundation loads applied at or near the ground surface. If a footing surcharge is located above a retaining wall within a horizontal distance of 0.4H, where H is the height of soil retained by the wall, then a horizontal lateral resultant force equal to 0.55 Q_L should be applied to the retaining wall at a height above the base of the wall equal to 0.6H. Q_L equals the equivalent resultant footing line load. This footing surcharge load applies equally to walls that are fixed or free to rotate. As an example, a retaining wall supporting 10 feet of soil has a footing 2 feet away from the top of the wall carrying a line load of 1,000 pounds per lineal foot. This footing is within 0.4H=4 feet of the retaining wall. The resultant horizontal force on the retaining wall from the footing surcharge load would be 0.55x1,000=550 pounds acting 0.6H=6 feet above the base of the retaining wall.

In addition to lateral earth pressures and adjacent footing loads, retaining walls must be designed to resist horizontal pressures that may be generated by surcharge loads applied at or near the ground surface. Where an imaginary 1:1 (H:V) plane projected downward from the outermost edge of a surcharge load intersects a retaining wall, that portion of the wall below the intersection should be designed for an additional horizontal thrust from a uniform pressure equivalent to one-third the maximum anticipated surcharge pressure in soil and one-fourth the maximum anticipated surcharge pressure in rock. In some cases, this value yields a conservative estimate of the actual lateral pressure imposed. I should be contacted if a more precise estimate of lateral loading on the retaining wall from surcharge pressures is desired.

Rigid retaining walls constrained against such movement could be subjected to "at-rest" lateral earth pressures equivalent to those exerted by the fluid pressures listed above plus a uniform load of 6•H pounds per square foot in soil and of 4•H pounds per square foot in rock, where H is the height of the backfill above footing level. Where an imaginary 1:1 (H:V) plane projected downward from the outermost edge of a surcharge load intersects a lower retaining wall, that portion of the constrained wall below the intersection should be designed for an additional horizontal thrust from a uniform pressure equivalent to one-half the maximum anticipated surcharge pressure in soil and one-third the maximum anticipated surcharge pressure in rock. In some cases, this value yields a conservative estimate of the actual lateral pressure imposed. I should be contacted if a more precise estimate of lateral loading on the retaining wall from surcharge pressures is desired.

A seismic pressure increment equivalent to a rectangular pressure distribution of 5H in psf may be used, where H is the height of the soil retained in feet.

Wall backfill should consist of soil that is spread in level lifts not exceeding 8 inches in thickness. Each lift should be brought to at least optimum moisture content and compacted to not less than 90 percent relative compaction, per ASTM test designation D 1557. Retaining walls may yield slightly during backfilling. Therefore, walls should be properly braced during the backfilling operations.

Where migration of moisture through retaining walls would be detrimental or undesirable, retaining walls should be waterproofed as specified by the project architect or structural engineer.

Retaining walls should be supported on footings designed in accordance with the recommendations presented above. A minimum factor of safety of 1.5 against overturning and sliding should be used in the design of retaining walls.

Slab-on-Grade Floors

The subgrade soil in slab and flatwork areas should be proof rolled to provide a firm, non-yielding surface. If moisture penetration through the slab would be objectionable, slabs should be underlain by a capillary moisture break consisting of at least 4 inches of clean, free-draining crushed rock or gravel graded such that 100 percent will pass the 1-inch sieve and none will pass the No. 4 sieve. Further protection against slab moisture penetration can be provided by means of a moisture vapor barrier membrane, placed between the drain rock and the slab. The membrane may be covered with 2 inches of damp, clean sand to protect it during construction.

Additional protection against moisture seepage into subsurface levels may be provided by installing a slab underdrain system. If selected, the slab underdrain system would consist of trenches, which are at least 12 inches deep and 6 inches wide, spaced no further than 10 feet apart beneath the floor slab. The bottoms of the trenches should slope to drain to a low-point by gravity. A 3-inch diameter, rigid perforated pipe should be placed near the bottom of the trench which is fully encapsulated in drain rock. The drainrock should be fully encapsulated in an approved filter fabric. The perforated pipes should be tied to closed conduits which outlet at appropriate discharge points.

Site Drainage

Positive drainage should be provided away from the improvements. Roof downspouts should discharge into closed conduits that drain into the site storm drain system. Surface drainage facilities (roof downspouts and drainage inlets) should be maintained entirely separate from subsurface drains (retaining wall backdrains and underslab drains). Drains should be checked periodically, and cleaned and maintained as necessary to provide unimpeded flow.

Supplemental Services

Earth Mechanics recommend that I be retained to review the project plans and specifications to determine if they are consistent with my recommendations. In addition, I should be retained to observe geotechnical construction, particularly site excavations, placement of retaining wall backdrains, fill compaction, and excavation of foundations, as well as to perform appropriate field observations and laboratory tests.

If, during construction, subsurface conditions different from those described in this report are observed, or appear to be present beneath excavations, I should be advised at once so that these conditions may be reviewed and my recommendations reconsidered. The recommendations made in this report are contingent upon my notification and review of the changed conditions.

If more than 18 months have elapsed between the submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at or adjacent to the site, the recommendations of this report may no longer be valid or appropriate. In such case, I recommend that I review this report to determine the applicability of the conclusions and recommendations considering the time elapsed or changed conditions. The recommendations made in this report are contingent upon such a review.

These services are performed on an as-requested basis and are in addition to this geotechnical investigation. I cannot accept responsibility for conditions, situations or stages of construction that I are not notified to observe.

LIMITATIONS

This report has been prepared for the exclusive use of Fabien Lannoye and James Fogarty and their consultants for the proposed project described in this report.

My services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. I provide no other warranty, either expressed or implied. My conclusions and recommendations are based on the information provided us regarding the proposed construction, the results of my field exploration and laboratory testing programs, and professional judgment. Verification of my conclusions and recommendations is subject to my review of the project plans and specifications, and my observation of construction.

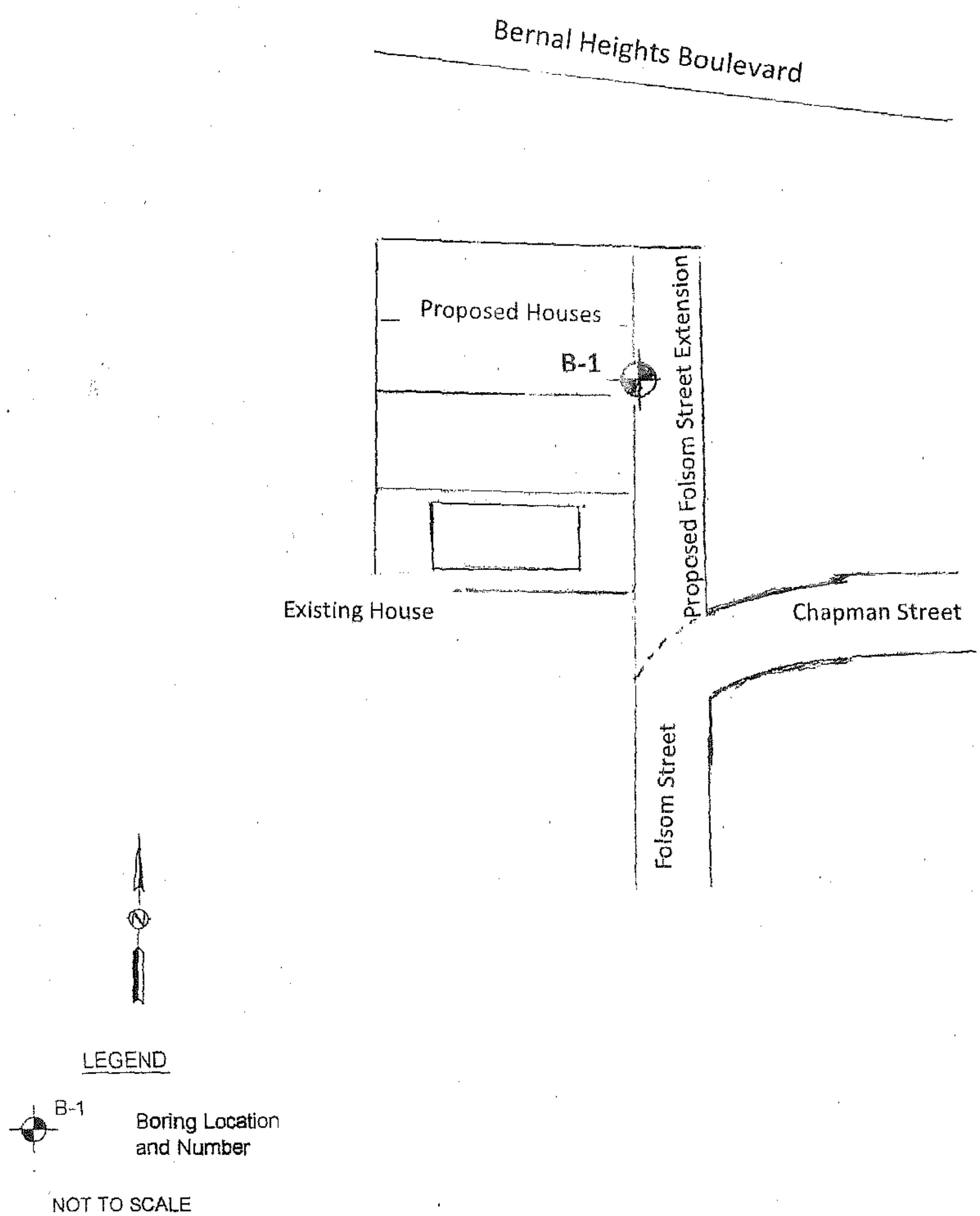
The test boring log represents subsurface conditions at the location and on the date indicated. It is not warranted that it is representative of such conditions elsewhere or at other times. Site conditions and cultural features described in the text of this report are those existing at the time of my field exploration, conducted on May 10, 2017, and may not necessarily be the same or comparable at other times.

The location of the test boring was established in the field by reference to existing features and should be considered approximate only.

The scope of my services did not include an environmental assessment or an investigation of the presence or absence of hazardous, toxic, or corrosive materials in the soil, surface water, groundwater or air, on or below, or around the site, nor did it include an evaluation or investigation of the presence or absence of wetlands.

APPENDIX A

List of Plates



H. Allen Gruen Geotechnical Engineer	Job. No: 17-4702 Appr: Drwn: LPDD Date:	BORING LOCATION MAP 3516 and 3526 Folsom Street San Francisco, California	PLATE 1

Location of Boring:	
Project: 3516 FOLSOM ST	Boring No.: 1
	Total Depth: 6.5
Job No.: 17-4702	Logged By: KJ
Proj. Mgr.: AG	Date: 5-10-17
Drilling Contractor: ACCESS	
Hammer Wt.: 140	Drop: 30

Water Depth (ft.):			
Time:			
Date:			

Backfilled, Time: Date: By:

Surface Elev.: Datum:

Conditions:

Sample Depth	Sampler Type	Blows/Foot	Inches Driven	Inches Recovered	Sample Condition	Pocket Penetrometer Shear Strength (KSF)	Moisture Content (%)	Dry Density (PSF)	% Passing #200 Sieve	Depth in Feet	Graphic Log	Description
										1		Brown Sandy LEAN CLAY (CL) with
	S+H	6								2		gravel, firm, moist
										3		
	S+H	12								4		- stiff
	2"	50								5		- Hard
										6		
	SPT	92										
										7		Refusal @ 6.5"
										8		
										9		No Free Water Encountered
										10		
										11		
										12		
										13		
										14		
										15		
										16		
										17		
										18		
										19		
										20		

H. Allen Gruen
Geotechnical Engineer

Job No: 17-4702
Appr:
Drwn: LPDD
Date: 5-10-17

LOG OF BORING 1

3516 and 3526 Folsom Street

San Francisco, California

PLATE 2

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

Shear Strength, psf
Confining Pressure, psf

Consol	Consolidation	Tx	2630 (240)	Unconsolidated Undrained Triaxial
LL	Liquid Limit (in %)	Tx sat	2100 (575)	Unconsolidated Undrained Triaxial, saturated prior to test
PL	Plastic Limit (in %)	DS	3740 (960)	Unconsolidated Undrained Direct Shear
PI	Plasticity Index	TV	1320	Torvane Shear
Gs	Specific Gravity	UC	4200	Unconfined Compression
SA	Sieve Analysis	LVS	500	Laboratory Vane Shear
■	Undisturbed Sample (2.5-inch ID)	FS	Free Swell	
◪	2-inch-ID Sample	EI	Expansion Index	
◩	Standard Penetration Test	Perm	Permeability	
⊠	Bulk Sample	SE	Sand Equivalent	

KEY TO TEST DATA

H. Allen Gruen
Geotechnical Engineer

Appr:
Drwn: LPDD
Date:

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

3516 and 3526 Folsom Street
San Francisco, California

PLATE
3

APPENDIX B

List of References

1. Bonilla, M. G., 1998, *Preliminary Geologic Map of the San Francisco South 7.5' Quadrangle and Part of the Hunters Point 7.5' Quadrangle, San Francisco Bay Area, California*, United States Geological Survey Open-File Report OF-98-354, Scale 1:24,000.

2. California Department of Conservation, Division of Mines and Geology, 1998, *Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada.*

3. CDMG, 2000, State of California Seismic Hazards Zones, City and County of San Francisco, California Division of Mines and Geology.

4. Seed, H. B., and Idriss, E., 1982, *Ground Motion and Soil Liquefaction During Earthquakes*, Earthquake Engineering Research Institute Monograph.

5. United States Geological Survey, 1993, San Francisco South Quadrangle, 7.5 Minute Series, Scale 1:24,000.

APPENDIX C

Field Exploration

My field exploration consisted of a geologic reconnaissance and subsurface exploration by means of one test boring that was logged by my Engineer on May 10, 2017. The test boring was drilled with a hand carried, portable drill rig utilizing continuous flight, 4-inch-diameter augers. The boring was drilled at the approximate location shown on Plate 1.

The log of the test boring is displayed on Plate 2. Representative undisturbed samples of the earth materials were obtained from the test boring at selected depth intervals with a 1.4-inch inside diameter, split-barrel Standard Penetration Test (SPT) sampler, a 2-inch inside diameter, split-barrel sampler, and a 2.5-inch inside diameter, modified California sampler.

Penetration resistance blow counts were obtained by dropping a 140-pound hammer through a 30-inch free fall. The sampler was driven 24 inches or less and the number of blows was recorded for each 6 inches of penetration. The blows per foot recorded on the Boring Log represent the accumulated number of blows that were required to drive the sampler the last 12 inches or fraction thereof.

The soil classifications are shown on the Boring Log and referenced on Plate 3.

Laboratory Testing

Natural water contents and percentages of gravel, sand, and fines were determined on selected soil samples recovered from the test boring. The data are recorded at the appropriate sample depths on the Boring Log.

APPENDIX D

Distribution

Mr. Fabien Lannoye (4 wet signed and stamped originals)

241 Amber Drive
San Francisco, CA 94131
jfogarty@sonic.net
Fabien@bluorange.com

From:	fabien@bluorange.com
To:	BOS Legislation, (BOS)
Cc:	Olson, Charles; Givner, Jon (CAT); Stacy, Kate (CAT); Byrne, Marlena (CAT); Rahaim, John (CPC); Sanchez, Scott (CPC); Gibson, Lisa (CPC); Navarrete, Joy (CPC); Lynch, Laura (CPC); Rodgers, AnMarie (CPC); Starr, Aaron (CPC); Horner, Justin (CPC); Ionin, Jonas (CPC); Calvillo, Angela (BOS); Somera, Alisa (BOS); BOS-Supervisors; BOS-Legislative Aides; Smith, Diana; Jalipa, Brent (BOS); Lew, Lisa (BOS)
Subject:	Re: SUPPLEMENTAL APPEAL LETTER: Mitigated Negative Declaration Appeal - Proposed Project at 3516 and 3526 Folsom Street - Appeal Hearing on September 12, 2017
Date:	Tuesday, September 12, 2017 12:16:57 PM
Attachments:	ILLINGWORTHandRODKIN-Memo Reply to Opinions 12Sep17-1.pdf

Good morning,

Please find attached a letter in response to the Appellants' letter
filed late yesterday.
Please add this letter to the files for the proposed Project at 3516 and
3526 Folsom Street - Appeal Hearing on September 12, 2017, Board of
Supervisors File No 170851.

Thank you.

Fabien Lannoye
Project sponsor

On 2017-09-11 19:22, BOS Legislation, (BOS) wrote:
> Good afternoon,
>
> Please find linked below a letter received by the Office of the Clerk
> of the Board from Ryan J. Patterson of Zacks, Freedman & Patterson, on
> behalf of the Appellants, regarding the appeal of the Mitigated
> Negative Declaration under CEQA for the proposed project at 3516 and
> 3526 Folsom Street.
>
> Supplemental Appeal Letter - September 11, 2017 [1]
>
> THE APPEAL HEARING FOR THIS MATTER IS SCHEDULED FOR A 3:00 P.M.
> SPECIAL ORDER BEFORE THE BOARD ON SEPTEMBER 12, 2017.
>
> Please Note: Our office received the above letter after the
> compilation of material for this hearing, and is not included in the
> Agenda Packet [2] for September 12, 2017. Copies will be distributed
> during the Board meeting, and will be included in the file as
> post-packet material.
>
> I invite you to review the entire matter on our Legislative Research
> Center [3] by following the link below:
>
> Board of Supervisors File No. 170851 [4]
>
> Regards,
>
> BRENT JALIPA
>

> LEGISLATIVE CLERK
>
> Board of Supervisors - Clerk's Office
>
> 1 Dr. Carlton B. Goodlett Place, Room 244
>
> San Francisco, CA 94102
>
> (415) 554-7712 | Fax: (415) 554-5163
>
> brent.jalipa@sfgov.org | www.sfbos.org [5]
>
> _ [6]   Click here [6] to complete a Board of Supervisors Customer
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> _DISCLOSURES:__ Personal information that is provided in
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> its committees. All written or oral communications that members of the
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> information from these submissions. This means that personal
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> information that a member of the public elects to submit to the Board
> and its committees--may appear on the Board of Supervisors' website or
> in other public documents that members of the public may inspect or
> copy._
>
> Links:
> ------
> [1]
> https://sfgov.legistar.com/View.ashx?M=F&ID=5416185&GUID=072EB373-C206-49CF-A8A1-E50287DC712E
> [2]
> https://sfgov.legistar.com/View.ashx?M=F&ID=5413976&GUID=3CAB4717-82BF-450F-9B31-505168D26F15
> [3] http://www.sfbos.org/index.aspx?page=9681
> [4]
> https://sfgov.legistar.com/LegislationDetail.aspx?ID=3112108&GUID=92A77E18-D666-4014-949C-84CCA25A088F&Options=ID|Text|&Search=170851
> [5] http://emailmg.ipage.com/www.sfbos.org
> [6] http://www.sfbos.org/index.aspx?page=104

Item #25
9/12/17
Project Sponsor Letter
Received 12:17pm

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality
1 Willowbrook Court, Suite 120
Petaluma, California 94954
Tel: 707-794-0400 *Fax: 707-794-0405*
www.Illingworthrodkin.com *illro@illingworthrodkin.com*

RECEIVED AFTER THE ELEVEN-DAY DEADLINE, BY NOON, PURSUANT TO ADMIN. CODE, SECTION 31.16(b)(5)
(Note: Pursuant to California Government Code, Section 65009(b)(2), information received at, or prior to, the public hearing will be included as part of the official file.)

Date: September 12, 2017

To: Fabien Lannoye
Bluorange Designs
241 Amber Drive
San Francisco, CA 94131

From: Paul R. Donavan, Sc.D.
Illingworth & Rodkin, Inc.
1 Willowbrook Court, Suite 120
Petaluma, CA 94954

Subject: Reply to Opinions of Engineering Design & Testing Corp. Regarding the Construction Vibration Evaluation for 3516 and 3526 Folsom Street

I reviewed the opinions expressed by Mr. Ridings and Mr. Viani regarding my memo Construction Vibration Evaluation for 3516 and 3526 Folsom Street dated March 24, 2017. I have copied their specific opinions below and show my responses directly below in *italics*.

Opinion:
The vibrations were from explosives, not continuously vibrating equipment. It is understood that explosives are not planned for this project. Continuous vibrations impart cyclical loads on the pipe. The Caltrans documents suggest that acceptable PPV values for continuous vibrations are half of acceptable values for surface blasting.

Response: The vibration values reported in Table 2 of the March 24, 2017 Illingworth and Rodkin, Inc. (I&R) memo are for continuous operations for construction equipment, not blasting. The Caltrans criteria cited are for continuous construction equipment operation.

Opinion:
In the Caltrans report referenced in the Vibration Evaluation where no damage was observed when blasting vibration levels were at certain levels, there is no description as to the type of damage that was not observed or how it was determined that there was no damage. Was the pipe dug up and examined to see whether the pipe had bent? Was the determination of no damage made because no leaks were observed? Steel pipe can be damaged, compromising its strength, without immediately detectable leakage. No correlation is shown between the types of damages that were not observed in the referenced reports on the one hand, and the type of damage to LI 09 that may expected with elevated vibration levels on the other hand. Because a comparison of what constitutes damage was not made, the Caltrans report data is not a valid reference.

Response: The Caltrans "report" is actually a Vibration Guidance Manual which is a compilation of information from many sources shown on Page 76 in Table 22. The table includes a statement of "effect" for various applications which give details such as "radial cracks develop in concrete" and "shafts misaligned", etc. For the two cases that pertain to explosions near buried pipe, the observation is simply "no damage". This taken mean that no damage occurred of any kind.

Opinion:
The operating conditions, commodity and pipe specifications were not listed in the Caltrans report. Ll 09 at the Project location is a 26-inch diameter steel pipe with a maximum operating pressure (MAOP) of 150 psig and at MAOP is at a 19.8% of the pipe's specified minimum yield strength. A higher stressed pipe will become damaged at a lower value PPV than a lower stressed pipe. There was no mention of operating stress levels of the pipes in the Caltrans report. Because a correlation between the operating stress levels in the Caltrans report pipes and LI09 was not made, the Caltrans report data again is not a valid reference.

Response: See above. Again the Caltrans document is not a report but rather a State of California Guidance Document. PG&E stated that 150 psig is the maximum allowable operating pressure and that it would take a pressure of at least 750 psig to cause the steel pipe to deform. This implies that line 109 is not a "higher stressed" pipe.

Opinion:
The Spectra project involved surface explosions, different operating stress levels in the pipe than Ll09, and because the Spectra project involved the installation of new pipe, the physical condition of the pipe was known. Although PG&E may have inspection documents that show the physical condition of portions of Ll 09 in the Project and adjoining area, this information was not used in the Vibration Evaluation. This section of L109 was installed in 1981 and the slope of the hill is steep. The slope in the project area is reported to be 28%. The slope of the hill from the north end of the project to Bernal Heights Road visually appears to be even steeper. Slippage of the pipe, localized corrosion, or impact damage may have taken place since 1981 and increased the stress levels in the pipe. It cannot be assumed that what was acceptable to the pipe in the Spectra project is acceptable for L109. As with the Caltrans reports, a correlation was not made between stress levels in the pipe. Further, the Spectra project involved installation of new pipe in what appears to be a nearly horizontal street. The Vibration Evaluation did not take into consideration the physical condition ofL109 or bending stresses that may exist with the changes in grade.

The Spectra analysis is inapplicable to the Project, and it is an inadequate basis for designing Project mitigation measures that will reduce Project impacts to a level of insignificance.

Response: The West Roxbury project was for explosions, not construction vibration. This citation was used a point of reference and not intended to be a criteria for the Folsom Street project. The calculated velocities are based on established ground vibration values for various type of construction equipment and these are at or below the criterion for industrial buildings. From the PG&E testing routinely done on gas transmission lines, there appears to be no special concerns for L190.

Opinion:
Based on the above, the Vibration Evaluation is not complete nor is it representative of this project and is not appropriate to use as a basis for determining safe levels of vibration to LI09.

Since the Vibration Evaluation is not complete or representative, it cannot be used as a reference or comparison to validate PG&E's maximum vibration level of 2 ips. PG&E did not provide a basis for their PPV value of 2 ips and it does not appear that they were they asked to provide one. As a result, there is no basis for any of the maximum vibration levels in the Vibration Evaluation and MND.

Response: Construction Vibration Evaluation for 3516 and 3526 Folsom Street is complete and representative of the project based on the equipment listed by the applicant and the accepted vibration levels associated with them. There is no reference to PG&E maximum vibration limit of 2 in/s. A PPV value of 2 in/s was cited based on that for industrial buildings.

Opinion:
For example, compaction of the street above L109. PG&E's March 30, 2017 letter to the San Francisco Planning Department states that the depth of cover over L109 could be as shallow as 24 inches. Per the Grading Plan prepared by David Franco dated 9/21/16 indicates that roadway excavation is estimated to be 12-inches. Placement and compaction of subgrade and/or base rock will require the use of compaction equipment. For example, using the Vibration Evaluation value of 0.21 ips at 25 feet for a vibratory compactor from the Illingsworth March 24, 2017 report titled "Construction Vibration Evaluation for 3516 and 3526 Folsom Street", with the compactor 3.3 feet away from the pipe, the PPV at the pipe is calculated to be 4.3 ips. With the compactor 1 foot above the pipe, the PPV is calculated to be 26.26 ips. This PPV level is significantly higher than the 2.0 ips that PG&E has said is acceptable. Although the basis for PG&E' s level has not been made known, it is reasonable to believe that significantly higher levels, such as 26.26 ips will damage L109, which may result in a catastrophic release of natural gas from L109.

Response: The use of a vibratory compactor is not planned for this project. As the street extension will be constructed from portland cement concrete.

Paul R, Donavan, Sc.D.
Principal
Illingworth & Rodkin, Inc.

From: Smith, Diana
To: BOS Legislation, (BOS)
Cc: Olson, Charles; Givner, Jon (CAT); Stacy, Kate (CAT); Byrne, Marlena (CAT); Rahaim, John (CPC); Sanchez, Scott (CPC); Gibson, Lisa (CPC); Navarrete, Joy (CPC); Lynch, Laura (CPC); Rodgers, AnMarie (CPC); Starr, Aaron (CPC); Horner, Justin (CPC); Ionin, Jonas (CPC); Calvillo, Angela (BOS); Somera, Alisa (BOS); BOS-Supervisors; BOS-Legislative Aides; Jalipa, Brent (BOS); Lew, Lisa (BOS); fabien@bluorange.com; Lee, Carolyn
Subject: Proposed Project at 3516 and 3526 Folsom Street - Appeal Hearing on September 12, 2017
Date: Tuesday, September 12, 2017 1:14:20 PM
Attachments: 3516-3526 Folsom - Letter to Board of Supervisors - September 12, 2017.pdf

---

Hello,

On behalf of Charles Olson, please find a letter regarding the proposed project at 3516 and 3526 Folsom Street attached.

Sincerely,
Diana

Diana Smith | Legal Assistant | **LUBIN OLSON**
Lubin Olson & Niewiadomski LLP | The Transamerica Pyramid | 600 Montgomery Street, 14th Floor | San Francisco, CA 94111
Phone: (415) 981-0550 | Facsimile: (415) 981-4343 | www.lubinolson.com | Email: dsmith@lubinolson.com

---

Item #25
9/12/17
Project Sponsor Letter
Received 1:14pm

LUBIN | OLSON
LUBIN OLSON & NIEWIADOMSKI LLP

THE TRANSAMERICA PYRAMID
600 MONTGOMERY STREET, 14TH FLOOR SAN FRANCISCO, CALIFORNIA 94111
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CHARLES R. OLSON
Direct Dial: (415) 955-5020
E-mail: colson@lubinolson.com

September 12, 2017

RECEIVED AFTER THE ELEVEN-DAY DEADLINE, BY NOON, PURSUANT TO ADMIN. CODE, SECTION 31.16(b)(5)
(Note: Pursuant to California Government Code, Section 65009(b)(2), information received at, or prior to, the public hearing will be included as part of the official file.)

VIA HAND DELIVERY

President London Breed
c/o Angela Calvillo, Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place
City Hall, Room 244
San Francisco, CA 94102

RE: Appeal of CEQA Mitigated Negative Declaration ("MND")
Planning Case No. 2013.1383ENV
Building Permit Application Nos. 2013.12.16.4318 and 2013.12.16.4322
3516-3526 Folsom Street ("Project Site")

Dear President Breed and Honorable Members of the Board of Supervisors:

This letter supplements our prior letter to the Board of Supervisors dated September 1, 2017, on behalf of the Project Sponsors for 3516 and 3526 Folsom Street in order to address the last-minute supplemental letter filed by the Appellants on September 11, 2017.

Once again, Appellants seek to delay the Project by presenting yet more "expert" opinions challenging the adequacy of the City's CEQA review after the Planning Commission's unanimous adoption of a Mitigated Negative Declaration (the "MND") on June 15, 2017. As these "expert" opinions attempt to poke holes in the analysis contained in the March 24, 2017 Vibration Evaluation by Illingworth & Rodkin, Inc., and the MND that was published on April 19, 2017, there can be no doubt as to the motives of the Appellants in filing their letter less than 24 hours prior to the Board's hearing of their appeal. The Vibration Evaluation has been in the public record for the past five and a half months, and the MND for the past four and half months. However, these "expert" opinions by Mr. Ridings and Mr. Viani still present no substantial evidence to support a fair argument that the Project may have a significant effect on the environment. Mitigation Measure M-NO-3: Vibration Management Plan fully complies with CEQA requirements and will ensure that construction of the Project would not have a significant effect on the PG&E pipeline.

First, Mr. Ridings and Mr. Viani err by misstating factual information about the Vibration Evaluation by attempting to cast doubt on references to Caltrans criteria and making purely speculative comments on the use of inappropriate construction equipment. In fact, the vibration values cited in the Vibration Evaluation are for continuous construction equipment operation, not blasting. Furthermore, the Vibration Evaluation was accurately based on the equipment that the General Contractor and its subcontractors intend to use during the construction of the Project. Second, in response to Opinion 2 of Mr. Ridings and Mr. Viani's letter regarding compaction of the street above the PG&E pipeline, using a vibration compactor is out of the question because there are other construction methods and other uses of materials that do not require compaction, which is why it was not included in the Project Sponsors' proposed list of construction equipment. PG&E typically uses a method called "plate wacker," which would achieve 95% compaction as required by the Project. There are also other methods, like hydraulic water jet compaction or other use of materials that do not require compaction, like pouring a slurry or other similar materials. Third, Opinion 4 of Mr. Ridings and Mr. Viani's letter is purely speculative in its discussion on the depth of cover, and will not be ascertained until the Project Sponsor undergoes potholing in the street. Fourth, Mr. Ridings and Mr. Viani ignore the analysis presented in the MND and the fact that Mitigation Measure M-NO-3 adequately addresses vibration effects by providing continuous monitoring of vibration levels. Any demolition or construction work that is done within 10 feet of the PG&E pipeline must be done with on-site PG&E supervision. If vibration levels on the PG&E pipeline exceed 2 ips, then all construction must stop. The construction methods and the Project will still be reviewed and approved by PG&E engineers, and will be subject to its regulations concerning work in proximity to a pipeline. In addition, the Planning Department and the Department of Building Inspection are responsible for the enforcement of Mitigation Measure M-NO-3. Appellants still fail to present any substantial evidence that calls into question the oversight that two public agencies, completely independent from the Project Sponsors, will provide to the Project.

The opinions from Mr. Ridings and Mr. Viani do not provide substantial evidence requiring the preparation of an environmental impact report. The Project Sponsors once again respectfully request that the Board reject this appeal and uphold the Planning Department's adoption of the MND.

Sincerely,

Charles R Olson

Charles R. Olson

cc: Fabien Lannoye and Anna Limkin
James Fogarty and Patricia Fogarty
Joy Navarrete, Planning Department, Environmental Planner
Justin Horner, Planning Department, Environmental Planner

ZACKS, FREEDMAN & PATTERSON
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235 Montgomery Street, Suite 400
San Francisco, California 94104
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www.zfplaw.com

September 11, 2017

VIA HAND DELIVERY AND EMAIL

President London Breed
c/o Angela Calvillo, Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place
City Hall, Room 244
San Francisco, CA 94102

Re: Appeal of CEQA Mitigated Negative Declaration
Planning Case No. 2013.1383ENV
Building Permit Application Nos. 2013.12.16.4318 and 2013.12.16.4322
3516 and 3526 Folsom Street ("Project Site")

Dear President Breed and Honorable Members of the Board of Supervisors:

Please find the following document enclosed:

Exhibit

O. Independent Evaluation of the San Francisco Planning Department Mitigated Negative Declaration, prepared by Engineering Design & Testing Corp. (Kenneth Ridings, P.E. and Steve Viani, P.E.), Sept. 11, 2017

The reviewing engineers conclude:

> As a result of these deficiencies in the MND, a significant possibility of a catastrophic release of natural gas from L109 during construction of the Project still exists. . . . **Based on our review and analysis, it is our expert opinion that there still exists a high risk that has not been mitigated based on our review of the MND. It is our opinion the failure to mitigate the risks are significant and a potential for damage and explosion of PG&E's gas transmission pipeline L109 still exists.** (Report, pp. 4, 10.)

Without question, this report constitutes substantial evidence requiring the preparation of an environmental impact report (EIR). A mitigated negative declaration cannot be adopted unless "there is **no substantial evidence** in light of the whole record before the public agency that the project, as revised, **may** have a significant effect on the environment." (Pub. Resources Code, § 21064.5 (emphasis added).)

"If the administrative record before the agency contains substantial evidence that the project may have a significant effect on the environment, **it cannot adopt a negative declaration**; it must go to on the third stage of the CEQA process: preparation and certification of an EIR." (Gentry v. City of Murrieta (1995) 36 Cal.App.4th 1359, 1372, as modified on denial of reh'g (Aug. 17, 1995) (emphasis added), citing Pub. Resources Code §§ 21100, 21151; Guidelines, §§ 15002, subd. (k)(3), 15063, subd. (b)(1), 15064, subds. (a)(1), (g)(1), 15362.))

Very truly yours,

ZACKS, FREEDMAN & PATTERSON, PC

Ryan J. Patterson
Attorneys for Herb Felsenfeld and Gail Newman

EXHIBIT O

OAKLAND DISTRICT OFFICE:
POST OFFICE BOX 5126
CONCORD, CA 94524

(925) 674-8010
FACSIMILE TRANSMISSION:
(925) 674-8424

September 11, 2017

SF Board of Superviors
San Francisco City Hall
1 Dr, Carlton B Goodlett Pl. #244
San Francisco, CA 94102

REFERENCE: 3516 and 3526 Folsom Street, San Francisco, CA
SF Planning Department Case No. 2013.1383ENV
ED&T File Number: OAK2319-61292

Dear President Breed and Honorable Members of the Board of Supervisors,

This letter is in response to a request for Engineering Design & Testing (ED&T) to conduct an independent evaluation of the San Francisco Planning Department Mitigated Negative Declaration (MND) for the 3516 & 3526 Folsom Street project (Project) as it pertains to Pacific Gas & Electric Company's (PG&E) natural gas transmission pipeline L109. Mr. Steven Viani, P.E. and Mr. Kenneth Ridings, P.E. reviewed the following documents in the evaluation, which are sufficient to analyze the Project's MND:

- The MND with a focus on Impact NO-3 and referenced footnote documents, Figures 1-12 and Mitigation Measures
- MND Appeal dated September 5, 2017
- Spectra Energy Partners - Algonquin Incremental Market Project – Analysis of the West Roxbury Crushed Stone Operations on Construction and Operation of the West Roxbury Lateral dated March 31, 2014
- Letter from Lubin Olson to President London Breed dated September 1, 2017 regarding Appeal of MND
- Reported email from Austin Sharp with PG&E (date understood to be mid-2014) to Debra Gerson and Herb Felsenfeld (nearby neighbors to the project) and Fabien Lannoye (Bluorange Designs) contained as Appendix A in letter from Lubin Olson to President London Breed dated September 1, 2017
- 49 Code of Federal Regulations Part 192 – Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

- ASME B31.8S-2016 Managing System Integrity of Gas Pipelines
- U.S. Department of Transportation - Pipeline and Hazardous Materials Administration – Reportable Incident Data
- Foot note 3: John Dolcini, Pipeline Engineer-Gas Transmission, Pacific Gas and Electric Company, Letter Re: 3516/3526 Folsom Street, March 30, 2017
- Foot note 20: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment, May 2006, pp. 8-1 to 8-3, Table 8-1.
- Foot note 30: US Department of Transportation, Federal Highway Administration, Construction Noise Handbook, Table 9.1, July 2011.
- Foot note 31: Illingworth and Rodkin, Inc., Construction Vibration Evaluation for 3516 and 3526 Folsom Street, March 24, 2017.
- Illingsworth & Rodkin Inc., Memo: Ground Characteristics and Effect on Predicted Vibration, April 14, 2017.
- California Department of Transportation, Transportation and Construction Vibration Guidance Manual, September 2013.
- PG&E Gas Transmission Pipeline Services—Integrity Management, 3516/26 Folsom Street, March 30, 2017.
- H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3516 Folsom Street, San Francisco, California, August 3, 2013. H. Allen Gruen, Geotechnical Engineer, Geotechnical Investigation, Planned Development at 3526 Folsom Street, San Francisco, California, August 3, 2013.
- Geotechnical Report Update, Proposed Residence at 3516 & 3526 Folsom Street San Francisco, California by H. Allen Gruen,11/29/16
- Geotechnical Responses to Project Review Letter, Proposed Residence at 3516 & 3526 Folsom Street San Francisco, California by H. Allen Gruen, 1/24/17
- Review of Proposed Pipeline Impacts 3516 & 3526 Folsom Street, San Francisco, California, Storesund Consulting, June 14, 2017
- Mitigated Negative Declaration Appeal, 3516 & 3526 Folsom Street September 5, 2017, San Francisco Planning Department
- David J. Franco PE, 3516 & 3526 Folsom Street Grading Plan, 9/21/16
- Planned Street and Utility Improvements at 3516 & 3526 Folsom Street San Francisco, California by H. Allen Gruen, 7/6/17

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Mr. Ridings is a licensed Professional Mechanical Engineer in California and other states. I worked in the "gas department" at PG&E for 25 years beginning in 1979 and have worked at ED&T since 2005.

While at PG&E, I worked in field operations (gas distribution and transmission) for 9 years and in corporate staff support departments for 16 years. While in field operations I supervised multi-disciplined work groups responsible for the engineering, design, operations and maintenance of 2700 miles of distribution and transmission pipelines, including locating and marking underground pipes, investigated gas incidents and damage caused by third party dig-ins and reviewed street construction plans for conflicts with gas facilities.

While in corporate staff support at PG&E, I investigated the cause of and emergency response to gas distribution and transmission incidents; interpreted regulatory code requirements; developed certain engineering, construction, and operations and maintenance standards for gas distribution facilities; oversaw the development and implementation of certain construction, engineering, operations and maintenance standards, procedures for gas distribution piping systems including the locating and marking of underground pipes; and oversaw staff that provided training and technical support to field operations.

Currently at ED&T I conduct engineering investigations to determine the cause of damage to or from fuel gas piping systems and facilities; infrastructure utilities and piping systems; HVAC and refrigeration systems; fire suppression systems; cranes/heavy equipment, machinery and equipment.

Mr. Viani has over 40 years professional experience planning, designing and constructing, civil, environmental and geotechnical projects. I am a registered civil engineer in California and two other states. In addition, I am a licensed engineering (A) and building (B) contractor with a hazardous waste removal endorsement. Throughout my career, I have been involved with the CEQA process for a variety of projects including wastewater treatment, environmental remediation and environmental protection. During my tenure with ED&T, I have been involved with numerous related assignments involving the identification and assessment of vibration from construction equipment and blast related vibration damage.

The above qualifies us to evaluate the MND as it pertains to PG&E's gas transmission pipeline L109.

Please note that the preceding is based on information available at the time of this writing. It is conceivable that additional information may be forthcoming which bears on stated observations and opinions. The right is reserved, therefore, to review and modify all observations and opinions at any future point in time should, in fact, additional information become available.

Our Curriculum Vitaes are attached.

Based on our review of the Project and the aforementioned documents, ED&T's findings and expert opinions of the MND are:

1. The Construction Vibration Evaluation (Vibration Evaluation) performed by Illingworth and Rodkin, Inc. on behalf of Bluorange is not complete and does not accurately determine what vibration level is safe for L109.
2. The Vibration Evaluation does not adequately address the types of equipment that may be used and the vibration levels imparted on L109 by said equipment.
3. Impact NO-3 was not adequately analyzed and mitigated.
4. The height of soil (cover) on top of L109 in the Project area has not been determined. The cover must be determined prior to issuance of a mitigated negative declaration because the following steps cannot be taken without this information:
   a. Determination of whether the pipeline risk will increase, decrease or remain the same following construction of the project.
   b. Determination of whether the soil cover over the pipe is too shallow and what mitigation measures need to be imposed.
   c. Determination of safe designs and specifications for the Project to ensure that the Project remains stable, rather than being significantly changed during construction as a result of observed physical conditions of L109 and depth of cover.
5. That a PG&E inspector, or an independent, qualified third party inspector, be present for the entire project.
6. That every project employee be trained in PG&E's requirements and restrictions for working in the vicinity gas transmission pipelines and requirements that are specific to the Project.

As a result of these deficiencies in the MND, a significant possibility of a catastrophic release of natural gas from L109 during construction of the Project still exists.

Opinion 1: The Vibration Evaluation for the proposed project references a Caltrans report where a Peak Particle Velocity (PPV) value of 25 inches/second (ips) associated with explosives near buried pipe resulted in no damage to the pipe, as did values for explosives near buried pipe of 50-150 ips. PPV is the speed of a particle in a medium as it transmits a wave. It is a measurement of vibration. These vibrations can cause damage to any structure.

The MND states that the Vibration Evaluation utilized a "conservative" 12 ips, a value that was in the Spectra Energy report, as the criterion for potential damage to L109. The Spectra project involved determining the impacts of blasting at a rock quarry on a proposed natural gas transmission pipeline in Massachusetts.

Problems with the Vibration Evaluation and MND include:

- The vibrations were from explosives, not continuously vibrating equipment. It is understood that explosives are not planned for this project. Continuous vibrations impart cyclical loads on the pipe. The Caltrans documents suggest that acceptable PPV values for continuous vibrations are half of acceptable values for surface blasting.

- In the Caltrans report referenced in the Vibration Evaluation where no damage was observed when blasting vibration levels were at certain levels, there is no description as to the type of damage that was not observed or how it was determined that there was no damage. Was the pipe dug up and examined to see whether the pipe had bent? Was the determination of no damage made because no leaks were observed? Steel pipe can be damaged, compromising its strength, without immediately detectable leakage. No correlation is shown between the types of damages that were not observed in the referenced reports on the one hand, and the type of damage to L109 that may expected with elevated vibration levels on the other hand. Because a comparison of what constitutes damage was not made, the Caltrans report data is not a valid reference.

- The operating conditions, commodity and pipe specifications were not listed in the Caltrans report. L109 at the Project location is a 26-inch diameter steel pipe with a maximum operating pressure (MAOP) of 150 psig and at MAOP is at a 19.8% of the pipe's specified minimum yield strength. A higher stressed pipe will become damaged at a lower value PPV than a lower stressed pipe. There was no mention of operating stress levels of the pipes in the Caltrans report. Because a correlation between the operating stress levels in the Caltrans report pipes and L109 was not made, the Caltrans report data again is not a valid reference.

- The Spectra project involved surface explosions, different operating stress levels in the pipe than L109, and because the Spectra project involved the installation of new pipe, the physical condition of the pipe was known. Although PG&E may have inspection documents that show the physical condition of portions of L109 in the Project and adjoining area, this information was not used in the Vibration Evaluation. This section of L109 was installed in 1981 and the slope of the hill is steep. The slope in the project area is reported to be 28%. The slope of the hill from the north end of the project to Bernal Heights Road visually appears to be even steeper. Slippage of the pipe, localized corrosion, or impact damage may have taken place since 1981 and increased the stress levels in the pipe. It cannot be assumed that what was acceptable to the pipe in the Spectra project is acceptable for L109. As with the Caltrans reports, a correlation was not made between stress levels in the pipe. Further, the Spectra project involved installation of new pipe in what appears to be a nearly horizontal street. The Vibration Evaluation did not take into consideration the physical condition of L109 or bending stresses that may exist with the changes in grade.

  The Spectra analysis is inapplicable to the Project, and it is an inadequate basis for designing Project mitigation measures that will reduce Project impacts to a level of insignificance.

- The 2014 email from PG&E states that there are three federally-approved methods to complete a transmission pipeline integrity management baseline assessment:
  - In-Line Inspections (ILI) – An ILI involves a tool (commonly known as a "pig") being inserted into the pipeline to identify any areas of concern such as a potential metal loss (corrosion) or geometric abnormalities (dents) in the pipeline.

- o External Corrosion Direct Assessment (ECDA) – Involves an indirect, above-ground electrical survey to detect coating defects and the level of cathodic protection. Excavations are performed to do a direct examination of the pipe in areas of concern as required by federal regulations.
- o Pressure Testing (PT) – PT is a strength test normally conducted using water, which is also referred to as a hydrostatic test.

PG&E performed an ECDA of L190 in this area in 2009 and another one was scheduled in 2015. No issues were found in 2009.

Based on the above, the Vibration Evaluation is not complete nor is it representative of this project and is not appropriate to use as a basis for determining safe levels of vibration to L109.

Since the Vibration Evaluation is not complete or representative, it cannot be used as a reference or comparison to validate PG&E's maximum vibration level of 2 ips. PG&E did not provide a basis for their PPV value of 2 ips and it does not appear that they were they asked to provide one. As a result, there is no basis for any of the maximum vibration levels in the Vibration Evaluation and MND.

Opinion 2: The Vibration Evaluation does not include types of equipment for some construction scenarios that are likely to occur such as excavation of the Chert bedrock, shoring and compaction of the street.

For example, compaction of the street above L109. PG&E's March 30, 2017 letter to the San Francisco Planning Department states that the depth of cover over L109 could be as shallow as 24 inches. Per the Grading Plan prepared by David Franco dated 9/21/16 indicates that roadway excavation is estimated to be 12-inches. Placement and compaction of subgrade and/or base rock will require the use of compaction equipment. For example, using the Vibration Evaluation value of 0.21 ips at 25 feet for a vibratory compactor from the Illingsworth March 24, 2017 report titled "Construction Vibration Evaluation for 3516 and 3526 Folsom Street", with the compactor 3.3 feet away from the pipe, the PPV at the pipe is calculated to be 4.3 ips. With the compactor 1 foot above the pipe, the PPV is calculated to be 26.26 ips. This PPV level is significantly higher than the 2.0 ips that PG&E has said is acceptable. Although the basis for PG&E's level has not been made known, it is reasonable to believe that significantly higher levels, such as 26.26 ips will damage L109, which may result in a catastrophic release of natural gas from L109.

Opinion 3: Based on Opinions 1 and 2, Impact NO-3 has not been adequately analyzed and mitigated.

Opinion 4: PG&E requires a minimum of 3 feet of soil cover over gas lines and a maximum of 7 feet. PG&E stated that the soil cover over L109 may be as low as 24-inches. PG&E did not address what corrective action is needed if the cover is less than required nor did they mention the risk impact if the cover is less than required.

Depth of cover may be a component of PG&E's Gas Transmission Pipeline Integrity Management program, a federal regulatory requirement of natural gas transmission system owners and operators such as PG&E. A less than required cover may impact the risk of that segment and mitigation measures may need to be taken. Mitigation measures are not included in the MND regarding the pipeline cover.

The impacts of less than required cover was not analyzed in the MND nor were mitigation measured addressed.

Any grading or excavation within 2 feet of L109 must be done by hand. Potholing and exposing the top portion of the pipe is required to determine which sections above the pipe can be graded or trenched by equipment. Potholing will expose the top portion of the pipe.

Grade cuts for street construction above L109 is 12-inches according to the Franco Grading Plan dated 9/2/16. Grade cuts of 12-inches would leave 12-inches above the pipeline where existing cover is 24-inches. Because of vibration and/or wheel loading restrictions, the equipment mentioned in the MND may not be safe to be used in shallow sections.

The design prepared for the extension of Folsom St. shown in the Grading Plan requires use of a full sized roller for compaction and the required level of aggregate base compaction is 95%, in 6 inch lifts. Compaction to 95% requires an increased number of passes over the more typical compaction level of 95% Modified Proctor testing. As noted above in Opinion 2, the PPV of a vibratory compactor 1 foot above the pipe is calculated to be 26.26 ips, which exceeds the maximum threshold of 2.0 set by PG&E.

Hand digging over L109 is required for all new utility crossings (water, sewer, electric, gas, communications) so there may be more locations where L109 will be potholed.

Exposing the pipeline before detailed design or construction begins also provides visual information regarding the physical condition of the pipe which can be used in performing the vibration analysis and PG&E's risk assessment of this section.

Given that:

- Some potholing and exposing L109 is required, and
- the information gained from potholing will yield information used in determining safe vibration levels, and
- the information from potholing will limit the types of construction equipment and activity in the vicinity of L109, and
- mitigation measures may be needed to correct less than required cover over L109,

exploratory potholing of L109 should have been completed prior to issuance of the MND.

Opinion 5: From January 2010 through September 8, 2017, excavation damage was the leading cause of unintended gas releases from transmission pipelines in California. PG&E is not under contract with the Project's general and sub-contractors/developer. Nor are the Project's general and sub-contractors/developer under contract with PG&E. There are many PG&E requirements/restrictions of the contractor when working within 10 feet of the pipeline, which is an approximate 3 feet from the front wall of the planned residences. Having an on-site inspector at all times would facilitate scheduling changes by the contractor and eliminate lack of communications and reduce the risk of damage to L109, but this was not required as a Mitigation Measure.

Opinion 6: Every Project employee should be trained in PG&E's requirements and restrictions for working in the vicinity of gas transmission pipelines. Given the significant risks posed by the Project, this should have been required as a Mitigation Measure.

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Based on our review and analysis, it is our expert opinion that there still exists a high risk that has not been mitigated based on our review of the MND. It is our opinion the failure to mitigate the risks are significant and a potential for damage and explosion of PG&E's gas transmission pipeline L109 still exists.

Regards,

P.E.

Kenneth R. Ridings, P.E.

P.E.

Steven P. Viani, P.E.

Attachments

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KENNETH R. RIDINGS
27526
EXP. 6/30/19
MECHANICAL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
STEVEN VIANI
No. C30965
3/31/18
CIVIL
STATE OF CALIFORNIA

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ENGINEER: MECHANICAL
PROCESS
UTILITIES

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EDUCATION

August, 1979 — Bachelor of Science, Mechanical Engineering, University of Utah, Salt Lake City, Utah

PROFESSIONAL EXPERIENCE:

2005 to present

Engineering Design and Testing Corp., Oakland, California
Assistant Vice President, District Engineering Manager and Consulting Engineer - Investigation of incidents involving natural gas piping systems and facilities; moisture intrusion and damage in residential and commercial buildings and industrial facilities; infrastructure utilities and piping systems; HVAC and refrigeration systems; fire suppression systems; cranes/heavy equipment, machinery and equipment. Services provided include failure analysis and causation identification, scope of damage evaluations, estimate repair/replacement costs, claims analysis, standards and codes interpretation, fire origin and cause, and construction monitoring and timeline scheduling.

1998 - 2004

Pacific Gas & Electric Company, San Francisco, California
Manager – Conducted investigations of major gas incidents. Responsible for development and implementation of construction, engineering, operations and maintenance standards, procedures for gas distribution piping systems. Prepared expert testimony and testified in California Courts on behalf of PG&E's gas distribution capital and expense investments for the 1999 regulatory funding proceedings.

1993 – 1998

Pacific Gas & Electric Company, San Francisco, California
Senior Distribution Engineer – Investigated cause and emergency response of gas distribution and transmission incidents. Interpreted regulatory code requirements. Developed engineering, construction, and operations and maintenance standards for pipe rehabilitation, valves, fittings, pressure control facilities and substructure enclosures. Investigated system operations, material, equipment, and facility failures.

1989 – 1993;
1984 – 1988

Pacific Gas & Electric Company, Fresno, California
Division Engineer – Supervised multi-disciplined work groups responsible for the engineering, design, operations and maintenance of transmission and

distribution systems, including cathodic protection. Investigated gas incidents including fires and explosions and damage caused by third party dig-ins.

1988 – 1989 **Pacific Gas & Electric Company, Fresno, California**
Transmission and Regulation Supervisor – Supervised technical workgroup responsible for operations and maintenance on 2700 miles of pipeline and 165 pressure control stations. Scheduled work, prepared and directed system sequence of operations changes, and diagnosed system operations.

1984 **Pacific Gas & Electric Company, Antioch, California**
Area Engineer - Responsible for cathodic protection, facility records management, design and cost estimate preparation, engineering of gas transmission pipelines and associated facilities.

1979 – 1984 **Pacific Gas & Electric Company, Walnut Creek, California**
Engineer - Designed and engineered gas transmission pipe line, metering, and compressor station facilities. Specified water treatment and heat exchanger operations and maintenance at compressor stations. Performed pipe loading and stress analysis, and hydraulic capacity and system planning analysis.

1978-1979 **Northwest Pipe Line Company, Salt Lake City, Utah**
Engineering Intern – Facility engineering, perform cathodic protection analysis and prepare recommendations.

PROFESSIONAL ORGANIZATIONS:

ASM International (ASM)
American Society of Mechanical Engineers (ASME)
California Conference of Arson Investigators (CCAI)
East Bay Claims Association – Vice President 2012-13
National Association of Fire Investigators (NAFI)
National Fire Protection Association (NFPA)
National Society of Professional Engineers (NSPE)
National Association of Subrogation Professionals (NASP)

September 2015

PROFESSIONAL REGISTRATIONS:

Registered Professional Engineer – Arizona (#44546)
Registered Professional Engineer – California (#M27526)
Registered Professional Engineer – Idaho (#14379)
Registered Professional Engineer – Hawaii (#14923)
Registered Professional Engineer – Montana (#19897)
Registered Professional Engineer – Nevada (#021117)
Registered Professional Engineer – Oregon (#78334PE)
Registered Professional Engineer – Utah (#180944-2202)
Registered Professional Engineer – Washington (#42731)
National Council of Examiners for Engineering and Surveying (#28431)

CONTINUING EDUCATION:

2010 Fire Pump Seminar
National Fire Protection Association
Reno, Nevada

2007 Investigation of Gas & Electric Appliance Fires
Western Michigan University
Kalamazoo, Michigan

2006 Fire and Explosion Investigation
National Association of Fire Investigators
Sarasota, Florida

2006 Mechanical and Electrical Estimating
RS Means
Las Vegas, Nevada

EXPERIENCE – ENGINEERING INVESTIGATIONS (partial listing)

Natural Gas Pipeline and Facilities

Damage to Pipelines Caused by Third Party Dig-Ins – Multiple Locations, California

Examine damaged pipe and site location, review utility locate and mark records, review "call before you dig" records, review third party records, and determine cause of dig-in. Evaluate scope of damage, emergency response and repair activities. Review utility repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Compressor Station Fire – Gillette, Wyoming

Examine station and equipment, review operating records and other documents and determine cause of fire.

Gas Explosions and Fires – Multiple Locations, California

Investigate and determine whether natural gas fueled explosions and fires were caused by natural gas utility facilities and/or operations.

Underwater River Crossings – Calgary, Canada

Examine three separate pipeline crossings underneath flooded rivers, review inspection records, conduct underwater survey, and determine scope of damage of pipelines. Evaluate the repair/replacement scope of work and estimated costs.

Overpressurization of Low Pressure Distribution System – Alameda, California

Lead investigation and determine cause of overpressurization of a low pressure system and evaluate gas utility emergency response. Examine pressure control station equipment and maintenance records, system operation records, emergency response sequence of events.

Pressure Regulator Stations – Multiple Locations, California

Determine cause of pressure regulator valve failures at multiple regulator stations and metering facilities.

Commercial and Residential (Single and Multi-Story)

Moisture/Water Intrusion – Multiple Locations

Investigation of 200+ incidents involving water supply, irrigation, HVAC, waste, drainage, and fire sprinkler system piping and associated fittings, connector hoses, and equipment; water heaters and boilers; restroom and kitchen faucets and appliances; washing machines.

Heat and Smoke Damaged Generator Ductwork – Mesa, Arizona
Review of drawings, fire damage reports, repair costs, business interruption estimates and other documents to determine scope of damage. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Leaking Chiller Tubes at Medical Center – Bakersfield, California
Examine chiller system and evaporator, review manufacturer drawings and equipment specifications, review operating records. Determine cause and scope of damage. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Dry Cleaning Equipment – Chandler, Arizona
Examine equipment, review equipment specifications, service records and other documents, determine cause of leaks in equipment steam chamber.

Collapsed Car Lift – San Francisco, California
Examine steel member framed, hydraulic powered car lift, review manufacturer specifications, drawings and other documents, determine cause of collapse.

Hail Damaged Roof Top HVAC Condensers – Scottsdale, Arizona
Examine condensers, identify impact damage caused by hail and determine reparability. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Leaking Hydraulic Elevator Casing – Multiple Locations
Examine elevator equipment, service records and other documents and determine cause of leak.

Water Damage to Elevator Components (multiple) – Multiple Locations
Examine elevator system components, identify water contacted components, and determine scope of damage, if any, to water contacted components. Evaluate repair cost proposals as to appropriateness of repair and associated costs.

Construction

Crane Tipover – San Ramon, California
Examine crane and highway construction site, review crane specifications, operator log and other documents and determine cause of tipover. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Mechanical Lift Tipover – Groveland, California
Examine lift and residence construction site, review lift specifications and determine cause of tipover.

Crawler Crane Tipover – West Olive, Michigan
Examine crane at generation plant, determine scope of damage from tipover and cost to repair. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Leaking Toilets in Condominiums Building – San Jose, California
Examine toilet installations, review manufacturer specifications and instructions, review test reports and determine cause of leaks.

Leaking Water Supply Valves in Multi-Unit Residential Buildings – Walnut Creek, California
Examine valves and installation, review manufacturer specifications and literature, determine cause of fractures in valve bodies.

Fire Investigations

Equipment and Appliances – Multiple Locations
Investigation of fires involving furnaces, water heaters, cooking and other appliances.

Industrial

Moisture/Water Intrusion – Multiple Locations
Investigation of incidents involving water supply, HVAC, boilers and water heater equipment, piping, and associated fittings.

Imploded Milk Storage Tank – Hanford, California
Examine tank, tank service and dairy operating records, manufacturer drawings and specifications and determine cause of implosion.

Imploded Fermentation Tank – Ukiah, California
Examine tank and process equipment at brewery, review operating records, drawings, sequence of operations, manufacturer specifications and other documents and determine cause of implosion. Review repair and pricing documents as to appropriateness of repairs and reasonableness of costs.

Imploded Storage Tank at Ethanol Plant – Cambridge, Nebraska
Examine plant and tank, review operating records and system design, coordinate testing of valve, and determine cause of collapse.

Single-Axis Solar Panel Tracker System Detachment – McCarran, Nevada
Examine tracker system and panels, review operating records and design documents, review snowfall and other weather records, and determine cause of detachment.

Ammonia Release at Cold Storage Facility – Phoenix, Arizona
Examine refrigeration equipment, review manufacturer specifications, review maintenance records, test components, and determine cause of ammonia release.

Utilities Service Interruption – Harahan, Louisiana
Review documents and determine duration and cause of service interruptions to a cold storage facility

Shiploader Tipover– Vancouver, Washington
Examine shiploader and bearing assembly, review design drawings and operating records, review video of incident, supervise other discipline engineers, and determine cause of tipover.

Damaged Retort MIG Thermometer – Corning, California
Examine retort, thermometer, and process equipment at olive processing facility, review operating records, FDA requirements, sequence of operations, manufacturer specifications and other documents and determine cause of damage to thermometer.

Logging Vehicle Fire Suppression System – Burns Lake, British Columbia, Canada
Examine fire damaged logging vehicle and fire suppression system, review multiple documents and determine why suppression system did not discharge.

Controlled Atmosphere Room at Cold Storage Facility – Multiple Locations, Washington
Examine facility Atmosphere Control System and refrigeration system, review test reports and facility records, and with a fruit harvest specialist, determine if damage to stored fruit was the result of a malfunction in the systems.

Chiller Coil Tube Leaks at Cold Storage Facility – Reedley, California
Examine facility and chiller tubes, review facility operations, review test reports and other documents and determine cause of leaks.

Fire Damaged Distillation Column at Ethanol Plant - Clinton, Iowa
Examine plant and column and review plant drawings and records. Determine scope of damage, cost of repairs and work schedule to facilitate repairs.

Digester Overpressure, Water Treatment Plant – Delano, California
Examine digester and associated equipment, review facility drawings, operating records and determine cause of overpressure.

Damaged PVC Piping System Containing CO2 Gas – Corning, California

Examine Carbon dioxide vaporizer and overhead PVC piping system in olive processing facility, review drawings, service records, weather records, operating and other documents and determine cause of damage.

Water Well Contamination – Live Oak, California

Examine well, review well inspection videos, water quality reports and other documents, and determine cause of contamination.

Water Well Collapse (2) – Corcoran, California

Examine well head and inspection videos, review drilling logs well test records and other operating documents and determine cause of collapse. Review repair documents as to appropriateness of repairs and reasonableness of costs.

Water Pumping Plant – Walnut Creek, California

Examine plant, review manufacturer specifications, design drawings and other documents, and determine cause of coupling detachment. Supervise other engineering disciplines to evaluate scope of water damage to building components, and electrical and mechanical equipment. Review repair documents as to appropriateness of repairs and reasonableness of costs.

Water Treatment Plant – Livermore, California

Examine damaged clarifier equipment, review construction, maintenance and test records, and determine cause of damage. Review repair documents as to appropriateness of repairs and reasonableness of costs.

Whirlybird Type Crane Tipover – Seattle, Washington

Examine crane, determine scope of damage, conduct research on used crane prices, and determine value of damage.

Fire Damaged Conveyor, Recycling Power Generation Plant – Oroville, California

Examine conveyor and associated electrical and mechanical equipment. Review construction drawings, operating records, repair cost estimates and other documents. Engage other engineering disciplines to determine scope of damage and reparability. Review repair documents as to appropriateness of repairs and reasonableness of costs.

Ammonia Refrigeration System – Coalinga, California

Examine refrigeration system, review facility and system drawings, service records and other documents and determine cause of ammonia release.

Corroded At-Grade Water Storage Tank – San Luis Obispo, California

Examine tank and attached piping, review cathodic protection system installation and service records, review other records, test insulation points, and determine cause. Determine scope of damage. Review repair documents as to appropriateness of repairs and reasonableness of costs. Monitor repair schedule.

Leaking At-Grade Gasoline Storage Tank – Las Vegas, Nevada

Examine tank, associated equipment, and tank farm cathodic protections system. Review tank and cathodic protection system drawings, operating records, manufacturer instructions, test records and other documents. Determine cause of leaks.

Marine

Ship Container Fire – Pacific Ocean

Examine ship containers and contents at Port of Seattle, review ship drawings and records, review manufacturer specification of container contents, and determine cause of fire.

Water Damaged Motors – Fairfield, California

Examine motors and packaging, review transport records and historical weather records, conduct laboratory tests, and determine if source of moisture was during transit or after motors were off-loaded from truck.

Pontoon Boat Lift Separation – Discovery Bay, California

Examine lift and documents and determine cause of separation.

Other

Hiker Fall – Muir Woods, California

Review documents, examine fall location, and determine if the involved trail had been maintained in accordance with regulatory requirements and to determine if the conditions of the incident location were dangerous and hazardous.

Roller Blader Fall – Ixtapa, Mexico

Conduct elevation survey and coefficient-of-friction tests on concrete trail.

Mobile Paper Shredder Truck – Fresno, California

Examine truck and paper shredder, review design drawings and determine cause of mechanical damage to shredder.

LEGAL CONSULTATION – PEER REVIEW (partial list)

Natural Gas Explosion – Seattle, Washington

Review gas utility maintenance and emergency response records, review Washington State regulatory requirements, review regulatory agency reports, review expert and testing agency reports and other documents and provide opinion as to the cause of the explosion.

Natural Gas Explosion – Sublette, Kansas

Review gas utility maintenance standards, maintenance and operating records, Kansas State regulatory requirements and other documents. Provide opinion as to cause of explosion.

Moisture Intrusion – Multiple

Review manufacturer, engineering, and investigation reports regarding separated piping system components. Provide opinions as to cause of separated components.

Steven P. Viani, P.E
spviani@aol.com
(916-952-8503)

Education and Specialized Training

BS Civil Engineering, California State University, Sacramento
Graduate courses in Geotechnical Engineering
Continuing education classes in claims avoidance, negotiations and project management
OSHA 40 hour training
USACOE Construction Quality Management Certification

Professional Registrations

Registered Civil Engineer in California, Arizona and Washington
Licensed A, B & Haz. Contractor (RMO Alvia Services Inc)

Employment History

State Water Resources Control Board (2-year assignment with Army Corps of Engineers)-Associate Engineer	(1977-1982)
Kellogg Corporation-Senior Engineer	(1982-1983)
Department of Health Services-Senior Engineer	(1984-1987)
Roy F. Weston, Inc.-Project Director	(1987-1990)
Canonie Environmental Services, Inc.-Western Regional Manager	(1990-1994)
Geo Con Inc.-Western Regional Manager	(1994-1998)
Layne-Christensen Co.-Western Regional Manager	(1998-1999)
BCN Company-Vice President of Operations	(1999-2001)
Donald B. Murphy Contractors Inc.-Regional Manager	(2001-2003)
Private Consulting/Alvia Services Inc	(2003-Present)

Representative Experience

Over the past 40 years, has held senior level positions in construction, consulting and governmental entities. Have managed, directed or performed projects ranging from $3000 Phase 1 Preliminary Site Assessments to $20 Million site remediations, including many large and significant environmental and geotechnical construction projects as a direct hire contractor. Have 25 plus years experience in managing business units and design departments with total P+L responsibility and staff management up to 35 people. Have worked nationwide and internationally in Asia and Europe.

Legal, Claims and Defect Oriented Experience

- Developed a remediation plan for the removal of construction debris in Malibu, CA. Project involved the determination of quantity, permitting, construction oversight and closure parcel containing illegally disposed debris. Los Angeles County and Coastal Commission involvement.
- Provided expert review of shoring/scaffolding failure at mid-rise residential/commercial building in San Francisco that was overloaded.
- Provided expert services for water damage and intrusion for single family housing, multi-family housing and businesses involving stucco, windows, roofs, siding from wind-driven rain, expansive soils and mechanical damage.
- Provide expert services for a fatal accident involving improperly secured construction equipment on a construction site in Northern California.

- Provided expert services, including accident reconstruction of a major fall injury case involving truck loading at an active wastewater treatment facility in the San Francisco area.
- Provided expert witness services for issues related to a subsiding rock retaining wall causing damage to an adjacent dwelling in San Francisco, CA.
- Provided inspection/evaluation of 50+ residential and commercial damaged by a refinery explosion in Utah.
- Provided expert engineering review of construction defects and standard of care associated with sewer lines, water lines, moisture intrusion, land movement, drainage systems, land development, soils testing, residential construction and other civil engineering defects.
- Provided expert witness services for cost and schedule claim by County of Monterey against CM and Prime Contractor involving asbestos containing materials and affected by mold.
- Provide expert witness service for pile driving operations affecting defectively designed and constructed stucco clad public library in LA area.
- Provided expert witness services and court testimony for construction defect case involving expansive soils, construction impacts and water damage to a house foundation in Irvine, CA.
- Provided expert services for construction dispute involving an environmental remediation groundwater collection and storage system constructed at a large refinery facility in New Jersey.
- Provided expert witness services for accident involving multi-party commercial construction site in Auburn, CA involving rolling scaffolding.
- Reviewed remedial measures for condo building in Sacramento affected by water intrusion through roofs, walls and walkways that resulted in mold.
- Provided expert witness testimony for contractual dispute involving adequacy of geotechnical report, differing site conditions and cost to repair for sewer line in Las Vegas, NV.
- Provided expert witness services for issues related to a subsiding rock retaining wall causing damage to an adjacent dwelling in San Francisco, CA.
- Provide expert services to insurance group for major excavation support failure in San Francisco to determine cause and cost to repair caused by differing soil conditions.
- Provide contract review and claims support for steel water reservoir project in Honouliuli, HI affected by delays, changes and differing site soil conditions.
- Provided contract review and cost to complete for a 900 unit military family housing project in Honolulu, HI. Project encountered with numerous changes that required renegotiation of unit prices, payment for acceleration and additional time related overhead.
- Successfully negotiated a $ 6 million termination for convenience claim for a Superfund site. Developed an estimate of contractor costs and negotiated a fair and reasonable settlement while representing a state government entity. Project required negotiation of an acceleration claim for previous contractor, expert testimony at various court proceedings and presentations to media.
- Prepared and negotiated a changed site conditions, acceleration, directed change, constructive change and defective and deficient contract document change order with the US Army Corps of Engineers for a slurry wall project.
- Developed and negotiated large change orders for quantity increases and changes for design/build environmental remediation projects.
- Developed claim document for high rise hotel in downtown Los Angeles involving directed changes, constructive changes, defective and deficient contract documents, acceleration and significant contractual issues.

Construction Oriented Experience

- Oversaw construction of large wastewater treatment plants, pump stations, earth-pressure balance and open road header tunnels and box sewers for Federal Government construction program in San Francisco. 12 foot diameter tunnel was 1 mile open face cut using road header and steel sets and wood lagging prior to permanent liner. Tunnel was constructed using Earth-pressure balance method with steel liner plate prior to permanent concrete liner was then cast.

- Designed and constructed micropile foundation system for elevated transit structure for BART.
- Designed and constructed a micropile supported foundation for Hotel Berry in Sacramento, CA.
- Constructed Administration, Switchyard and Electrical Control steel framed buildings consisting of about 50,000 square feet for a combined–cycle gas fired power plant.
- Designed/built a pre-engineered steel framed maintenance building for major northern California public utility at a wind energy facility.
- Designed and constructed a micropile foundation for a community college administration building in Alameda, CA.
- Designed and built a micropile project for a new state building in Sacramento.
- Designed and constructed micropile foundation system for elevated transit structure for BART.
- Designed and constructed a micropile supported foundation for Hotel Berry in Sacramento, CA.
- Designed and built a micropile slope stabilization project for the emergency support of a sewer main sliding into a creek in Thousand Oaks.
- Constructed slope stabilization for a hydro-electric powerhouse in the Sierra Nevada Mountains involving rock anchors, soil nails, drains and shotcrete.
- Constructed projects using ground anchors, tiebacks, compaction grouting, chemical grouting, jet grouting, soil mixing, shotcrete, micropiles, driven piles and sheet piles, often under design/build contracts.
- Constructed soil nail, soldier pile and wood lagged excavation support projects for building excavations and soil removal projects.
- Constructed numerous slurry wall projects for seepage control using soil-bentonite, soil-cement-bentonite, soil-cement-bentonite-fly ash and soil-attapulgite for groundwater control on civil and environmental projects. Size of barrier walls ranged from 100,000 sf to 350,000 sf.
- Constructed ADA upgrade and remodel for US Coast Guard Pacific Strike Force Facility in Novato.
- Investigated, designed and oversaw abatement of asbestos affected state buildings after Loma Prieta earthquake in 1989.
- Managed lead abatement, asbestos abatement, structural repairs and painting for 1400 military housing units at Beale Air Force base.
- Designed and managed asbestos abatement activities for 500,000 square feet of office space for TRW buildings in El Segundo.
- Performed ground improvement projects involving dynamic compaction and vibro compaction/vibro-replacement.

<u>Consulting Oriented Experience</u>

- On contract to provide soils investigation and consulting services to pool contractors in N. Calif.
- Provide consulting and design services for residential and commercial structures affected by fire, wind, structural design deficiencies, impacts, earthquakes and other factors.
- Planning and conceptual design for construction of a multi-waste stream processing center for an industrial waste recycling center in San Diego County, CA.
- Developed geotechnical reports for new housing, including stick-built and manufactured housing throughout California.
- Evaluation of AST's and treatment ponds at oil collection facility in Santa Maria, CA.
- Performed forensic investigations for wastewater treatment plants, schools, commercial buildings and houses for water intrusion damage, expansive soils, presence of mold and construction defects.
- Designed and oversaw abatement of numerous asbestos abatement projects in California.
- Planned and permitted high tech chemical storage and fabrication facilities internationally.
- Developed large scale Phase 1 property transfer program for major renovation of prime San Francisco real estate.

- Performed numerous Phase 1 Preliminary Site Assessments, Remedial Investigations, Feasibility Studies and Corrective Measures Studies using a variety of technologies.
- Assistant author on document concerning repairs and lining UST's.

Remediation and Environmental Experience

- Expert services related to evaluation and removal of UST and AST systems on California.
- Developed a Remedial Investigation /Feasibility Study for the Purity Oil Sales Superfund site in Malaga, CA. Site was former oil processor that had filled onsite ponds and AST's with construction debris containing oil, PCB, lead and asbestos that impacted soil, surface water and groundwater. RI/FS included on-site and off-site investigation, surface water sampling, development of remedial objectives and interim remedial measures.
- Developed a Remedial Investigation/Feasibility Study/Remedial Design for the removal of PCB's and PAH's from a site in Norwalk, CA. Documents were submitted to LAFD and City of Norwalk for approval prior to initiating cleanup. Clean closure granted.
- As part of a construction claim on a 4-story parking structure at San Francisco International Airport, evaluated an earthwork claim concerning the presence of hazardous waste, rock, trash and unsuitable materials and their effect on the project schedule. Further analysis of environmental requirements on illegal filling of wetlands in San Francisco Bay.
- Completed the remediation of the Capri Pumping Services site in East Los Angeles, CA. Site was contaminated with lead, copper, cadmium, solvents and petroleum hydrocarbons. Remediation of this State Superfund site included preparation of a health risk assessment for lead exposure to the surrounding community.
- Oversaw the remediation of the Jibboom Superfund Site in Sacramento, CA. Site was a former scrap yard that had impacted the area with lead, PCB, and hydrocarbons. Extensive air monitoring of the perimeter was performed to limit migration of contaminants. Later designed remediation of inside surfaces at remaining building involving PCB, lead and asbestos.
- Site manager for the McColl Superfund site in Fullerton, CA. Involvement included site sampling of surface and subsurface runoff, construction of site facilities and management of remedial contractors.
- Project manager for the Kyocera facility in Sorrento Valley, CA. Project involved leaking UST solvent tank that impacted groundwater and adjacent wetlands and ponds. Project included on-site and off-site investigation, development of remedial alternatives, permitting and monitoring.
- Remediated a PCP impacted groundwater plume using funnel-gate technology at a wood treating facility. Project involved innovative concept using activated carbon in a passive treatment system.
- Designed and remediated 2500 CY TCA impacted soil inside an existing manufacturing structure in Southern California.
- Designed, permitted and remediated 70,000 CY of TPH impacted soil removal for the closure of the Lockheed C plant in Burbank, California. Clean closure granted.
- Oversaw the design and construction of a groundwater treatment facility for pesticide contaminated soils in Fresno, California as well as excavation of 10,000 CY of pesticide impacted soils.
- Remediated a TCE/TCA impacted groundwater plume using a Deep Soil Mix (DSM) wall that was 65 feet deep and had a surface area of 50,000 SF at an active rail yard.
- Remediated soil impacted with solvents using vapor extraction at the Xerox site in Santa Ana. California. Project included permitting, monitoring and maintenance.
- Constructed a gasoline extraction trench using biopolymer slurry and an HDPE membrane at the port of Los Angeles.
- Developed environmental analysis for portion of former Superfund site that would be removed from Superfund designation to assess impacts on new owners of that piece of property.

Jalipa, Brent (BOS)

Subject: FW: File 170851

From: Ramon Romero [mailto:Ramon49r@aol.com]
Sent: Thursday, September 07, 2017 2:38 PM
To: Board of Supervisors, (BOS) <board.of.supervisors@sfgov.org>
Cc: Ronen, Hillary <hillary.ronen@sfgov.org>
Subject: File 170851

RAMON E. ROMERO
66 Banks Street
San Francisco, CA 94110

September 7, 2016

President London Breed & Members of the Board of Supervisors
c/o Angela Calvillo, Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place
City, Hall, Room 244
San Francisco, CA 94102

RE: Appeal of CEQA Mitigated Negative Declaration
Planning Case No. 2013.12.16.4318 and 2-13.12.16.4322
Building Permit Application Nos. 2013.12.16.4318 and 2-13.12.16.4322
3516-3526 Folsom Street

Dear President Breed and Members of the Board of Supervisors,

I am the resident and homeowner of 66 Banks Street located near the above-referenced lots. I have resided at that address since May of 1994. I am also the owner of the vacant lot (Lot29) located directly behind my home and directly across from the lot designated as 3516 Folsom. I am writing to comment on the matters before you.

President Breed may recall that I served with her on the San Francisco Redevelopment Commission which, of course, dealt extensively with real estate development projects both for residential and commercial purposes. I was appointed to the Redevelopment Commission in 1998 by Mayor Willie L. Brown, Jr. and reappointed by him in 2001. I was subsequently reappointed to the Commission in 2005 by Mayor Gavin Newsom. It was during my last appointment that I served on the Commission with President Breed. During my tenure, I was twice elected President of the Commission and had the honor of being the first Latino to serve in that capacity. My 11½ years of service on the Commission is described in detail in the resolution that was adopted at the time of my resignation. See Item 4(b) of the Commission meeting minutes at this link: http://sfocii.org/sites/default/files/FileCenter/Documents/332-a_102009MINS.pdf

During 2015, I attended two meetings of the Bernal Heights East Slope Design Review Board at which Mr. Fabien Lannoye presented his and Mr. Fogarty's plans for development at the two sites in question. I found

Mr. Lannoye to be congenial, cooperative, attentive, and understanding of the input provided by BernalHeights residents who were in attendance. He presented his building plans in writing for everyone to review and answered questions directly and without equivocation. His behavior was professional and friendly at all times without exception. This was all true in the face of sometimes hostile, emotional, and irrational attacks from a couple of the individuals in attendance.

I should add that the development of the house that I reside in at 66 Banks, as well as the two houses next to mine, met hostile resistance from the neighbors when the homebuilder went through the planning process in the early-1990's. My house and the two next to me were built on the same hillside field where Mr. Lannoye and Mr. Fogarty seek to build. Similarly, the developer, Mr. Aldo Stemberga, was required to build a street in order to build the houses he eventually completed. Even though I was totally unaware and uninvolved in Mr. Stemberga's development, I was met with hostility from some of the neighbors simply because I purchased and moved into my house. I was shocked to see that kind of a reaction from otherwise rational San Franciscans who live in a dense urban environment and should accept the fact that privately owned, vacant, buildable lots will ultimately be developed as our city grows.

The appellants' objection concerning the gas pipeline is nothing more than a scare tactic. There is no gas leak in the pipeline on the slope in question. After careful study and review it has been determined that it is a stable pipeline. Its location is clearly marked by a PG&E post stating that there is a pipeline below. Is this the only underground gas pipeline in San Francisco? Of course not and streets and houses have been constructed all over the city without blowing up the surrounding neighborhoods. Leaflets were passed out throughout our neighborhood warning that we were in the "blast zone." My house is among the closest to the pipeline in question. I refuse to be swayed by such terroristic tactics and the Board should not be either.

I moved into my house in 1994 and purchased the lot directly behind my house in 1997. My desire was to keep open space behind me for as long as I could. I have succeeded in doing so for more than 20 years. However, I knew that because I did not buy all six lots behind my house that there might be development of the other five lots someday. These six lots sit on an attractive grassy hillside and it is understandable that residents in the area would want to keep it that way. I enhanced the beauty of my lot by planting a succulent garden. I intend to continue that use of my lot for the foreseeable future. The people who oppose this development want to keep all of these lots as open space, i.e., like a *de-facto* extension of Bernal Hill Park. Unfortunately, they do not have the right to do so and have conjured up any argument that they can think of to maintain this open space.

It is my understanding that Mr. Lannoye has cooperated with Planning Agency staff and Department of Public Works staff in advancing his development plans. In particular, he has expressed to me his willingness to mitigate as much as possible any potential adverse effect on the two houses that are located at the bottom of the extension of Folsom Street that he intends to construct.

All of the objections that have been stated by the appellants in previous Planning Commission meetings have been studied and dismissed by the Planning Commission.

It is inevitable that you reach the same conclusion that I have, i.e., that Mr. Lannoye and Mr. Fogarty have the right to build on their lots. These lots are zoned for the purpose that they intend. They have cooperated with Planning Department and Department of Public Works staff in planning the houses and the street. Most importantly, they have attempted to cooperate with the residents in good faith. San Franciscans who live in a dense urban environment should accept the fact that privately owned, vacant, buildable lots will ultimately be developed as our city grows.

The Board should deny the instant appeals without further delay.

Very truly yours,

Ramon E. Romero

Sent from my iPhone