FINAL ENVIRONMENTAL IMPACT REPORT

# TREASURE ISLAND / YERBA BUENA ISLAND REDEVELOPMENT PROJECT

## Volume 5 – Appendices D-I

CITY AND COUNTY OF SAN FRANCISCO
PLANNING DEPARTMENT
CASE NO. 2007.0903E

STATE CLEARINGHOUSE NO. 2008012105

DRAFT EIR PUBLICATION DATE: JULY 12, 2010

DRAFT EIR PUBLIC HEARING DATE: AUGUST 12, 2010

DRAFT EIR PUBLIC COMMENT PERIOD: JULY 12, 2010 - AUGUST 26, 2010
(EXTENDED TO SEPTEMBER 10, 2010)

COMMENTS AND RESPONSES PUBLICATION DATE: MARCH 10, 2011

FINAL EIR CERTIFICATION DATE: APRIL 21, 2011

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Changes from the Draft EIR are indicated by a dot (●) in the left margin.

# TREASURE ISLAND / YERBA BUENA ISLAND REDEVELOPMENT PROJECT FINAL EIR

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### VOLUME 1



### VOLUME 2

# APPENDIX D: NOISE CALCULATIONS

**TI/YBI Redevelopment Project**

**Vibration propogation from Construction Equipment**

Formula from FTA, 2006 = PPVequip = PPVref x (25/D)^1.5
where

PPV refs @ 25 ft =

| | PPV@25ft |
|---|---|
| pile driver (impact) | 1.518 |
| pile driver (sonic) | 0.734 |
| Bulldozer (large) | 0.089 |
| Truck(loaded) | 0.076 |
| Jackhammer | 0.035 |

Enter distance = 50 Adjacent Buildings

Resultant PPV =

| | |
|---|---|
| pile driver (impact) | 0.536694 |
| pile driver (sonic) | 0.259508 |
| Bulldozer (large) | 0.031466 |
| Truck(loaded) | 0.02687 |
| Jackhammer | 0.012374 |
| Truck | |

| | Lv@25 ft |
|---|---|
| pile driver (impact) | 112 |
| pile driver (sonic) | 105 |
| Bulldozer (large) | 87 |
| Truck(loaded) | 86 |
| Jackhammer | 79 |

Resultant Lv =

| | |
|---|---|
| pile driver (impact) | 102.9691 |
| pile driver (sonic) | 95.9691 |
| Bulldozer (large) | 77.9691 |
| Truck(loaded) | 76.9691 |
| Jackhammer | 69.9691 |

PPV refs @ 25 ft =

| | PPV@25ft |
|---|---|
| pile driver (impact) | 1.518 |
| pile driver (sonic) | 0.734 |
| Bulldozer (large) | 0.089 |
| Truck(loaded) | 0.076 |
| Jackhammer | 0.035 |

Enter distance = 100

Resultant PPV =

| | |
|---|---|
| pile driver (impact) | 0.18975 |
| pile driver (sonic) | 0.09175 |
| Bulldozer (large) | 0.011125 |
| Truck(loaded) | 0.0095 |
| Jackhammer | 0.004375 |

| | Lv@25 ft |
|---|---|
| pile driver (impact) | 112 |
| pile driver (sonic) | 105 |
| Bulldozer (large) | 87 |
| Truck(loaded) | 86 |
| Jackhammer | 79 |

Resultant Lv =

| | |
|---|---|
| pile driver (impact) | 93.9382 |
| pile driver (sonic) | 86.9382 |
| Bulldozer (large) | 68.9382 |
| Truck(loaded) | 67.9382 |
| Jackhammer | 60.9382 |

PPV refs @ 25 ft =

| | PPV@25ft |
|---|---|
| pile driver (impact) | 1.518 |
| pile driver (sonic) | 0.734 |
| Bulldozer (large) | 0.089 |
| Truck(loaded) | 0.076 |
| Jackhammer | 0.035 |

Enter distance = 200

Resultant PPV =

| | |
|---|---|
| pile driver (impact) | 0.067087 |
| pile driver (sonic) | 0.032439 |
| Bulldozer (large) | 0.003933 |
| Truck(loaded) | 0.003359 |
| Jackhammer | 0.001547 |

| | Lv@25 ft |
|---|---|
| pile driver (impact) | 112 |
| pile driver (sonic) | 105 |
| Bulldozer (large) | 87 |
| Truck(loaded) | 86 |
| Jackhammer | 79 |

Resultant Lv =

| | |
|---|---|
| pile driver (impact) | 84.9073 |
| pile driver (sonic) | 77.9073 |
| Bulldozer (large) | 59.9073 |
| Truck(loaded) | 58.9073 |
| Jackhammer | 51.9073 |

Noise Appendix
Table Noise-1
**Traffic Noise Level Estimates**

**AM PEAK HOUR**

| No. | Avenue of the Palms, north of 1st Str | TOTAL # VEHICLES | Auto % | Auto | Medium Truck % | MT | Heavy Truck % | HT | VEHICLE TYPE % Bus % | Bus | Motorcycle % | moto | Vehical Speed miles/hour | Distance to Receptor (feet) | TNM 2.5 Lookup Result (dBA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Existing | 407 | 85 | **346** | 3 | **12** | 5 | **20** | 3 | **12** | 4 | **16** | 25 | 50 | 61.9 |
| 2 | Exist + Project (Funded) | 1,516 | 86 | **1,298** | 3 | **45** | 5 | **76** | 2 | **36** | 4 | **61** | 25 | 50 | 67.6 |
| 3 | Exist + Project (Enhanced) | 1,241 | 83 | **1,027** | 3 | **37** | 5 | **62** | 5 | **65** | 4 | **50** | 25 | 50 | 67.2 |
| 4 | Exist + Alternative (Funded) | 1,264 | 85 | **1,076** | 3 | **38** | 5 | **63** | 3 | **36** | 4 | **51** | 25 | 50 | 66.9 |
| 5 | Exist + Alternative (Enhanced) | 1,040 | 82 | **850** | 3 | **31** | 5 | **52** | 6 | **65** | 4 | **42** | 25 | 50 | 66.6 |
| 6 | 2030 No Project | 1,516 | 87 | **1,322** | 3 | **45** | 5 | **76** | 1 | **12** | 4 | **61** | 25 | 50 | 67.2 |
| 7 | 2030 + Project (Funded) | 1,516 | 86 | **1,298** | 3 | **45** | 5 | **76** | 2 | **36** | 4 | **61** | 25 | 50 | 67.6 |
| 8 | 2030 + Project (Enhanced) | 1,040 | 82 | **850** | 3 | **31** | 5 | **52** | 6 | **65** | 4 | **42** | 25 | 50 | 66.6 |
| 9 | 2030 + Alternative (Funded) | 864 | 84 | **724** | 3 | **26** | 5 | **43** | 4 | **36** | 4 | **35** | 25 | 50 | 66.5 |
| 10 | 2030 + Alternative (Enhanced) | 1,040 | 82 | **850** | 3 | **31** | 5 | **52** | 6 | **65** | 4 | **42** | 25 | 50 | 66.6 |

| No. | Avenue of the Palms, south of 1st Str | TOTAL # VEHICLES | VEHICLE TYPE % Auto % | Auto | Medium Truck % | MT | Heavy Truck % | HT | VEHICLE TYPE % Bus % | Bus | Motorcycle % | moto | Vehical Speed miles/hour | Distance to Receptor (feet) | TNM 2.5 Lookup Result (dBA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | Existing | 431 | 85 | **367** | 3 | **13** | 5 | **22** | 3 | **12** | 4 | **17** | 25 | 50 | 62.2 |
| 12 | Exist + Project (Funded) | 1,855 | 86 | **1,596** | 3 | **56** | 5 | **93** | 2 | **36** | 4 | **74** | 25 | 50 | 68.3 |
| 13 | Exist + Project (Enhanced) | 1,632 | 84 | **1,371** | 3 | **49** | 5 | **82** | 4 | **65** | 4 | **65** | 25 | 50 | 68.2 |
| 14 | Exist + Alternative (Funded) | 1,667 | 86 | **1,431** | 3 | **50** | 5 | **83** | 2 | **36** | 4 | **67** | 25 | 50 | 67.9 |
| 15 | Exist + Alternative (Enhanced) | 1,371 | 83 | **1,141** | 3 | **41** | 5 | **69** | 5 | **65** | 4 | **55** | 25 | 50 | 67.8 |
| 16 | 2030 No Project | 1,993 | 87 | **1,742** | 3 | **60** | 5 | **100** | 1 | **12** | 4 | **80** | 25 | 50 | 68.4 |
| 17 | 2030 + Project (Funded) | 1,993 | 86 | **1,718** | 3 | **60** | 5 | **100** | 2 | **36** | 4 | **80** | 25 | 50 | 68.6 |
| 18 | 2030 + Project (Enhanced) | 1,371 | 83 | **1,141** | 3 | **41** | 5 | **69** | 5 | **65** | 4 | **55** | 25 | 50 | 67.6 |
| 19 | 2030 + Alternative (Funded) | 1,267 | 85 | **1,079** | 3 | **38** | 5 | **63** | 3 | **36** | 4 | **51** | 25 | 50 | 66.9 |
| 20 | 2030 + Alternative (Enhanced) | 1,371 | 83 | **1,141** | 3 | **41** | 5 | **69** | 5 | **65** | 4 | **55** | 25 | 50 | 67.6 |

| No. | 1st Street, east of Avenue of the Palm | TOTAL # VEHICLES | VEHICLE TYPE % Auto % | Auto | Medium Truck % | MT | Heavy Truck % | HT | VEHICLE TYPE % Bus % | Bus | Motorcycle % | moto | Vehical Speed miles/hour | Distance to Receptor (feet) | TNM 2.5 Lookup Result (dBA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | Existing | 24 | 38 | **9** | 3 | **1** | 5 | **1** | 50 | **12** | 4 | **1** | 25 | 50 | 54.6 |
| 22 | Exist + Project (Funded) | 717 | 83 | **595** | 3 | **22** | 5 | **36** | 5 | **36** | 4 | **29** | 25 | 50 | 64.8 |
| 23 | Exist + Project (Enhanced) | 589 | 77 | **453** | 3 | **18** | 5 | **29** | 11 | **65** | 4 | **24** | 25 | 50 | 64.9 |
| 24 | Exist + Alternative (Funded) | 599 | 82 | **491** | 3 | **18** | 5 | **30** | 6 | **36** | 4 | **24** | 25 | 50 | 64.2 |
| 25 | Exist + Alternative (Enhanced) | 491 | 75 | **367** | 3 | **15** | 5 | **25** | 13 | **65** | 4 | **20** | 25 | 50 | 64.5 |
| 26 | 2030 No Project | 717 | 86 | **619** | 3 | **22** | 5 | **36** | 2 | **12** | 4 | **29** | 25 | 50 | 64.2 |
| 27 | 2030 + Project (Funded) | 717 | 83 | **595** | 3 | **22** | 5 | **36** | 5 | **36** | 4 | **29** | 25 | 50 | 64.8 |
| 28 | 2030 + Project (Enhanced) | 491 | 75 | **367** | 3 | **15** | 5 | **25** | 13 | **65** | 4 | **20** | 25 | 50 | 64.5 |
| 29 | 2030 + Alternative (Funded) | 599 | 82 | **491** | 3 | **18** | 5 | **30** | 6 | **36** | 4 | **24** | 25 | 50 | 64.2 |
| 30 | 2030 + Alternative (Enhanced) | 491 | 75 | **367** | 3 | **15** | 5 | **25** | 13 | **65** | 4 | **20** | 25 | 50 | 64.5 |

**PM PEAK HOUR**

| No. | Avenue of the Palms north of 1st Stre | TOTAL # VEHICLES | VEHICLE TYPE % Auto % | Auto | Medium Truck % | MT | Heavy Truck % | HT | VEHICLE TYPE % Bus % | Bus | Motorcycle % | moto | Vehical Speed miles/hour | Distance to Receptor (feet) | TNM 2.5 Lookup Result (dBA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | Existing | 315 | 83 | **261** | 3 | **9** | 5 | **16** | 5 | **16** | 4 | **13** | 25 | 50 | 61.3 |
| 32 | Exist + Project (Funded) | 2,057 | 86 | **1,770** | 3 | **62** | 5 | **103** | 2 | **40** | 4 | **82** | 25 | 50 | 68.8 |
| 33 | Exist + Project (Enhanced) | 1,726 | 83 | **1,427** | 3 | **52** | 5 | **86** | 5 | **92** | 4 | **69** | 25 | 50 | 68.7 |
| 34 | Exist + Alternative (Funded) | 1,875 | 86 | **1,610** | 3 | **56** | 5 | **94** | 2 | **40** | 4 | **75** | 25 | 50 | 68.4 |
| 35 | Exist + Alternative (Enhanced) | 1,545 | 82 | **1,268** | 3 | **46** | 5 | **77** | 6 | **92** | 4 | **62** | 25 | 50 | 68.3 |
| 36 | 2030 No Project | 2,057 | 87 | **1,794** | 3 | **62** | 5 | **103** | 1 | **16** | 4 | **82** | 25 | 50 | 68.5 |
| 37 | 2030 + Project (Funded) | 2,057 | 86 | **1,770** | 3 | **62** | 5 | **103** | 2 | **40** | 4 | **82** | 25 | 50 | 68.8 |
| 38 | 2030 + Project (Enhanced) | 1,545 | 82 | **1,268** | 3 | **46** | 5 | **77** | 6 | **92** | 4 | **62** | 25 | 50 | 68.3 |
| 39 | 2030 + Alternative (Funded) | 1,875 | 86 | **1,610** | 3 | **56** | 5 | **94** | 2 | **40** | 4 | **75** | 25 | 50 | 68.4 |
| 40 | 2030 + Alternative (Enhanced) | 1,545 | 82 | **1,268** | 3 | **46** | 5 | **77** | 6 | **92** | 4 | **62** | 25 | 50 | 68.3 |

| No. | Avenue of the Palms south of 1st Stre | TOTAL # VEHICLES | VEHICLE TYPE % Auto % | Auto | Medium Truck % | MT | Heavy Truck % | HT | VEHICLE TYPE % Bus % | Bus | Motorcycle % | moto | Vehical Speed miles/hour | Distance to Receptor (feet) | TNM 2.5 Lookup Result (dBA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41 | Existing | 370 | 84 | **310** | 3 | **11** | 5 | **19** | 4 | **16** | 4 | **15** | 25 | 50 | 61.9 |
| 42 | Exist + Project (Funded) | 2,509 | 86 | **2,168** | 3 | **75** | 5 | **125** | 2 | **40** | 4 | **100** | 25 | 50 | 69.6 |
| 43 | Exist + Project (Enhanced) | 2,326 | 84 | **1,955** | 3 | **70** | 5 | **116** | 4 | **92** | 4 | **93** | 25 | 50 | 69.7 |
| 44 | Exist + Alternative (Funded) | 2,527 | 86 | **2,184** | 3 | **76** | 5 | **126** | 2 | **40** | 4 | **101** | 25 | 50 | 69.6 |
| 45 | Exist + Alternative (Enhanced) | 2,084 | 84 | **1,742** | 3 | **63** | 5 | **104** | 4 | **92** | 4 | **83** | 25 | 50 | 69.3 |
| 46 | 2030 No Project | 2,775 | 87 | **2,426** | 3 | **83** | 5 | **139** | 1 | **16** | 4 | **111** | 25 | 50 | 69.8 |
| 47 | 2030 + Project (Funded) | 2,775 | 87 | **2,402** | 3 | **83** | 5 | **139** | 1 | **40** | 4 | **111** | 25 | 50 | 70.0 |
| 48 | 2030 + Project (Enhanced) | 2,084 | 84 | **1,742** | 3 | **63** | 5 | **104** | 4 | **92** | 4 | **83** | 25 | 50 | 69.3 |
| 49 | 2030 + Alternative (Funded) | 2,527 | 86 | **2,184** | 3 | **76** | 5 | **126** | 2 | **40** | 4 | **101** | 25 | 50 | 69.6 |
| 50 | 2030 + Alternative (Enhanced) | 2,084 | 84 | **1,742** | 3 | **63** | 5 | **104** | 4 | **92** | 4 | **83** | 25 | 50 | 69.3 |

| No. | Avenue of the Palms south of 1st Stre | TOTAL # VEHICLES | VEHICLE TYPE % Auto % | Auto | Medium Truck % | MT | Heavy Truck % | HT | VEHICLE TYPE % Bus % | Bus | Motorcycle % | moto | Vehical Speed miles/hour | Distance to Receptor (feet) | TNM 2.5 Lookup Result (dBA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | Existing | 55 | 59 | **32** | 3 | **2** | 5 | **3** | 29 | **16** | 4 | **2** | 25 | 50 | 56.8 |
| 52 | Exist + Project (Funded) | 946 | 84 | **792** | 3 | **28** | 5 | **47** | 4 | **40** | 4 | **38** | 25 | 50 | 65.9 |
| 53 | Exist + Project (Enhanced) | 796 | 76 | **608** | 3 | **24** | 5 | **40** | 12 | **92** | 4 | **32** | 25 | 50 | 66.3 |
| 54 | Exist + Alternative (Funded) | 864 | 83 | **720** | 3 | **26** | 5 | **43** | 5 | **40** | 4 | **35** | 25 | 50 | 65.5 |
| 55 | Exist + Alternative (Enhanced) | 711 | 75 | **534** | 3 | **21** | 5 | **36** | 13 | **92** | 4 | **28** | 25 | 50 | 66.0 |
| 56 | 2030 No Project | 946 | 86 | **816** | 3 | **28** | 5 | **47** | 2 | **16** | 4 | **38** | 25 | 50 | 65.3 |
| 57 | 2030 + Project (Funded) | 946 | 84 | **792** | 3 | **28** | 5 | **47** | 4 | **40** | 4 | **38** | 25 | 50 | 65.9 |
| 58 | 2030 + Project (Enhanced) | 711 | 75 | **534** | 3 | **21** | 5 | **36** | 13 | **92** | 4 | **28** | 25 | 50 | 66.0 |
| 59 | 2030 + Alternative (Funded) | 864 | 83 | **720** | 3 | **26** | 5 | **43** | 5 | **40** | 4 | **35** | 25 | 50 | 65.5 |
| 60 | 2030 + Alternative (Enhanced) | 711 | 75 | **534** | 3 | **21** | 5 | **36** | 13 | **92** | 4 | **28** | 25 | 50 | 66.0 |

**SATURDAY PEAK HOUR**

| No. | Avenue of the Palms north of 1st Stre | TOTAL # VEHICLES | Auto % | Auto | Medium Truck % | MT | Heavy Truck % | HT | Bus % | Bus | Motorcycle % | moto | Vehical Speed miles/hour | Distance to Receptor (feet) | TNM 2.5 Lookup Result (dBA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61 | Existing | 221 | 83 | **182** | 3 | **7** | 5 | **11** | 5 | **12** | 4 | **9** | 25 | 50 | 59.8 |
| 62 | Exist + Project (Funded) | 2,343 | 86 | **2,026** | 3 | **70** | 5 | **117** | 2 | **36** | 4 | **94** | 25 | 50 | 69.3 |
| 63 | Exist + Project (Enhanced) | 2,044 | 85 | **1,734** | 3 | **61** | 5 | **102** | 3 | **65** | 4 | **82** | 25 | 50 | 69.0 |
| 64 | Exist + Alternative (Funded) | 2,123 | 86 | **1,832** | 3 | **64** | 5 | **106** | 2 | **36** | 4 | **85** | 25 | 50 | 68.9 |
| 65 | Exist + Alternative (Enhanced) | 1,852 | 84 | **1,565** | 3 | **56** | 5 | **93** | 4 | **65** | 4 | **74** | 25 | 50 | 68.7 |
| 66 | 2030 No Project | 2,343 | 87 | **2,050** | 3 | **70** | 5 | **117** | 1 | **12** | 4 | **94** | 25 | 50 | 69.0 |
| 67 | 2030 + Project (Funded) | 2,343 | 86 | **2,026** | 3 | **70** | 5 | **117** | 2 | **36** | 4 | **94** | 25 | 50 | 69.3 |
| 68 | 2030 + Project (Enhanced) | 1,852 | 84 | **1,565** | 3 | **56** | 5 | **93** | 4 | **65** | 4 | **74** | 25 | 50 | 68.7 |
| 69 | 2030 + Alternative (Funded) | 2,123 | 86 | **1,832** | 3 | **64** | 5 | **106** | 2 | **36** | 4 | **85** | 25 | 50 | 68.9 |
| 70 | 2030 + Alternative (Enhanced) | 1,852 | 84 | **1,565** | 3 | **56** | 5 | **93** | 4 | **65** | 4 | **74** | 25 | 50 | 68.7 |

| No. | Avenue of the Palms south of 1st Stre | TOTAL # VEHICLES | Auto % | Auto | Medium Truck % | MT | Heavy Truck % | HT | Bus % | Bus | Motorcycle % | moto | Vehical Speed miles/hour | Distance to Receptor (feet) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71 | Existing | 300 | 84 | **252** | 3 | **9** | 5 | **15** | 4 | **12** | 4 | **12** | 25 | 50 | 60.8 |
| 72 | Exist + Project (Funded) | 2,931 | 87 | **2,543** | 3 | **88** | 5 | **147** | 1 | **36** | 4 | **117** | 25 | 50 | 70.2 |
| 73 | Exist + Project (Enhanced) | 2,736 | 86 | **2,343** | 3 | **82** | 5 | **137** | 2 | **65** | 4 | **109** | 25 | 50 | 70.1 |
| 74 | Exist + Alternative (Funded) | 2,835 | 87 | **2,459** | 3 | **85** | 5 | **142** | 1 | **36** | 4 | **113** | 25 | 50 | 70.0 |
| 75 | Exist + Alternative (Enhanced) | 2,477 | 85 | **2,115** | 3 | **74** | 5 | **124** | 3 | **65** | 4 | **99** | 25 | 50 | 69.7 |
| 76 | 2030 No Project | 3,135 | 88 | **2,747** | 3 | **94** | 5 | **157** | 0 | **12** | 4 | **125** | 25 | 50 | 70.3 |
| 77 | 2030 + Project (Funded) | 3,135 | 87 | **2,723** | 3 | **94** | 5 | **157** | 1 | **36** | 4 | **125** | 25 | 50 | 70.5 |
| 78 | 2030 + Project (Enhanced) | 2,477 | 85 | **2,115** | 3 | **74** | 5 | **124** | 3 | **65** | 4 | **99** | 25 | 50 | 69.7 |
| 79 | 2030 + Alternative (Funded) | 2,835 | 87 | **2,459** | 3 | **85** | 5 | **142** | 1 | **36** | 4 | **113** | 25 | 50 | 70.0 |
| 80 | 2030 + Alternative (Enhanced) | 2,477 | 85 | **2,115** | 3 | **74** | 5 | **124** | 3 | **65** | 4 | **99** | 25 | 50 | 69.7 |

| No. | Avenue of the Palms south of 1st Stre | TOTAL # VEHICLES | Auto % | Auto | Medium Truck % | MT | Heavy Truck % | HT | Bus % | Bus | Motorcycle % | moto | Vehical Speed miles/hour | Distance to Receptor (feet) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 81 | Existing | 79 | 73 | **58** | 3 | **2** | 5 | **4** | 15 | **12** | 4 | **3** | 25 | 50 | 56.7 |
| 82 | Exist + Project (Funded) | 1,088 | 85 | **921** | 3 | **33** | 5 | **54** | 3 | **36** | 4 | **44** | 25 | 50 | 66.3 |
| 83 | Exist + Project (Enhanced) | 950 | 81 | **771** | 3 | **29** | 5 | **48** | 7 | **65** | 4 | **38** | 25 | 50 | 66.4 |
| 84 | Exist + Alternative (Funded) | 982 | 84 | **828** | 3 | **29** | 5 | **49** | 4 | **36** | 4 | **39** | 25 | 50 | 65.9 |
| 85 | Exist + Alternative (Enhanced) | 859 | 80 | **691** | 3 | **26** | 5 | **43** | 8 | **65** | 4 | **34** | 25 | 50 | 66.0 |
| 86 | 2030 No Project | 1,088 | 87 | **945** | 3 | **33** | 5 | **54** | 1 | **12** | 4 | **44** | 25 | 50 | 65.8 |
| 87 | 2030 + Project (Funded) | 1,088 | 85 | **921** | 3 | **33** | 5 | **54** | 3 | **36** | 4 | **44** | 25 | 50 | 66.3 |
| 88 | 2030 + Project (Enhanced) | 859 | 80 | **691** | 3 | **26** | 5 | **43** | 8 | **65** | 4 | **34** | 25 | 50 | 66.0 |
| 89 | 2030 + Alternative (Funded) | 982 | 84 | **828** | 3 | **29** | 5 | **49** | 4 | **36** | 4 | **39** | 25 | 50 | 65.9 |
| 90 | 2030 + Alternative (Enhanced) | 859 | 80 | **691** | 3 | **26** | 5 | **43** | 8 | **65** | 4 | **34** | 25 | 50 | 66.0 |

**Existing - A.M. Weekday Peak Hour Noise Levels Leq**

| | Roadway Segment | Existing | Existing plus Project (Funded) | dBA Diffence | Significant Increase? | Existing plus Project (Enhanced) | dBA Difference | Significant Increase? |
|---|---|---|---|---|---|---|---|---|
| 1 | Avenue of the Palms, north of 1st Street | 61.9 | 67.6 | 5.7 | **Yes** | 67.2 | 5.3 | **Yes** |
| 2 | Avenue of the Palms, south of 1st Street | 62.2 | 68.3 | 6.1 | **Yes** | 68.2 | 6.0 | **Yes** |
| 3 | 1st Street, east of Avenue of the Palms | 54.6 | 64.8 | 10.2 | **Yes** | 64.9 | 10.3 | **Yes** |

**2030 - A.M. Weekday Peak Hour Noise Levels Leq**

| Roadway Segment | Existing | 2030 plus Project (Funded) | dBA Diffence | Significant Increase? | 2030 plus Project (Enhanced) | dBA Difference | Significant Increase? |
|---|---|---|---|---|---|---|---|
| Avenue of the Palms, north of 1st Street | 61.9 | 67.6 | 5.7 | **Yes** | 66.6 | 4.7 | **Yes** |
| Avenue of the Palms, south of 1st Street | 62.2 | 68.6 | 6.4 | **Yes** | 67.6 | 5.4 | **Yes** |
| 1st Street, east of Avenue of the Palms | 54.6 | 64.8 | 10.2 | **Yes** | 64.5 | 9.9 | **Yes** |

**Existing - P.M. Weekday Peak Hour Noise Levels Leq**

| Roadway Segment | Existing | Existing plus Project (Funded) | dBA Diffence | Significant Increase? | Existing plus Project (Enhanced) | dBA Difference | Significant Increase? |
|---|---|---|---|---|---|---|---|
| Avenue of the Palms, north of 1st Street | 61.3 | 68.8 | 7.5 | **Yes** | 68.7 | 7.4 | **Yes** |
| Avenue of the Palms, south of 1st Street | 61.9 | 69.6 | 7.7 | **Yes** | 69.6 | 7.7 | **Yes** |
| 1st Street, east of Avenue of the Palms | 56.8 | 65.9 | 9.1 | **Yes** | 66.3 | 9.5 | **Yes** |

**2030 - P.M. Weekend Peak Hour Noise Levels Leq**

| Roadway Segment | Existing | 2030 plus Project (Funded) | dBA Diffence | Significant Increase? | 2030 plus Project (Enhanced) | dBA Difference | Significant Increase? |
|---|---|---|---|---|---|---|---|
| Avenue of the Palms, north of 1st Street | 61.3 | 68.8 | 7.5 | **Yes** | 68.3 | 7.0 | **Yes** |
| Avenue of the Palms, south of 1st Street | 61.9 | 70.0 | 8.1 | **Yes** | 69.3 | 7.4 | **Yes** |
| 1st Street, east of Avenue of the Palms | 56.8 | 65.9 | 9.1 | **Yes** | 66.0 | 9.2 | **Yes** |

**Existing - Saturday Peak Hour Noise Levels Leq**

| Roadway Segment | Existing | Existing plus Project (Funded) | dBA Diffence | Significant Increase? | Existing plus Project (Enhanced) | dBA Difference | Significant Increase? |
|---|---|---|---|---|---|---|---|
| Avenue of the Palms, north of 1st Street | 69.3 | 69.3 | 0.0 | **No** | 69.0 | -0.3 | **No** |
| Avenue of the Palms, south of 1st Street | 60.8 | 70.2 | 9.4 | **Yes** | 70.1 | 9.3 | **Yes** |
| 1st Street, east of Avenue of the Palms | 56.7 | 66.3 | 9.6 | **Yes** | 66.4 | 9.7 | **Yes** |

**2030 - Saturday Peak Hour Noise Levels Leq**

| Roadway Segment | Existing | 2030 plus Project (Funded) | dBA Diffence | Significant Increase? | 2030 plus Project (Enhanced) | dBA Difference | Significant Increase? |
|---|---|---|---|---|---|---|---|
| Avenue of the Palms, north of 1st Street | 69.3 | 69.3 | 0.0 | **No** | 68.7 | -0.6 | **No** |
| Avenue of the Palms, south of 1st Street | 60.8 | 70.5 | 9.7 | **Yes** | 69.7 | 8.9 | **Yes** |
| 1st Street, east of Avenue of the Palms | 56.7 | 66.3 | 9.6 | **Yes** | 66.0 | 9.3 | **Yes** |

# APPENDIX E: AIR QUALITY HEALTH RISK ASSESSMENT

## Exposure to Diesel Particulate Matter (DPM) During Construction

### Phase 1 Construction

Receptors that would be exposed to DPM during construction of Phase 1 would include existing residents on Treasure Island, existing residents on Yerba Buena Island East and Yerba Buena Island West as well as workers located on the islands. As shown in the figure below, the maximum exposed individual in each of these groups would be exposed to DPM concentrations as follows:

(1) Treasure Island Existing Maximum Exposed Individual Resident (MEIR): 0.25μg/m$^3$

(2) Yerba Buena Island (East) MEIR: 0.23 μg/m$^3$

(3) Yerba Buena Island (West) MEIR: 0.31 μg/m$^3$

(4) Maximum Exposed Individual Worker (MEIW): 0.35 μg/m$^3$


*(Maximum Exposed Individuals from Phase 1 Construction)*

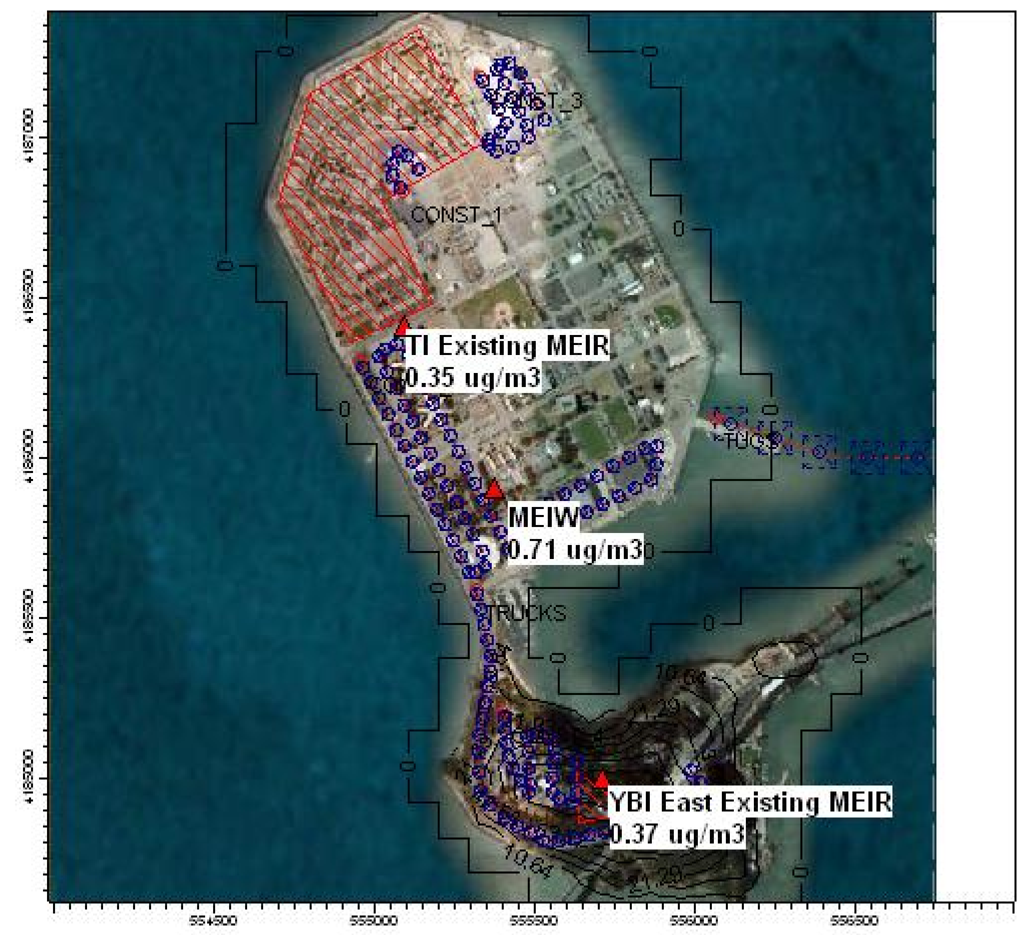
**Phase 2 Construction**

Receptors that would be exposed to DPM during construction of Phase 2 would include existing residents on Treasure Island, existing residents on Yerba Buena Island East as well as workers located on the islands. As shown in the figure below, the maximum exposed individual in each of these groups would be exposed to DPM concentrations as follows:

(1) Treasure Island Existing MEIR: 0.35μg/m$^3$

(2) Yerba Buena Island (East) MEIR: 0.37 μg/m$^3$

(3) Maximum Exposed Individual Worker (MEIW): 0.35 μg/m$^3$




*(Maximum Exposed Individuals from Phase 2 Construction)*

**Phase 3 Construction**

Receptors that would be exposed to DPM during construction of Phase 3 would include existing residents on Treasure Island, existing residents on Yerba Buena Island West, new residences constructed during Phase 2 as well as workers located on the islands. As shown in the Figure below, the maximum exposed individual in each of these groups would be exposed to DPM concentrations as follows:

(1) Treasure Island Existing MEIR: 0.05μg/m$^3$

(2) Yerba Buena Island (West) MEIR: 0.06 μg/m$^3$

(3) Phase 2 MEIR: 0.36 μg/m$^3$

(3) Maximum Exposed Individual Worker (MEIW): 0.55 μg/m$^3$


*(Maximum Exposed Individuals from Phase 3 Construction)*

**Phase 4 Construction**

Receptors that would be exposed to DPM during construction of Phase 4would include existing residents on Yerba Buena Island East and Yerba Buena Island West, new residences constructed during Phase 2 and 3 as well as workers located on the islands. As shown in the Figure below, the maximum exposed individual in each of these groups would be exposed to DPM concentrations as follows:

(1) Yerba Buena Island (East) MEIR: 0.01 μg/m$^3$

(2) Yerba Buena Island (West) MEIR: 0.01 μg/m$^3$

(3) Phase 2 MEIR: 0.12 μg/m$^3$

(4) Phase 3 MEIR: 0.14 μg/m$^3$

(5) Maximum Exposed Individual Worker (MEIW): 0.17 μg/m$^3$


*(Maximum Exposed Individuals from Phase 4 Construction)*

## Detailed Risk Calculations by Receptor Group from Construction DPM

### Existing Treasure Island Residential Receptors

Existing residents located on the northwest corner of the island would be exposed to DPM emissions generated during construction of Phases 1, 2 and 3 of the proposed project. The maximum annual average DPM concentration at any receptor within this neighborhood during construction of Phases 1, 2 and 3 would be $0.25\mu g/m^3$, $0.35\mu g/m^3$, and $0.05\mu g/m^3$, respectively. It should be noted that the maximum annual average DPM concentration for each of these phases would occur at a different receptor within this neighborhood; therefore this analysis presents a conservative analytic assumption as it assumes that an individual receptor would be exposed to the maximum concentration throughout construction. As shown below, incremental cancer risk at the MEIR in this neighborhood from construction of the proposed project would be approximately 8.8 in one million.

Phase 1 (Dose-inh) $= \frac{0.25\mu g/m^3 * 302 \text{ L/kg-day} * 1 * 350 \text{ days/year} * 3 \text{ years} * 10^{-6}}{(25{,}550 \text{ days})}$
$= 3.1 * 10^{-6}$

Phase 2 (Dose-inh) $= \frac{0.35\mu g/m^3 * 302 \text{ L/kg-day} * 1 * 350 \text{ days/year} * 3 \text{ years} * 10^{-6}}{(25{,}550 \text{ days})}$
$= 4.3 * 10^{-6}$

Phase 3 (Dose-inh) $= \frac{0.05\mu g/m^3 * 302 \text{ L/kg-day} * 1 * 350 \text{ days/year} * 3 \text{ years} * 10^{-6}}{(25{,}550 \text{ days})}$
$= 0.6 * 10^{-6}$

Total (Dose-inh) $= (3.1 * 10^{-6}) + (4.3 * 10^{-6}) + (0.6 * 10^{-6})$
$= 8.0 * 10^{-6}$

Cancer Risk $= 8.0 * 10^{-6}$ mg/kg-day * 1.1 $(\text{mg/kg-day})^{-1}$
$= 8.8 * 10^{-6}$
*~ 8.8 in one million*

### Phase 2 Treasure Island Residential Receptors

New residences constructed on Treasure Island during Phase 2 would likely be occupied during construction of Phases 3 and 4 and would therefore be exposed to elevated concentrations of DPM. During construction of Phase 3, the maximum exposed receptor in the area developed during Phase 2 would be exposed to a DPM concentration of up to $0.36\mu g/m^3$ and would be located at the south eastern portion of this area. During construction of Phase 4, the maximum exposed Phase 2 receptor would be exposed to a DPM concentration of up to $0.12\mu g/m^3$ and would be located near the northern end of the Phase 2 development area. It should be noted that the maximum annual average DPM concentration would occur a different receptor within this cluster of receptors during Phases 3 and 4, thereby rendering this a conservative analysis. As shown below, incremental cancer risk at the MEIR would be 9.9 in one million.

$$\text{Phase 3 (Dose-inh)} = \frac{0.36\ \mu g/m^3 * 302\ L/kg\text{-}day * 1 * 350\ days/year * 3\ years * 10^{-6}}{(25{,}550\ days)} = 4.5 * 10^{-6}$$

$$\text{Phase 4 (Dose-inh)} = \frac{0.12\ \mu g/m^3 * 302\ L/kg\text{-}day * 1 * 350\ days/year * 9\ years * 10^{-6}}{(25{,}550\ days)} = 4.5 * 10^{-6}$$

$$\text{Total (Dose-inh)} = (4.5 * 10^{-6}) + (4.5 * 10^{-6}) = 9.0 * 10^{-6}$$

$$\text{Cancer Risk} = 9.0 * 10^{-6}\ mg/kg\text{-}day * 1.1\ (mg/kg\text{-}day)^{-1} = 9.9 * 10^{-6}$$

*~ 9.9 in one million*

## Phase 3 Treasure Island Residential Receptors

New residences constructed on the east side of Treasure Island during Phase 3 would likely be occupied during construction of Phase 4 and would therefore be exposed to DPM emissions associated with construction activities. During construction of Phase 4, the maximum exposed resident on the east side of the island would be exposed to an annual average DPM concentration of approximately 0.14µg/m$^3$. As shown below, this would result in an incremental cancer risk of 5.7 in one million.

$$\text{Phase 4 (Dose-inh)} = \frac{0.14\ \mu g/m^3 * 302\ L/kg\text{-}day * 1 * 350\ days/year * 9\ years * 10^{-6}}{(25{,}550\ days)} = 5.2 * 10^{-6}$$

$$\text{Cancer Risk} = 5.2 * 10^{-6}\ mg/kg\text{-}day * 1.1\ (mg/kg\text{-}day)^{-1} = 5.7 * 10^{-6}$$

*~ 5.7 in one million*

## Existing Yerba Buena Receptors (West)

Existing residences on the western edge of Yerba Buena Island would be exposed to DPM emissions during construction of Phase 1. During Phase 2 it was assumed that existing residents would move out and residences would be demolished and rebuilt. It was assumed that these residences would then be reoccupied during construction of Phases 3 and 4. As a conservative analysis it was assumed that the same receptors would move back into the residences to be reconstructed and would therefore be exposed to elevated DPM concentrations during construction of Phases 1, 3 and 4. As shown below, maximum incremental cancer risk in this neighborhood would be 5.4 in one million.

Phase 1 (Dose-inh) $= \frac{0.31\ \mu g/m^3 * 302\ L/kg\text{-}day * 1 * 350\ days/year * 3\ years * 10^{-6}}{(25{,}550\ days)}$
$= 3.8 * 10^{-6}$

Phase 3 (Dose-inh) $= \frac{0.06\ \mu g/m^3 * 302\ L/kg\text{-}day * 1 * 350\ days/year * 3\ years * 10^{-6}}{(25{,}550\ days)}$
$= 0.7 * 10^{-6}$

Phase 4 (Dose-inh) $= \frac{0.01\ \mu g/m^3 * 302\ L/kg\text{-}day * 1 * 350\ days/year * 9\ years * 10^{-6}}{(25{,}550\ days)}$
$= 0.4 * 10^{-6}$

Total (Dose-inh) $= (3.8 * 10^{-6}) + (0.7 * 10^{-6}) + (0.4 * 10^{-6})$
$= 4.9 * 10^{-6}$

Cancer Risk $= 4.9 * 10^{-6}$ mg/kg-day * 1.1 $(mg/kg\text{-}day)^{-1}$
$= 5.4 * 10^{-6}$
*~ 5.4 in one million*

**Existing Yerba Buena Receptors (East)**

Existing residences located on Yerba Buena Island east of the residences described above would be exposed to elevated DPM concentrations during construction of Phases 1 and 2. During Phase 3 it was assumed that existing residents would move out and residences would be demolished and rebuilt. It was assumed that these residences would then be reoccupied during construction of Phase 4. As a conservative analysis it was assumed that the same receptors would move back into the residences to be reconstructed and would therefore be exposed to elevated DPM concentrations during construction of Phases 1, 2 and 4. As shown below, maximum incremental cancer risk in this neighborhood would be 8.7 in one million.

Phase 1 (Dose-inh) $= \frac{0.23\ \mu g/m^3 * 302\ L/kg\text{-}day * 1 * 350\ days/year * 3\ years * 10^{-6}}{(25{,}550\ days)}$
$= 2.9 * 10^{-6}$

Phase 2 (Dose-inh) $= \frac{0.37\ \mu g/m^3 * 302\ L/kg\text{-}day * 1 * 350\ days/year * 3\ years * 10^{-6}}{(25{,}550\ days)}$
$= 4.6 * 10^{-6}$

Phase 4 (Dose-inh) $= \frac{0.01\ \mu g/m^3 * 302\ L/kg\text{-}day * 1 * 350\ days/year * 9\ years * 10^{-6}}{(25{,}550\ days)}$
$= 0.4 * 10^{-6}$

Total (Dose-inh) $= (2.9 * 10^{-6}) + (4.6 * 10^{-6}) + (0.4 * 10^{-6})$
$= 7.9 * 10^{-6}$

Cancer Risk $= 7.9 * 10^{-6}$ mg/kg-day * 1.1 $(mg/kg\text{-}day)^{-1}$
$= 8.7 * 10^{-6}$
*~ 8.7 in one million*

**Worker Risk**

Risk at worker receptors was evaluated by modeling DPM concentrations throughout Treasure Island and Yerba Buena Island. The maximum annual average DPM concentration modeled for each phase was used to determine maximum incremental cancer risk at the MEIW. This represents an extremely conservative analysis as the maximum DPM concentration was modeled at a different receptor under each phase. As shown below, risk at the MEIW would be approximately 10 in one million.

Phase 1 (Dose-inh) $= \frac{0.35\ \mu g/m^3 * 149\ L/kg\text{-}day * 1 * 245\ days/year * 3\ years * 10^{-6}}{(25{,}550\ days)}$
$= 1.50 * 10^{-6}$

Phase 2 (Dose-inh) $= \frac{0.71\ \mu g/m^3 * 149\ L/kg\text{-}day * 1 * 245\ days/year * 3\ years * 10^{-6}}{(25{,}550\ days)}$
$= 3.04 * 10^{-6}$

Phase 3 (Dose-inh) $= \frac{0.55\ \mu g/m^3 * 149\ L/kg\text{-}day * 1 * 245\ days/year * 3\ years * 10^{-6}}{(25{,}550\ days)}$
$= 2.36 * 10^{-6}$

Phase 4 (Dose-inh) $= \frac{0.17\ \mu g/m^3 * 149\ L/kg\text{-}day * 1 * 245\ days/year * 9\ years * 10^{-6}}{(25{,}550\ days)}$
$= 2.19 * 10^{-6}$

Total (Dose-inh) $= (1.50 * 10^{-6}) + (3.04 * 10^{-6}) + (2.36 * 10^{-6}) + (2.19 * 10^{-6})$
$= 9.09 * 10^{-6}$

Cancer Risk $= 9.09 * 10^{-6}$ mg/kg-day * 1.1 (mg/kg-day)$^{-1}$
$= 9.999 * 10^{-6}$

Treasure Island
Construction DPM Emissions for HRA

Annual Diesel Particulate Matter Emissions (tons per year)

| | Phase 1-TI | Phase 1-YBI | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 1-VC | Phase 2-VC | Phase 3-VC | Phase 4-VC | Phase 5-VC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 0.886 | 0.700 | | | | | 0.508 | | | | |
| 2012 | 0.810 | 0.641 | | | | | 0.845 | | | | |
| 2013 | 0.738 | 0.585 | | | | | 3.20 | | | | |
| 2014 | | | 0.576 | | | | | 3.06 | | | |
| 2015 | | | 0.634 | | | | | 2.73 | | | |
| 2016 | | | 0.470 | | | | | 3.19 | | | |
| 2017 | | | | 0.586 | | | | | 2.67 | | |
| 2018 | | | | 0.524 | | | | | 1.53 | | |
| 2019 | | | | 0.468 | | | | | 2.07 | | |
| 2020 | | | | | 0.288 | | | | | 2.13 | |
| 2021 | | | | | 0.256 | | | | | 1.34 | |
| 2022 | | | | | 0.228 | | | | | 0.982 | |
| 2023 | | | | | | 0.341 | | | | | 0.799 |
| 2024 | | | | | | 0.303 | | | | | 0.488 |
| 2025 | | | | | | 0.268 | | | | | 0.194 |
| 2026 | | | | | | | | | | | 0.016 |
| 2027 | | | | | | | | | | | 0.043 |
| 2028 | | | | | | | | | | | 0.014 |
| 70-Year Average | 0.0348 | 0.0275 | 0.0240 | 0.0225 | 0.0110 | 0.0130 | 0.0651 | 0.1283 | 0.0895 | 0.0636 | 0.0222 |

Note: Construction schedule is 10 hours per day, 5 days per week, 52 week per year.
Includes onsite construction equipment; does not include tugs and offsite haul trucks.

PROJECT TITLE:
Funded Transit Scenario
Cancer Risk - All Sources

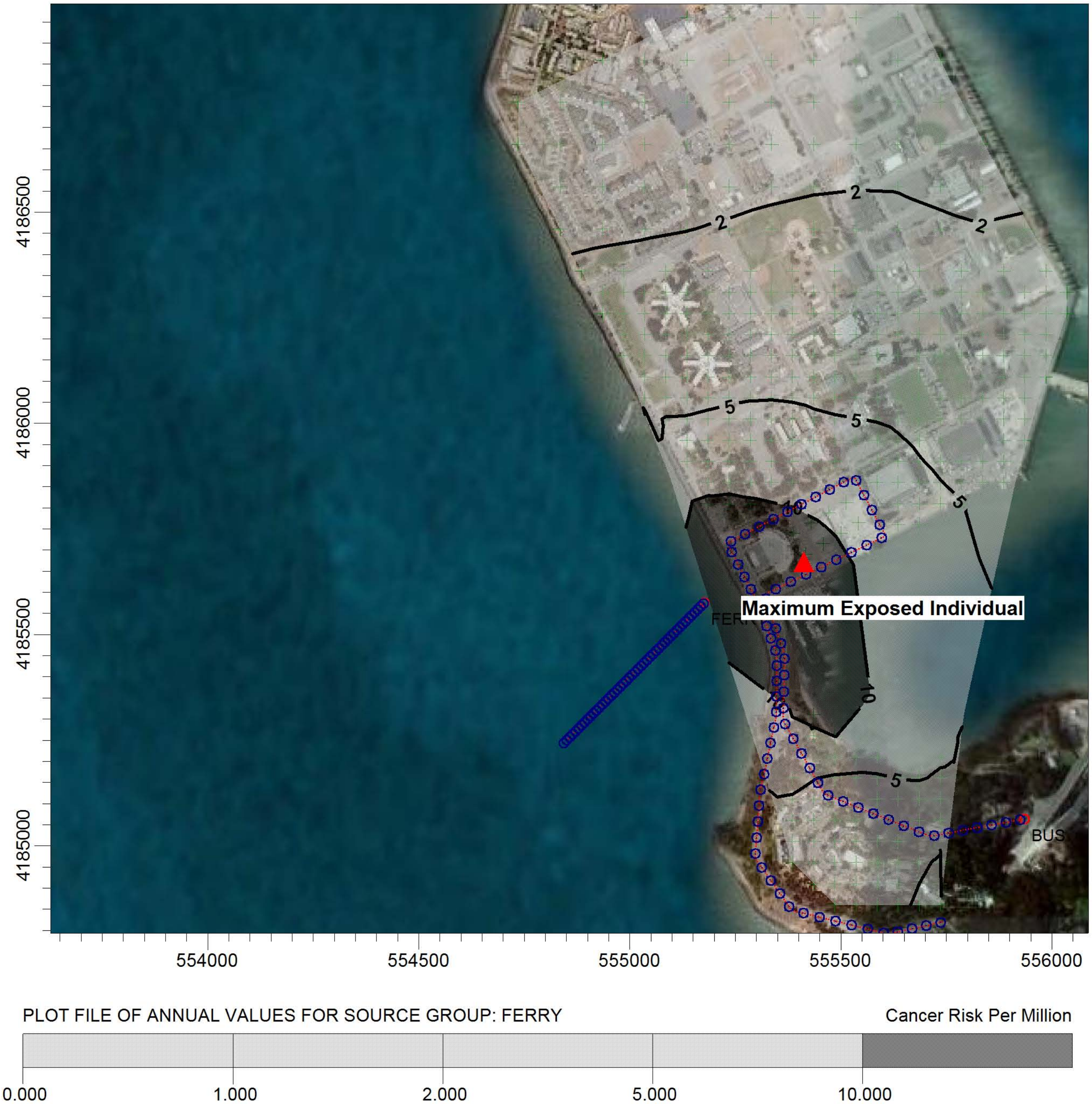

PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

Cancer Risk Per Million

0.000 1.000 2.000 5.000 10.000

| COMMENTS: | SOURCES: **2** | COMPANY NAME: **Environmental Science Associates** | |
|---|---|---|---|
| | RECEPTORS: **337** | | |
| | | SCALE: 1:15,000 (0 — 0.5 km) | |
| | MAX: **15.01645 Cancer Risl** | DATE: **1/8/2010** | |

PROJECT TITLE:
Funded Transit Scenario
Cancer Risk - Ferry Emissions Only

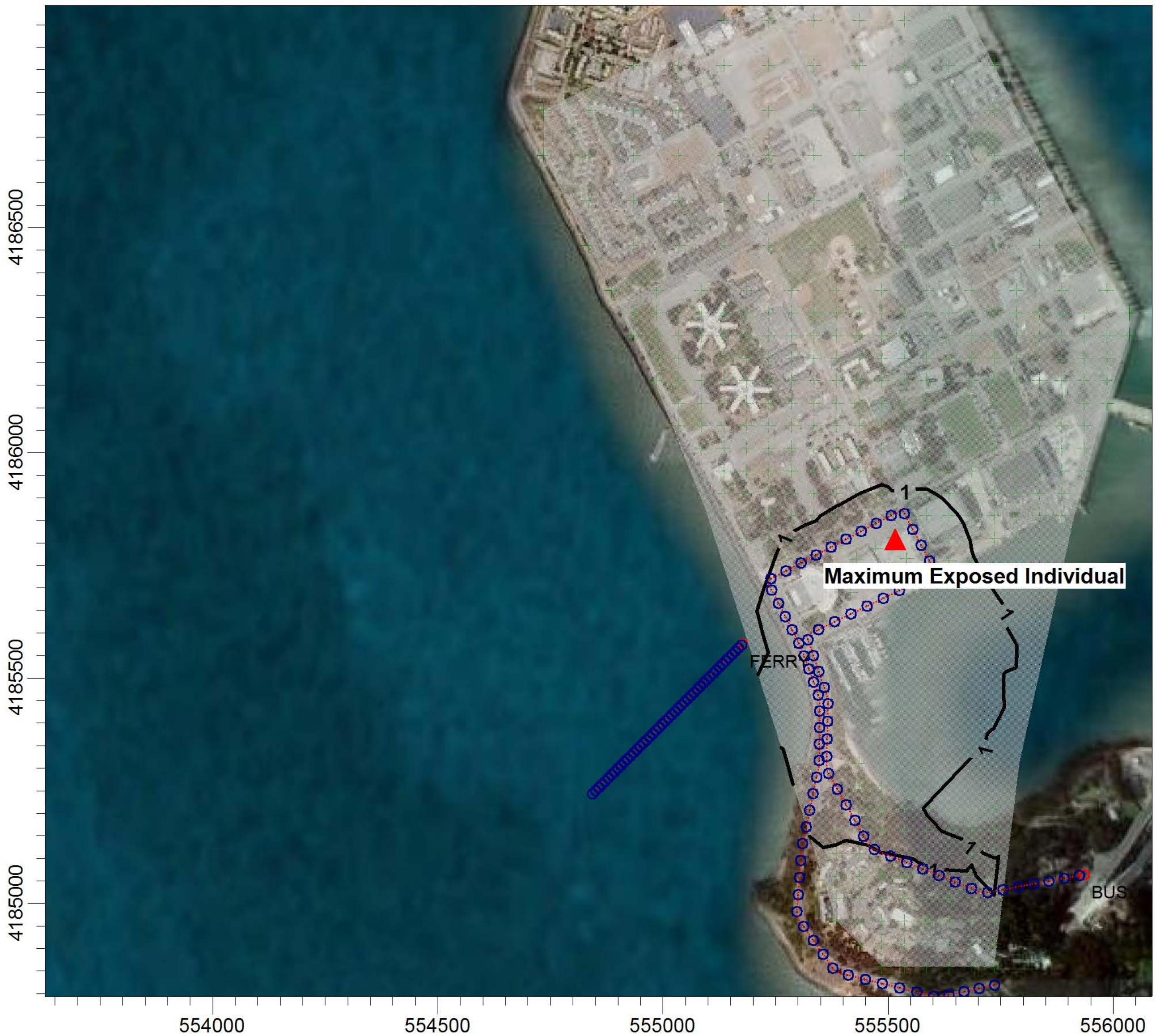



| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| | **2** | **Environmental Science Associates** | |
| | RECEPTORS: **337** | | |
| | | SCALE: 1:15,000<br>0 — 0.5 km | |
| | MAX: **13.1593 Cancer Risk** | DATE: **1/8/2010** | |

PROJECT TITLE:

Funded Transit Scenario

Cancer Risk - Bus Emissions Only




PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: BUS

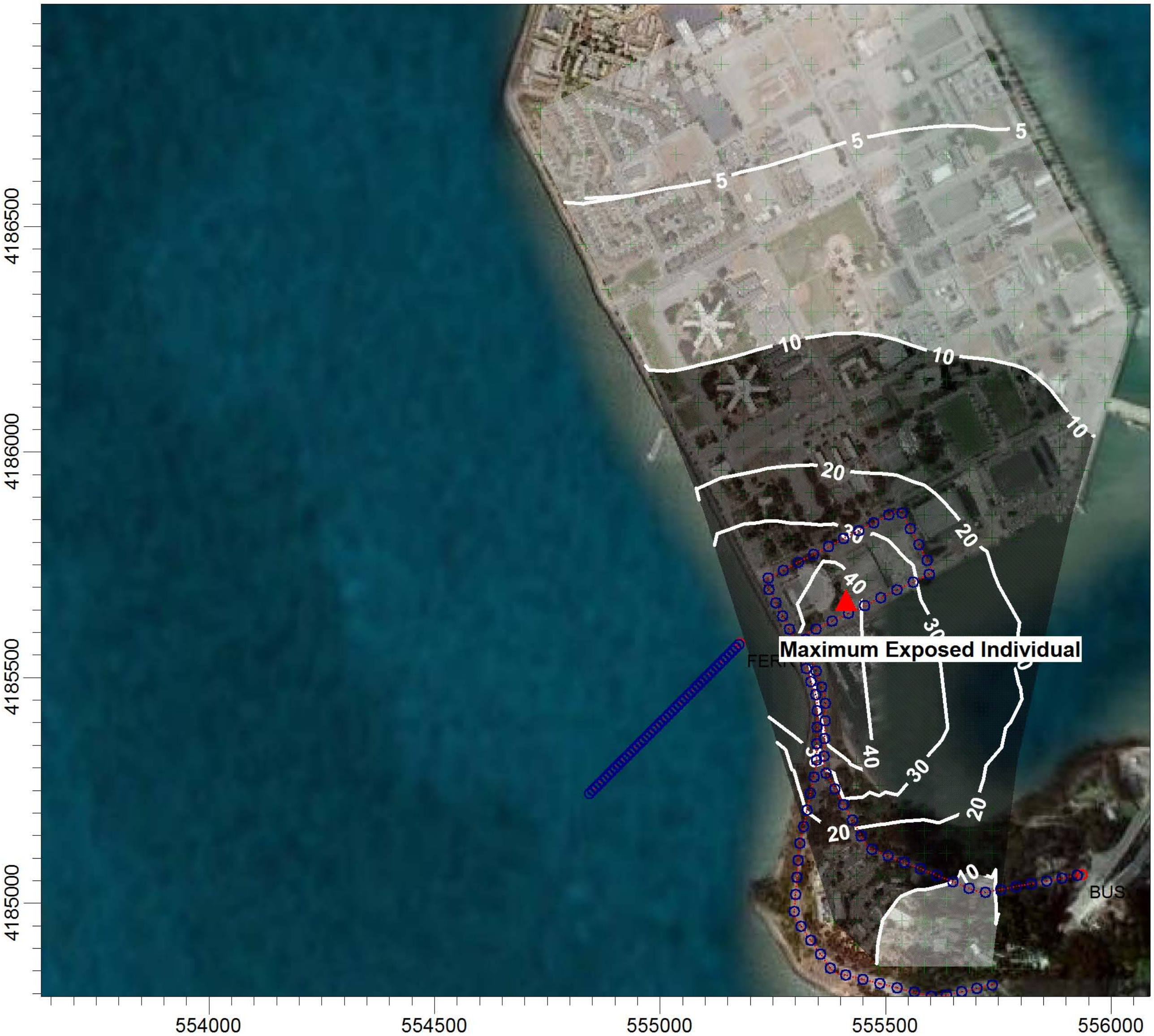
Cancer Risk Per Million

0.000 | 1.000 | 2.000 | 10.000

| | | | |
|---|---|---|---|
| COMMENTS: | SOURCES: **2** | COMPANY NAME: **Environmental Science Associates** | |
| | RECEPTORS: **337** | | |
| | | SCALE: 1:15,000 (0 — 0.5 km) | |
| | MAX: **1.94316 Cancer Risk** | DATE: **1/8/2010** | |

PROJECT TITLE:

Enhanced Transit Scenario
Cancer Risk - All Sources



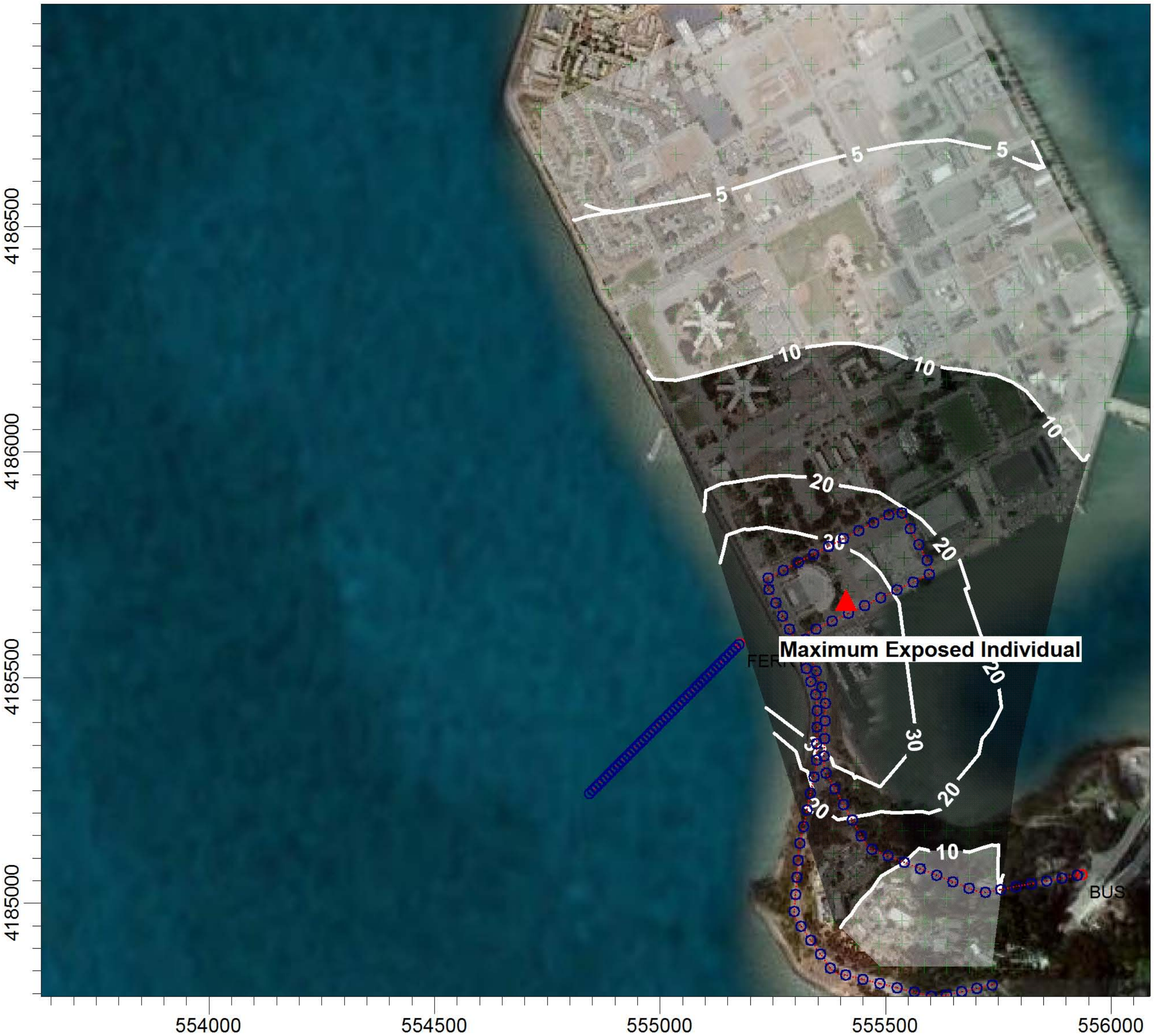

PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

Cancer Risk Per Million

0.000 | 5.000 | 10.000 | 20.000 | 30.000 | 40.000

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| | 2 | **Environmental Science Associates** | |
| | RECEPTORS: | | |
| | **337** | | |
| | | SCALE: 1:15,000<br>0 ——— 0.5 km | |
| | MAX: | DATE: | |
| | **44.64478 Cancer Risl** | **1/8/2010** | |

PROJECT TITLE:
Enhanced Transit Scenario
Cancer Risk - Ferry Emissions Only




PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: FERRY

Cancer Risk Per Million

0.000 | 5.000 | 10.000 | 20.000 | 30.000

| | | |
|---|---|---|
| COMMENTS: | SOURCES: **2** | COMPANY NAME: **Environmental Science Associates** |
| | RECEPTORS: **337** | |
| | | SCALE: 1:15,000 (0 – 0.5 km) |
| | MAX: **39.48109 Cancer Risl** | DATE: **1/8/2010** |

PROJECT TITLE:
Enhanced Transit Scenario
Cancer Risk - Bus Emissions Only


PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: BUS

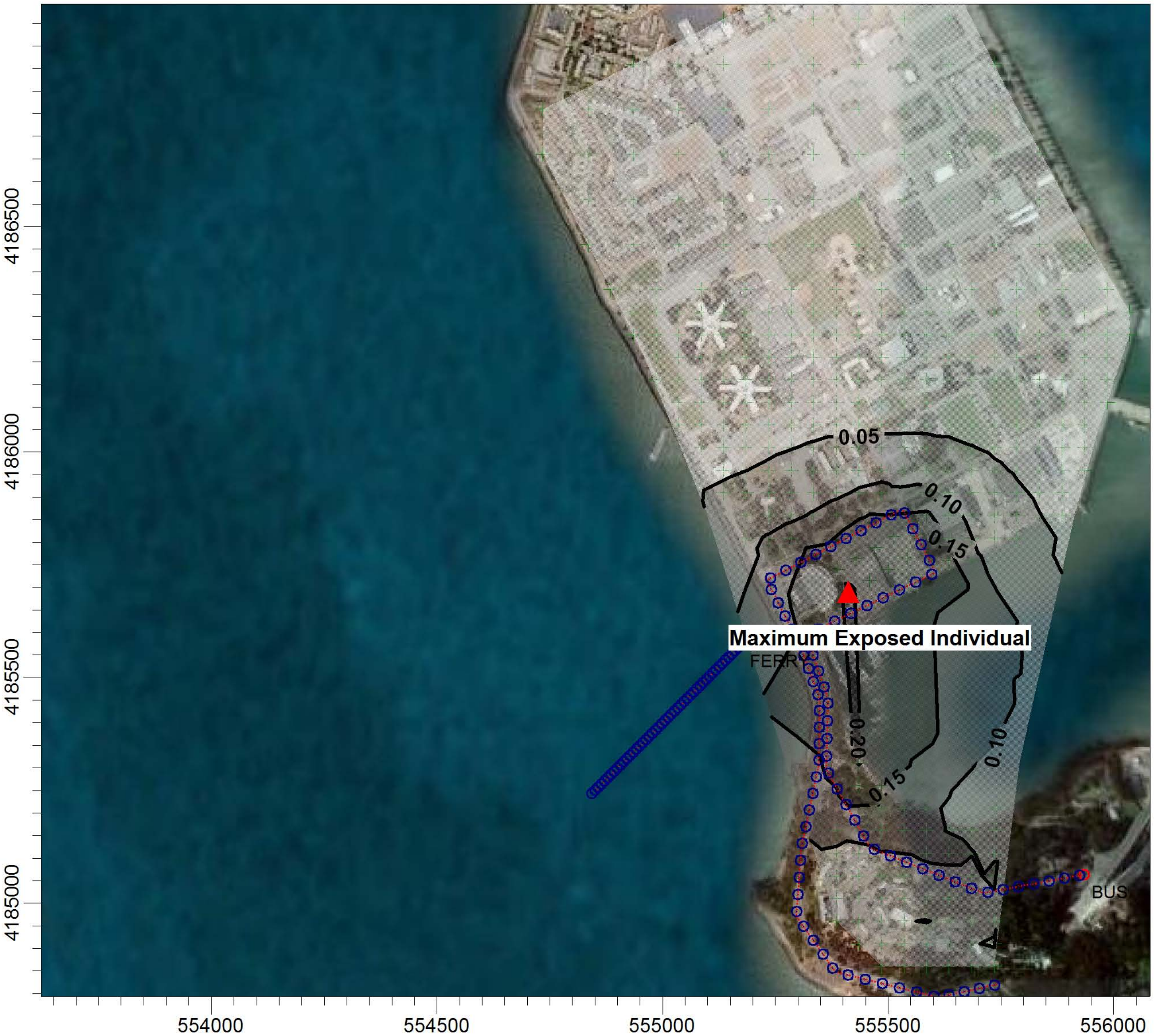
Cancer Risk Per Million

0.000 1.000 2.000 5.000 10.000

| | | |
|---|---|---|
| COMMENTS: | SOURCES: **2** | COMPANY NAME: **Environmental Science Associates** |
| | RECEPTORS: **337** | |
| | | SCALE: 1:15,000 (0 – 0.5 km) |
| | MAX: **5.40898 Cancer Risk** | DATE: **1/8/2010** |

ISC-AERMOD View - Lakes Environmental Software

PROJECT TITLE:
Funded Transit Scenario
PM2.5 Concentrations (Includes Ferry, Bus, and Passenger Vehicle Emissions)



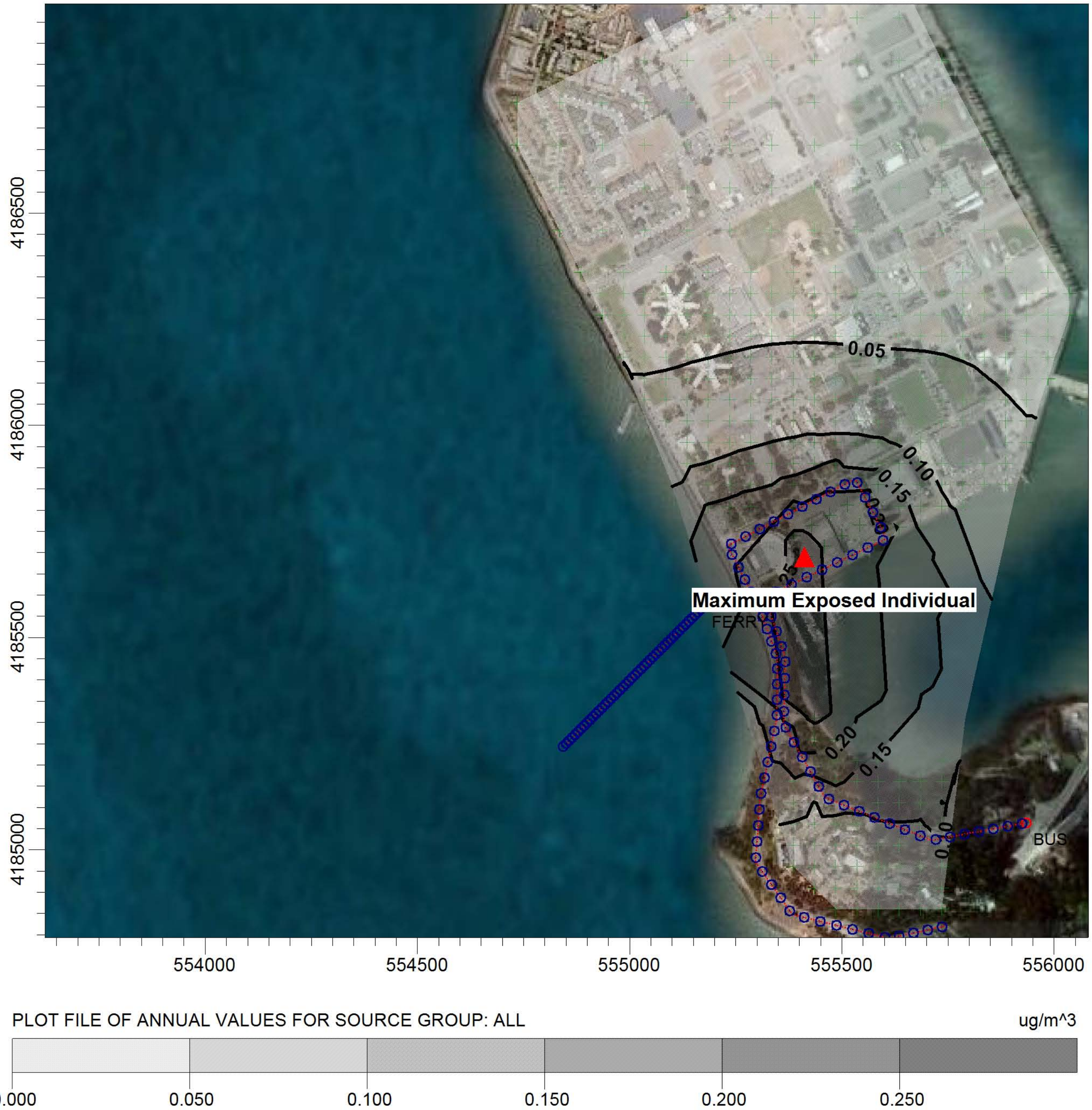

PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

ug/m^3

0.000 | 0.050 | 0.100 | 0.150 | 0.200

| COMMENTS: | SOURCES: | COMPANY NAME: |
|---|---|---|
| | 2 | **Environmental Science Associates** |
| | RECEPTORS: **337** | |
| | | SCALE: 1:15,000 (0 — 0.5 km) |
| | MAX: **0.20281 ug/m^3** | DATE: **1/8/2010** |

PROJECT TITLE:
Enhanced Transit Scenario
PM2.5 Concentrations (Includes Ferry, Bus, and Passenger Vehicle Emissions)




| | | |
|---|---|---|
| COMMENTS: | SOURCES: 2 | COMPANY NAME: **Environmental Science Associates** |
| | RECEPTORS: 337 | |
| | | SCALE: 1:15,000 (0 – 0.5 km) |
| | MAX: **0.27143 ug/m^3** | DATE: **1/8/2010** |

# APPENDIX F: APPROACH TO GREENHOUSE GAS EMISSIONS TREASURE ISLAND/YERBA BUENA ISLAND REDEVELOPMENT PROJECT EIR

ESA

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# memorandum

date July 2, 2010

to Barbara Sahm
Turnstone Consulting

from Chris Sanchez
Environmental Science Associates

subject Approach to Greenhouse Gas Emissions
Treasure Island/Yerba Buena Island Redevelopment Project EIR (ESA No. D207246)

The following outlines ESA's approach to the greenhouse gas emissions (GHG) inventory that will be used in the Treasure Island/Yerba Buena Island Redevelopment Project Environmental Impact Report (EIR).

## Short-term (One-Time) Impacts

Short-term or one-time emissions from the development of this Project are associated with vegetation removal and re-vegetation of the Project site, and construction-related activities. While construction activities also result in life-cycle emissions of GHG associated with the manufacture and transport of building materials and infrastructure, life-cycle emissions are not included in the final inventory as these emissions would be accounted for under Assembly Bill (AB) 32 in other industry sectors and are specifically identified as "speculative" in the 2009 CEQA Amendments. A discussion of lifecycle emissions and the uncertainties in their quantification will be included in the GHG section of the EIR.

### *Vegetation Sequestration Change*

The overall $CO_2$ emissions due to vegetation change would result from the amount that can be expected to be sequestered by new plantings. The Project would result in approximately 4,323 net new trees on both islands. This assumes relocation of 100 trees on Treasure Island (TI), removal of all of the remaining 1,677 existing trees on all of TI and the developed areas of Yerba Buena Island (YBI), and the planting of 6,000 new trees, as proposed by the applicant. The Proposed Project's net increase in trees would continue to sequester carbon after 20 years, although at a slower rate that is typically offset by losses from clipping, pruning, and occasional death. Although some of the 100 existing trees to remain may still be sequestering carbon, without specific knowledge as to the age of these existing trees, they were not considered in this conservative analysis. The BAAQMD Greenhouse Gas Model (BGM) model was used to estimate sequestration emissions associated with these trees assuming an equal split between medium-growth hardwoods and medium-growth conifers. BGM calculations show that temporary sequestering would remove approximately 22 MT $CO_2$e emissions annually.

Additionally, the proposed athletic fields would also sequester carbon and would have a net GHG benefit even after consideration of lawn maintenance practices. A majority of the proposed 40-acre sports park would consist of grass playing fields. Also considering residential and community plantings in addition to playing fields, the project would result in a net increase of 106 acres of lawn[1], which was used to calculate sequestration. BAAQMD's BGM model does not calculate sequestration from grasses but only from trees. Consequently, the calculation of sequestration from grasslands was performed using available studies. Sequestration rates for landscape grass range from 794 to 1,786 kg of carbon per hectare per year, depending on management practices employed.[2] Conservatively assuming the lowest sequestration rate, 106 additional acres of athletic fields and lawn would sequester approximately 1,124 MT $CO_2$e for the average 33 years of grassland sequestration or about 34 MT annually.[3,4] Total vegetation sequestration from trees and grass would total 56 MT of $CO_2$. As discussed above, other landscape plantings (shrubs, etc.) would also sequester carbon, but would only marginally increase relative to existing plantings. This annualized sequestering is subtracted from the total Project-related GHG emissions in Table 2 (Annual Proposed Project Related Operational $CO_2$e Emissions), on p. 4.

Ten to fifteen acres of wetlands are also proposed to be created as a method of storm water treatment. Other project variants also propose relatively smaller areas of wetlands. Wetlands act as both a carbon sink due to carbon sequestration as well as a carbon source resulting from methane generation. Recent studies indicate that estuarine wetlands are likely a net GHG sink "because they support both rapid rates of carbon sequestration and low methane emissions."[5] Additionally, use of wetlands for storm water treatment reduces the energy-related GHG emissions as compared with standard treatment technologies. However, given the developing nature of science around plant-specific carbon sequestration rates that are not related to forestry or agriculture, a quantitative estimate of the net carbon benefits of wetlands creation was not undertaken for this analysis, although wetlands would likely result in further GHG emission savings.

### *Construction-Related Activities*

$CO_2$ emissions associated with different aspects of construction activities for urban development can be estimated using a combination of software programs. BAAQMD's BGM model does not calculate GHG emissions from construction sources. Consequently, these emissions were calculated using the OFFROAD2007 and the EMFAC2007 models to generate emission factor data for construction equipment and motor vehicles, respectively. These values serve as inputs for the URBEMIS2007 model, which estimates emissions from several

1 CNG e-mail response from Kim Diamond on March 1, 2010.

2 West et al., *Considering the Influence of Sequestration Duration and Carbon Saturation on Estimates of Soil Carbon Capacity*, *Climatic Change*, January 2007.

3 West et al., *Considering the Influence of Sequestration Duration and Carbon Saturation on Estimates of Soil Carbon Capacity*, *Climatic Change*, January 2007.

4 The Sports Park may include some artificial turf fields, reducing the amount of grass by an unknown amount (see pp. 88-89 in the Treasure Island and Yerba Buena Island Design for Development, Public Review Draft, March 5, 2010). If this were to occur, the vegetation sequestration identified in this paragraph would be slightly less, and the resulting total operational GHG emissions shown in Tables 3 and 4 would be slightly greater. This change would not alter the conclusions regarding service population GHG emissions.

5 Bridgeham, Scott D., et al., *The Carbon Balance of North American Wetlands*, December 2006.

different phases of urban development including from emissions from construction sources based on emission factors and information specific to the Project.

Assumptions regarding construction timing and the number, type, and operating hours of equipment are based on the number and type of equipment that would be used in the construction of the Proposed Project, as well as the duration of each construction phase. These assumptions are used with $CO_2$ specific emission factors compiled in OFFROAD 2007 and EMFAC2007. Available models do not analyze emissions from construction-related electricity or natural gas consumption. Construction-related electricity and natural gas emissions vary based on the amount of electric power used during construction and other unknown factors that make them too speculative to quantify. In addition, this analysis assumes that all heavy duty construction equipment is diesel or gasoline powered and no substantial electrically-powered pieces of construction equipment are envisioned as necessary, based on the project description. While recently implemented federal standards (Tier 3 and Tier 4) will reduce emissions of nitrogen oxides and particulate matter on newly manufactured diesel construction equipment, these reductions are achieved through use of post combustion engineering applications to the diesel engine[6] and will not result in reduced $CO_2e$ emissions and no adjustments are warranted for this newer equipment.

Table 1, below, summarizes the construction activity-related GHG inventory and presents the emissions estimates in metric tons of $CO_2$. The table indicates that an estimated 243,039 MT $CO_2e$ emissions from Project construction equipment would be emitted over the course of the minimum construction period of 17 years. This is a conservative emission estimate that does not account for any Best Management Practices that may reduce GHG emissions.

**TABLE 1**
**CONSTRUCTION GENERATED GHG EMISSIONS OF THE PROPOSED PROJECT**

| | Emissions (metric tons $CO_2e$) | | | |
|---|---|---|---|---|
| **Emission Source** | **$CO_2$** | **$CH_4$** | **$N_2O$** | **Total $CO_2e$** |
| Worker Trips | 7,402 | 9 | 59 | 7,470 |
| Construction Equipment | 189,851 | 228 | 1,508 | 191,587 |
| Haul Trucks | 42,892 | 51 | 341 | 43,284 |
| Barge Tugs | 693 | 1 | 5 | 699 |
| **Total** | **240,838** | **289** | **1,913** | **243,040** |
| Construction Emissions (40-Year project lifetime amortization) | 6,021 | 7 | 48 | 6,076 |

Source: ESA, 2010

If these one-time emissions are annualized assuming a 40-year development life (which is likely low), the one-time emissions contribute approximately 6,076 MT $CO_2e$ emissions annually. These annualized emissions are added to the total Project-related GHG emissions in Table 2 (Emissions of GHG from the Proposed Project).

6 http://www.dieselnet.com/standards/us/nonroad.php, accessed March 31, 2010.

## Long-Term Operational Impacts

Long-term operational or annual emissions from the development of this Project include indirect GHG emissions from electricity use in residential and non-residential buildings and emissions from natural gas combustion used in residential and non-residential buildings, mobile sources, municipal sources, area sources, transit services, water conveyance and waste disposal. Table 2 (Emissions of GHG from the Proposed Project) lists the emissions for each of these categories. Table 3 presents the same information for the Proposed Project with Expanded Transit Service. Although the adopted BAAQMD CEQA Guidelines specifically state that they are not recommending a significance threshold relative to construction-related emissions of GHG's, the Guidelines also state that a lead agency should quantify construction related emissions and make a determination of significance relative to them. For this reason, amortized construction emissions were included in the inventory for the purposes of threshold comparison.

**TABLE 2**
**EMISSIONS OF GHG FROM THE PROPOSED PROJECT**

| | Emissions (metric tons $CO_2$e per year) | | | |
|---|---|---|---|---|
| **Emission Source/Sink** | **$CO_2$** | **$CH_4$** | **$N_2O$** | **Total $CO_2$e** |
| Construction Emissions (40 Year amortization) | 6,021 | 7 | 48 | 6,076 |
| Carbon sequestration of trees and grasses (40 Year amortization) | - 56 | -- | -- | - 56 |
| Motor vehicle trips | 45,431 | 139 | 2,729 | 48,299 |
| Buses | 971 | -- | 1 | 972 |
| Ferries | 3,215 | 5 | 26 | 3,246 |
| Shuttle Buses | 247 | 5 | 6 | 258 |
| Natural gas | 5,188 | 10 | 3 | 5,201 |
| Grid Electricity | -- | -- | -- | 1,030 |
| Solid Waste generation | -- | -- | -- | 4,544 |
| Water Conveyance | 452 | -- | 3 | 455 |
| Wastewater Treatment & Conveyance | On island WWTP Treatment & Conveyance Energy included in Grid Electricity Above | | | |
| Area Source (landscape maintenance) | 3 | -- | -- | 3 |
| **Total Project Operational Greenhouse Gas Emissions** | 64,472 | 166 | 2,816 | **70,025** |

Source: ESA, 2010

**TABLE 3**
**EMISSIONS OF GHG FROM THE PROPOSED PROJECT WITH EXPANDED TRANSIT SERVICE**

| | Emissions (metric tons $CO_2$e per year) | | | |
|---|---|---|---|---|
| **Emission Source/Sink** | **$CO_2$** | **$CH_4$** | **$N_2O$** | **Total $CO_2$e** |
| Construction Emissions (40 Year amortization) | 6,021 | 7 | 48 | 6,076 |
| Carbon sequestration of trees and grasses | -56 | -- | -- | - 56 |
| Motor vehicle trips | 38,147 | 116 | 2,292 | 40,555 |
| Buses | 1,905 | -- | 1 | 1,906 |
| Ferries | 9,645 | 15 | 77 | 9,737 |
| Shuttle Buses | 247 | 5 | 6 | 258 |
| Natural gas | 5,188 | 10 | 3 | 5,201 |
| Grid Electricity | -- | -- | -- | 1,030 |
| Solid Waste generation | -- | -- | -- | 4,544 |
| Water Conveyance | 452 | -- | 3 | 455 |
| Wastewater Treatment & Conveyance | On Island WWTP Treatment & Conveyance Energy included in Grid Electricity Above | | | |
| Area Source (landscape maintenance) | 3 | -- | -- | 3 |
| **Total Proposed Project with Expanded Transit Service Operational Greenhouse Gas Emissions** | 61,552 | 153 | 2,430 | **69,709** |

Source: ESA, 2010

### *Indirect Project Electrical GHG Emissions*

Both residential and non-residential uses require electricity for space and water heating, air conditioning, lighting, and plug-in outlets. Non-residential buildings may also require electricity to run mechanical or process equipment. The amount of energy and, therefore, the amount of associated GHG emissions emitted per dwelling unit would vary with the type of residential building.

GHGs are indirectly emitted as a result of the increased demand for electricity required for a proposed project. GHGs are emitted during the generation of electricity from fossil fuels. When electricity is used in a building, some portion of the electricity generation typically takes place off-site at the power plant, while other percentages are generated by renewable resources such as hydroelectric dams. The relative percentages of renewable and non-renewable resources vary from year to year based on the magnitude of available water flows at hydroelectric dams and other source variables. SFPUC receives a majority of its electricity from Hetch Hetchy hydroelectric sources. As a result, GHG emission rate data specific to SFPUC is one of the lowest for utilities in California. For 2007, the last verifiable year of analysis available, the SFPUC electrical emission factor was 39.53 pounds of $CO_2$e per Megawatt hour.[7] This factor, 39.53 pounds per megawatt hour, is provided in terms of $CO_2$e and the individual contribution of a separate $CH_4$ and $N_2O$, are not available. While fuel combustion generates $CH_4$ and $N_2O$, the

[7] Ostrander, Calla, Climate Action coordinator, City of San Francisco Department of the Environment, e-mail communication, June 23, 2010.

emissions of these GHGs typically comprise less than 1 percent of $CO_2$e emissions from electricity generation and natural gas consumption. Energy use in a building may be divided into (1) energy consumed by the built environment, and (2) energy consumed by uses that are independent of the construction of the building, such as plug-in appliances. In California, Title 24 governs energy consumed by the built environment, including the HVAC system, water heating, and some fixed lighting.

While BAAQMD's BGM program can quantify GHG emissions from electrical demand, it does not allow the user to adjust the statewide average emission factors which are currently using values from an incorrect CCAR source. Consequently, electrical GHG emissions were independently calculated using the SFPUC-specific emission factor for the last verifiable year to achieve a more refined analysis. Project electrical GHG emissions were calculated based on energy demand estimates contained in the 2009 Final Treasure Island Development Energy Study.[8] This study contains the results of an analysis undertaken to estimate building and site energy use for the Treasure Island/Yerba Buena Development Program. The analysis also defines profiles for this energy use, identifying how much energy is used annually. The resulting energy use quantities were then converted to GHG emissions by multiplying by the appropriate emission factors[9] and incorporating information on local electricity production. The net Project-related electrical GHG emissions would be 1,030 MT of $CO_2$e per year.

### *Project Natural Gas Combustion Emissions*

Project electrical GHG emissions were also calculated based on natural gas demand estimates contained in the 2009 Final Treasure Island Development Energy Study. GHG emission estimates from natural gas used the BAAQMD BGM program. The net Project-related natural gas GHG emissions would be 5,201 MT of $CO_2$e per year.

### *Area Sources*

Area source emissions stem from hearths (including gas fireplaces, wood-burning fireplaces, and wood-burning stoves) and small mobile fuel combustion sources such as lawnmowers and other landscape maintenance equipment. Fuel combustion associated with these sources produce direct GHG emissions. Since emissions from project-wide natural gas demand are already included in the natural gas combustion estimate above, no separate calculation for gas fireplaces is necessary. Further, BAAQMD and the City and County of San Francisco restrict the installation of wood-burning fireplaces and stoves to pellet stoves or EPA-approved devices in new construction.[10] This analysis assumes that hearth emissions would be from natural gas combustion and does not consider pellet stoves or wood-burning fireplaces beyond what was assumed from natural gas demand. An estimated 3 MT of $CO_2$e would be generated annually by landscape maintenance related to proposed new residential and commercial buildings. Emissions from landscape maintenance of proposed athletic fields are

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[8] ARUP, *TICD Treasure Island Development Energy Study*, Final, December 2009.

[9] The Beta version of the BGM model of the BAAQMD does not allow user alterations of the statewide emissions factors embedded in the model. Per discussion with BGM developer Tim Rimpo of Rimpo & Associates at the BAAQMD's May 25, 2009 BGM training workshop, the next version of the model will allow for the user to input utility-specific emission rates. Consequently electrical emissions were calculated using custom spreadsheets and not using BGM, as the PG&E emissions factor of 524 pounds of eCO2/mWhr is substantially less than the statewide emission factor of 805 pounds of CO2 per mWhr.

[10] BAAQMD Regulation 6, Rule 3-304: "Effective for construction permits issued after January 1, 2009, no person or builder shall commence construction of a new building or structure permitted to contain or containing a wood-burning device or install a new wood-burning device resulting from a remodel unless the device meets the requirements of Section 6-3-303."

accounted for in the earlier analysis of carbon sequestration of these proposed fields. While there will also be approximately 180 acres of open space and wetlands associated with the Project, these land uses do not require the same degree of maintenance (weekly to monthly operation of landscaping equipment) as manicured landscaping, and any seasonal emissions related to equipment operations such as for fire control, would not represent a substantial contribution to these estimated annual emissions.

### *Water and Wastewater Treatment and Conveyance*

Municipal sources of GHG emissions that can contribute to a GHG inventory include drinking water supply and wastewater treatment. In general, the majority of municipal sector GHG emissions are related to the energy used to convey, treat, and distribute water and wastewater. Thus, these emissions are generally indirect emissions from the production of electricity to power these systems. Additional emissions from wastewater treatment include $CH_4$ and $N_2O$, which are emitted directly from the wastewater.

The 2009 Final Treasure Island Development Energy Study accounted for electrical demand associated with all on-Island infrastructure activities. This included:

- Wastewater treatment plant operations and distribution facilities;
- Recycled water treatment plant operations and distribution facilities;
- Storm water treatment distribution facilities (storm water treatment itself is through natural, non-energy consuming processes like bioswales); and
- Potable water distribution. (Potable water treatment was not included in that report's estimate, and is discussed more below.)

Therefore, GHG emissions from wastewater treatment and conveyance are already contained in the emissions estimate for electrical demand discussed previously.

Treatment of potable water would be done off-Island and was not included in the 2009 Final Treasure Island Development Energy Study. The amount of electricity required to treat and supply water depends on the volume of water involved. According to Section IV.K, Utilities and Service Systems, of the DEIR, the Project would generate a net new water demand of 1.08 million gallons per day (mgd) after accounting for the demand by existing uses that would remain on the Islands.

Three processes are necessary to supply potable water to residential and commercial users: (1) supply and conveyance of the water from the source; (2) treatment of the water to potable standards; and (3) distribution of the water to individual users. Indirect emissions resulting from electricity use were determined by multiplying electricity use by California statewide $CO_2$, $CH_4$ and $N_2O$ emission factors from CCAR's General Reporting Protocol. Statewide emission factors are used rather than local PG&E factors to reflect the fact that drinking water in San Francisco is pumped from the Hetch Hetchy reservoir, and therefore has the potential to be pumped through the jurisdiction of different electricity providers. However, much of San Francisco's water is supplied via gravity flow and therefore the emission factors used are likely conservative estimates.

Energy use for different aspects of water treatment (e.g., source water pumping and conveyance, water treatment, distribution to users) was determined using the stated volume of water and energy intensities values from the

California Energy Commission. The BGM program of the BAAQMD was not used to calculate water and wastewater-related GHG emissions because it does not allow for user adjustment of water demand.

Emissions associated with wastewater treatment include indirect emissions necessary to power the treatment process and direct emissions from degradation of organic material in the wastewater, which are biogenic in nature and not considered as part of the Project's GHG inventory. Because the wastewater treatment plant is located on Treasure Island and the electrical demand for the treatment plant and on-island conveyance needs were accounted for in the 2009 Final Treasure Island Development Energy Study, GHG emissions from wastewater treatment and conveyance are already contained in the emissions estimate for electrical demand discussed previously.

While BAAQMD's BGM program can quantify GHG emissions from water demand treatment and conveyance, it does not allow the user to adjust the calculations to remove the wastewater treatment component. Consequently, water demand treatment and conveyance GHG emissions were independently calculated using the same methods and emission factors as BGM. In total, all water and wastewater treatment and conveyance for the Project are expected to produce approximately 455 MT of $CO_2$e annually.

### *Solid Waste Disposal Emissions*

The Project's proposed residential and non-residential uses would generate waste. A large percentage of this waste would be diverted from landfills either by waste generation reduction, recycling, or composting. San Francisco currently diverts a large portion of its waste generated (approximately 72 percent) and has goals to even further reduce the amount of waste sent to a landfill. The remainder of the waste not diverted would be disposed of at a landfill. Landfills emit GHG emissions associated with the anaerobic breakdown of material. The BAAQMD BGM model was used to estimate GHG emissions from solid waste generation. BGM uses the waste disposal rates for the various land uses from values compiled by CalRecycle (formerly the California Integrated Waste Management Board ).[11] These are likely overestimates since they do not account for the recent increases in waste percentages that would are diverted from a landfill. BGM also includes emissions from haul trucks transporting waste to the landfill. The total GHG emissions from solid waste generation are predicted by BGM to be 4,544 MT $CO_2$e per year for the Project. These estimates are likely conservative given the fact there are aggressive goals for waste reduction in San Francisco and that waste generation estimates are based on 1999 data (the most recent available) when statewide recycling rates were substantially lower than the present day 72 percent in San Francisco. In addition, this estimate does not account for the carbon sequestration that would occur as a result of disposal in the landfill of carbon that would not degrade. Although solid waste emissions are not included in the proposed BAAQMD "GHG Quantification Guidance Standard"[12] they are calculated and presented for the purposes of full disclosure and are not considered relative to BAAQMD's proposed GHG significance thresholds. Additionally, on-site composting would reduce the waste haul trips associated with waste generation assumed in the calculation.

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[11] California Integrated Waste Management Board, Statewide Waste Characterization Study Results and Final Report, available at http://www.calrecycle.ca.gov/publications/LocalAsst/34000009.pdf, December, 1999.

[12] Bay Area Air Quality Management District, *California Environmental Quality Act Air Quality Guidelines*, Table 4-3: GHG Quantification Guidance Standard, page 4-6. http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/Draft%20BAAQMD%20CEQA%20Guidelines_Dec%207%202009.ashx, accessed on March 31, 2010.

### *Mobile Source (Motor Vehicle) Emissions – Proposed Project*

The Proposed Project consists of high-density, compact residential and commercial development located within walking distance of an intermodal transit hub to maximize walking, bicycling, and use of public transportation, and to minimize the use and impacts of private automobiles.

As discussed in the Project Description and the Transportation Impact Sections of the DEIR, the Proposed Project would include numerous elements that would reduce motor vehicle trips compared to a similar project without trip reduction elements (termed a "business as usual" or BAU project). Specifically, the impact analysis considers both the Proposed Project transit scenario and a Proposed Project with Expanded Transit Service scenario. The Proposed Project would include the following trip-reduction elements:

- Ferry service every 50 minutes (corresponding to a single ferry operating at one of the existing docks in San Francisco);
- AC Transit bus service to downtown Oakland with service every 10 minutes;
- Continued SF Muni line 108 - Treasure Island bus service to Treasure Island with no island circulation; and
- On-island fleet shuttle service using alternatively fueled shuttle buses.

The Proposed Project with Expanded Transit Service would include the same elements as the Proposed Project's transit scenario, plus the following additions:

- New ferry service to San Francisco every 15 minutes (corresponding to three ferries operating at one of the existing docks in San Francisco);
- Modification of the existing SF Muni line 108 – Treasure Island bus service to increase peak hour frequency from every 15 minutes to every 7 minutes in the AM peak hour and every 5 minutes in the PM peak hour. Additionally, existing buses would be replaced with larger capacity buses;
- New SF Muni bus service to the San Francisco Civic Center area.

The mobile source emissions considered for this Project would result from the typical daily operation of motor vehicles by residents and non-residents. Vehicle trip generation from the Proposed Project is based upon information from the *Treasure Island and Yerba Buena Island Redevelopment Plan Transportation Impact Study*. The Proposed Project would result in a net increase of 30,330 standard vehicle trips per day over existing conditions. Emissions for vehicle trips were calculated using the URBEMIS2007 computer model. Trip generation rates of the model were adjusted to reflect the project-specific vehicle trip generation of the *Transportation Impact Study*. The model default vehicle trip lengths specific to urban areas of the San Francisco Bay Area Air Basin were adjusted to account for the fact that a majority of the vehicle trips would be destined for off-island locations. Consequently these trips would necessitate an additional 1.7 miles or 3.2 miles if traveling toward San Francisco or Oakland, respectively. Using a trip distribution ratio of 79 percent toward San Francisco and 21 percent toward Oakland from the transportation study, a composite average trip length addition factor of 2.0 miles was added to each default trip length.

URBEMIS2007 calculates the $CO_2$ emissions from motor vehicle trips based on trip generation and trip lengths. For mobile sources, $CH_4$ and $N_2O$ were explicitly calculated using emission factors from CCAR, multiplied by their respective GWP and added to the $CO_2$ emissions to result in total $CO_2e$ emissions from mobile sources. Vehicles associated with the Proposed Project would emit approximately 48,299 MT $CO_2e$ per year.

### *Mobile Source (Motor Vehicle) Emissions – Proposed Project with Expanded Transit Service*

The Proposed Project with Expanded Transit Service would result in reduced trip generation as a result of increased ferry and transit services provided under this scenario. GHG emissions for this scenario were calculated in the same manner as the Proposed Project. The Proposed Project with Expanded Transit Service would result in a net increase of 25,466 standard vehicle trips per day over existing conditions, which would emit approximately 40,554 MT $CO_2e$ per year.

### *Transit Service GHG Emissions – Proposed Project*

Emissions from the intermodal Transit Hub are associated with increased public transport needed to serve the Proposed Project. GHGs are emitted from public buses when the vehicles are in transit and when the vehicles are idling at the curbside. The emissions are based on the net new miles and trips made by transit servicing the Project. The details of the net new transit service were provided by Fehr & Peers.

Bus emissions were estimated using emission factors for diesel buses generated by the EMFAC2007 model of ARB, daily vehicle bus trip generation provided by Fehr & Peers, and trip lengths estimated based on destinations. New transit trips under the Proposed Project would consist of new AC Transit service to downtown Oakland. A bus trip length of 8.3 miles to downtown Oakland was assumed. AC Transit currently has three hydrogen fuel cell buses as part of a demonstration project and 12 more will be in service in 2010. These 15 AC Transit zero-emission busses represent approximately two percent of its current fleet of 674 buses. Consequently, as a conservative analysis, GHG emissions from new bus service under the Proposed Project is assumed to be entirely diesel, although the likelihood is that by the 2030 build-out year of the Project, a substantially greater percentage of buses could emit zero emissions. Therefore the estimate of transit related GHG emission is considered a worst-case analysis and likely overestimates future emissions.

The total amount of GHG emissions from the diesel transit service under the Proposed Project is estimated to be 972 MT of $CO_2e$ per year. Additionally, there would be 120 daily alternatively fueled on-island shuttle trips generated by the Proposed Project. The type of alternative fuel has not been specified and for the purpose of this analysis was assumed to be compressed natural gas (CNG) based on its ubiquity as an alternative bus fuel. Shuttle bus routes would consist of two separate island loops on TI and one on YBI. A worst case loop length of 2.5 miles was assumed. The analysis used CCAR emission factors for CO2, $CH_4$ and $N_2O$ for CNG. GHG emissions from the alternative fueled shuttle busses are estimated to be approximately 258 MT of $CO_2e$ per year.

### *Transit Service GHG Emissions – Proposed Project with Expanded Transit Service*

In addition to transit service to downtown Oakland the Proposed Project with Expanded Transit Service would also provide additional Muni line 108 – Treasure Island service to the Transbay Terminal and a new service line to the Civic Center area of San Francisco. Emissions from additions to SF Muni bus service under the Proposed Project with Expanded Transit Service scenario assumed trip lengths from Treasure Island to the Transbay Terminal (3.6 miles) for additions to Muni line 108, and to the Civic Center area of San Francisco (5.3 miles) as a new service line (consistent with the Transportation Impact Study).

Although San Francisco uses carbon-free electricity to power its electric buses and trolleys, these vehicles do not and would not serve the Islands. While approximately 17 percent of the SFMTA non-electric bus fleet consist of hybrid buses that reduce fuel usage by 25 percent, as a conservative assumption, all new SFMTA bus trips were assumed to be diesel. Additionally, San Francisco transit buses use a 20 percent blend of biodiesel fuel (B20, 20 percent biodiesel, 80 percent petroleum diesel). Use of biodiesel reduces GHG emission based on a lifecycle analysis of fuel production. However exhaust emission of $CO_2$ from B20 have been demonstrated to be similar to that of standard diesel. Consequently, as a conservative analysis of GHG emissions from new Muni bus service under the Proposed Project with Expanded Transit Service is based on exhaust emissions only and is not based on life cycle considerations. It is estimated however that the total lifecycle GHG emissions for biodiesel are 41 percent less than those from petroleum diesel.[13] The total amount of GHG emissions from the diesel transit service under the Proposed Project with Expanded Transit Service is estimated to be 1,906 MT of $CO_2$e per year. Similar to the Proposed Project with base transit service, the Proposed Project with Expanded Transit Service would also generate 120 daily alternative-fueled on-island shuttle trips. GHG emissions from the alternative-fueled shuttle buses are estimated to be approximately 258 MT of $CO_2$e per year.

### *Ferry Service GHG Emissions – Proposed Project*

Emissions from the proposed new ferry service were estimated using fuel consumption data provided by Elliot Bay Design Group specific to the types of ferries under consideration for the project.[14] These emissions estimates examined three different engine and generator configurations. The worst case configuration was assumed for fuel consumption. The daily profile assumed 15 round trips with eight percent of the daily operations at commute speed, 10 percent of the daily operations at maneuvering speed, 15 percent of the daily operations at cruise speed, 25 percent of the daily operations at dock and 42 percent of the day idle (not in use) over a 24-hour period. Ferries were assumed to use shore power during idle time at the dock. The analysis used CCAR emission factors for $CO_2$, $CH_4$ and $N_2O$ for diesel. GHG emissions from the ferry service are estimated to be approximately 3,245 MT of $CO_2$e per year.

### *Ferry Service GHG Emissions – Proposed Project with Expanded Transit Service*

The Proposed Project with Expanded Transit Service would increase ferry service from every 50 minutes (corresponding to a single ferry operating at one of the existing docks in San Francisco) under the proposed Project to ferry service to San Francisco every 15 minutes (corresponding to a three ferries operating at one of the existing docks in San Francisco). GHG emissions for this scenario were calculated in the same manner as the Proposed Project. The Proposed Project with Expanded Transit Service would result in approximately 9,737 MT $CO_2$e per year.

### *Total Annual GHG Emissions – Proposed Project*

As shown in Table 2, using all the emission source categories quantified above, the total annual GHG emissions generated from the Project, with the design features related to energy use and transit, is approximately 70,025 MT $CO_2$e per year. The table reveals that the majority of annual Project emissions is the result of vehicle use (69 percent), followed by natural gas demand (7 percent).

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[13] Hill, Jason, et.al., Environmental, *Economic and Energetic Costs and Benefits of Biodiesel and Ethanol Biofuels*, Proceedings of the National Acadmy of Science, June 2, 2006.
[14] Elliot Bay Design Group, Memorandum to Wilson Meany Sullivan, August 15, 2009.

Several emissions sources were not quantified in this inventory, due to the inherent speculative nature of assumptions required for their estimation. These sources include lifecycle emissions and emissions from refrigeration leaks. Life-cycle emissions of GHG would be associated with the manufacture and transport of building materials and infrastructure. Life-cycle emissions are not included in the final inventory as these emissions would be accounted for under AB 32 in other industry sectors and are specifically identified as "speculative" in the 2009 CEQA Amendments. A discussion of lifecycle emissions and the uncertainties in their quantification will be included in the GHG section of the EIR. Emissions associated with leaks of high global warming potential gases such as from refrigeration leaks were not quantified. While the BAAQMD's BGM model can calculate emissions from refrigerant losses, the model requires specific data (the pounds of charge of refrigerant for all air handling units) to make this calculation. At the entitlement stage of development, data necessary to estimate emissions is not readily available. Therefore GHG emissions from leaking refrigeration gases could not be quantified for the Proposed Project.

### *Total Annual GHG Emissions –Proposed Project with Expanded Transit Service*

As shown in Table 3, using all the emission source categories quantified above, the total annual GHG emissions generated from the Proposed Project with Expanded Transit Service with the design features related to energy use and transit is approximately 69,709MT $CO_2$e per year. The table reveals that the majority of annual Project emissions is the result of vehicle use (58 percent), followed by ferries (14 percent).

BAAQMD is the only agency with jurisdiction over the Proposed Project that has adopted quantitative CEQA thresholds of significance for operational-related GHG emission impacts. At present, two options relevant to the Proposed Project are under consideration for operational GHG emission thresholds; the lead agency can choose either option. Option 1 is based on a project's total operational GHG emissions of 1,100 MT $CO_2$e per year. The Proposed Project's total operational emissions would exceed this level, which means that if this threshold were used, the Proposed Project's GHG impact could be considered significant. Option 2, which would apply to most land use development projects, including residential, commercial, industrial, and public land uses, is based on the amount of a project's operational GHG emissions per capita of the service population, a threshold of 4.6 MT $CO_2$e per year.

Although, the adopted BAAQMD CEQA Guidelines specifically state that they are not recommending a significance threshold relative to construction-related emissions of GHGs, the Guidelines do state that a lead agency should quantify construction related emissions and makes a determination of significance relative to them. For this reason amortized construction emissions were included in the inventory for the purposes of threshold comparison.

The resulting emissions for the Proposed Project and the Proposed Project with Expanded Transit Service can then be divided by a service population calculated as the sum of 16,830 additional net new residents and 2,390 net new employees for a total service population of 19,220. This results in service population emissions of 3.6 MT/yr/service population for the Proposed Project and for the Proposed Project with Expanded Transit Service. Because service population-based emissions would be less than the BAAQMD significance threshold of 4.6 MT/year/service population, the Proposed Project and the Proposed Project with Expanded Transit Service would be considered to have a less than significant impact with respect to emissions of GHG.

# APPENDIX G: TREASURE ISLAND WIND CONDITIONS TECHNICAL MEMORANDUM

# Technical Memorandum

TO: Nancy Clark
Turnstone Consulting
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San Francisco, CA 94107

FROM: Charles Bennett
Environmental Science Associates
225 Bush Street, Suite 1700
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DATE: April 10, 2010

SUBJECT: Potential Wind Conditions at Treasure Island
Under the Proposed Treasure Island / Yerba Buena Redevelopment Plan
Pedestrian Area Testing
San Francisco, California
ESA 209672

## I. Introduction and Overview

A series of wind tunnel tests were performed in January 2010 for the proposed Treasure Island / Yerba Buena Redevelopment Project (the Project) in the City of San Francisco. Although the Project would include development on both Islands, the changes in pedestrian level wind conditions on Yerba Buena Island due to the Project are generally expected to be both relatively small in magnitude and highly localized to individual building sites, compared to the larger scale and larger magnitude changes anticipated to occur on Treasure Island. This study therefore focused on Treasure Island; the wind tests were performed to define the pedestrian wind environment that would exist around the proposed development there. Pedestrian-level wind speeds were measured at a limited number of selected points for the Treasure Island site as it presently exists and at 200 points with the Proposed Project in place to quantify resulting pedestrian-level winds in public spaces near the Proposed Project.

The north half of Treasure Island now contains primarily two-story buildings, the central part contains scattered buildings up to three and four stories in height, and the south end of the Island contains several five-story buildings and hangars that are the tallest structures on the island. For the purpose of wind testing, the existing buildings at the site that would remain after site redevelopment were considered to be part of the existing setting conditions. These include the existing elementary school in the north, the Job Corps buildings in the center, and Buildings 1, 2 and 3 in the south of the Island. In addition, the two existing four-story star-shaped structures west of the Job Corps site were also considered as part of the existing setting conditions.

The development of the Project at the Treasure Island site would include demolition of many of the remaining existing buildings, minor elevation changes due to grading of the building sites and streets, and the construction of the many separate building clusters with buildings ranging in height from approximately 35 to 600 feet. The Project would include construction of approximately 19 high-rise towers, among a substantial base of low- and mid-rise buildings, on Treasure Island.

Because no building designs exist at this stage of development planning, this study used a proposed representative height and massing design to represent the Project in the wind-tunnel; a bulk model of this representative design was tested to evaluate likely effects that the Project would have on the street-level wind conditions on streets and within pedestrian areas of the development, in existing facility and recreation areas, and in the proposed locations of planned parks and open spaces. The intent of the study was to determine the general wind conditions that would exist within the development and to determine whether they would be compatible with the uses proposed at the site.

The Proposed Project would allow for flexibility in the shape and precise location of the towers; tower volumes may change as specific building designs are proposed. Although different building configurations will result in different ground-level wind effects, this study provides a solid basis for understanding the general street-level wind conditions that would result in pedestrian spaces from the overall massing of Project buildings.

Summaries of the test results and the study conclusions follow. Details of the background and test methods are presented in this technical memorandum in Section II, Background. The test results and discussion are presented in Section III, Test Cases and Study Results.

## Summaries of Tests

Two development scenarios were modeled and tested in the wind tunnel. The scenarios were: 1) Existing Setting, and 2) Project. Five wind directions were tested for each scenario: North-Northwest, Northwest, West-Northwest, West and South-Southeast. A relatively small number of test points (29) were measured to characterize the existing setting. These were judged to be sufficient to characterize the existing wind environment over most of the Island. Many test points (200) were measured to characterize the Project, due to the need to determine the future wind environment in more detail and with some certainty.

Although the Project site is not subject to the City of San Francisco Planning Code Section 148, the Section 148 wind hazard criterion, an equivalent wind speed not to exceed 26 mph for one hour per year, is used to evaluate a significant wind impact for the purposes of the California Environmental Quality Act (CEQA) in San Francisco. The other Section 148 wind criteria, an 11 mph pedestrian-comfort criterion and a 7 mph seating-comfort criterion, are based on wind speeds not to be exceeded 10% of the time (see detail on page 8). These Section 148 comfort criteria are not CEQA significance criteria. This study's discussions of wind hazards and of the wind speeds exceeded 10% of the time provide the reader with a basis for comparison with these familiar wind hazard and wind comfort criteria.

### *Existing Setting*

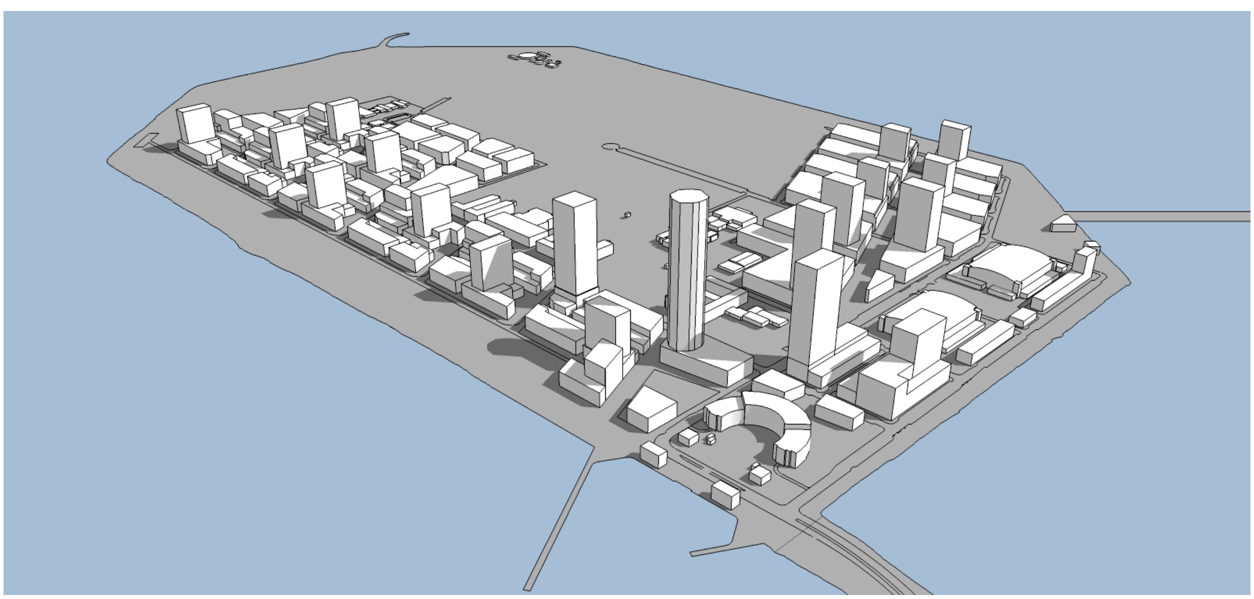
For the purpose of wind testing, the existing setting consists generally of the existing buildings on and in the vicinity of the Project site that would remain after site redevelopment. These include the existing elementary school in the north, the Job Corps buildings in the center, and Buildings 1, 2 and 3 in the south of the Island. In addition, the two existing four-story star-shaped structures west of the Job Corps site were also considered as part of the existing setting.

Treasure Island, the Project site, is located in San Francisco Bay, where conditions are typically very windy. The average of the wind speeds exceeded only 10% of the time, as measured at the 29 existing test points, is over 16 mph; existing wind speeds range from 10 to 20 mph. The highest wind speed measured in the test (20 mph) occurs at the south end of the southern-most Job Corps building. Two (2) of the 29 points meet the Section 148 pedestrian-comfort criterion of 11 mph; one of these is located at the north entrance to Building 3 and one is in the yard of the existing school.

The wind hazard criterion of Planning Code Section 148 is exceeded at 23 of the 29 existing test locations. In addition, it is certain that the wind hazard criterion is exceeded at a very large number of other existing locations all over the Island.

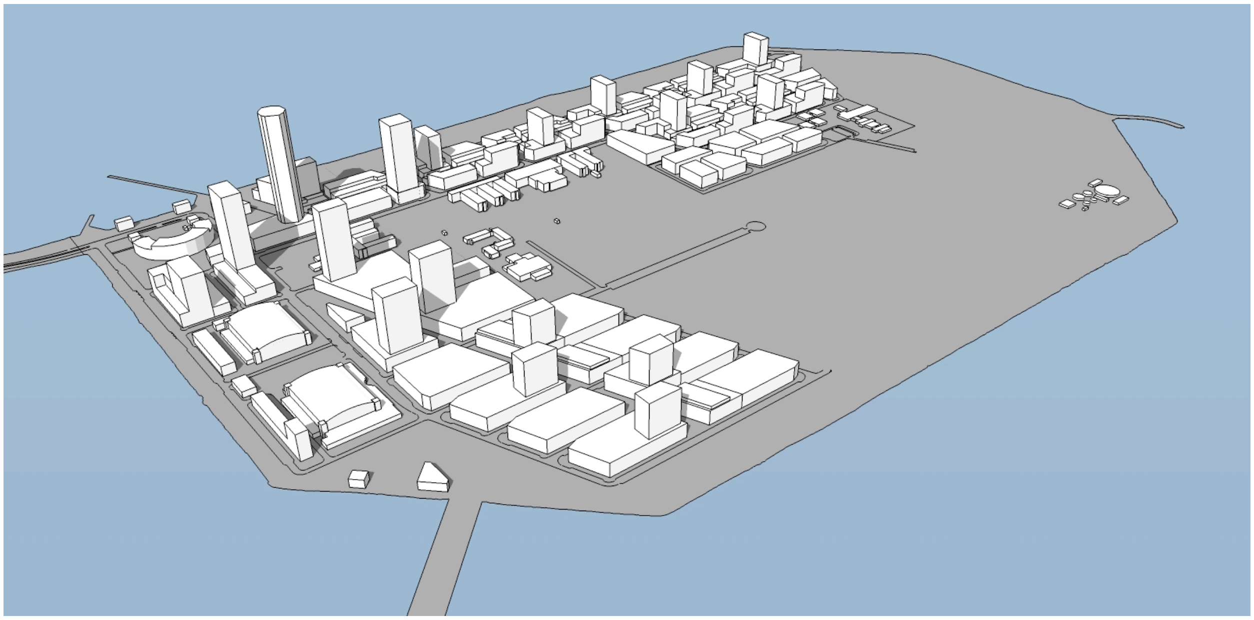
### *Project*

The Proposed Project scenario consists of a representative massing for the Proposed Project added to the existing buildings that would remain after site redevelopment. These include the existing elementary school in the north, the Job Corps buildings in the center, and Buildings 1, 2 and 3 in the south of the Island. Most of the other existing buildings would be demolished. The Proposed Project would involve construction of many separate building clusters with buildings ranging in height from approximately 35 to 600 feet. The proposed Redevelopment Plan would include construction of approximately 19 high-rise towers, among a substantial base of low- and mid-rise buildings, on Treasure Island. See Figures 1 and 2.



SOURCE: PERKINS + WILL, 2010

**FIGURE 1**
**Cityside View – Representative Massing of Proposed Project**



SOURCE: PERKINS + WILL, 2010

**FIGURE 2**
**Eastside View – Representative Massing of Proposed Project**

Wind speeds were measured at 200 locations within the Project and vicinity. These 200 points do not include the 6 test points that were used only to measure existing wind conditions. Of these 200 Project test points, 23 were also measured for the existing scenario. The following comparisons are made between the existing and Project wind conditions for winds measured at these 23 common locations.

With the Proposed Project, wind conditions at the exterior of the built areas would remain very windy, while wind speeds at locations within the interior of the development would generally decrease. The average of the 10% exceeded wind speeds measured for the 23 common test points would be less than 12 mph, a decrease of nearly 5 mph. Wind speeds at the common test points would range from 8 to 19 mph, with 13 of the 23 points meeting the Planning Code's pedestrian-comfort criterion. Nine existing exceedances of the pedestrian-comfort criterion would be eliminated, one new exceedance would be created, and 12 existing exceedances would remain.

With the Project, as compared to existing conditions, wind speeds would increase at two locations; remain unchanged at two locations; and decrease at 19 locations. Wind speed increases would range up to 4 mph; wind speed decreases would range up to 10 mph. The highest wind speed (19 mph) would occur at the south end of an existing Job Corps building that fronts on Avenue C.

With the Project, the Planning Code's wind hazard criterion would be exceeded at 2 of the 23 common test locations, 16 fewer than the existing 18 exceedances at those 23 locations. In addition, as is the case for the existing wind conditions, it is certain that the wind hazard criterion would be exceeded at many other exposed locations on the Island.

# Study Summary and Conclusions

Comparative wind tests conclusively show that the Proposed Project would reduce wind speeds and the occurrence of wind hazards throughout most of the built area of the Project. The study also shows that the Project would have no adverse effect on winds in the open spaces outside of the built area.

Wind speeds would vary widely across the Project development area. Of course, wind speeds would remain high in the shoreline parks and open spaces, which are fully exposed to the winds approaching Treasure Island over the Bay. Since the Project would face the shoreline and the approaching Bay winds would reach the Project generally unabated, wind speeds would be higher along the Project edges and generally would diminish in the interior of the developed neighborhoods of the Project. Although the wind speeds exceeded 10% of the time would be 12 mph or more at nearly 2/3 of the 200 Project test locations, 10% exceeded wind speeds at 74 test point locations would be at or less than the 11 mph pedestrian-comfort criterion of Section 148.

Wind speeds that would occur within the interior of the Project would be similar to those found in some of San Francisco's windier areas, such as Mission Bay.

The strong existing winds and their accompanying higher incidence of wind hazards would still occur in the exposed shoreline parks and open spaces. Existing wind hazards would continue to occur in the new Project open spaces, including a number of locations along the Cityside Waterfront Park, Cultural Park and Waterfront Plaza. These strong winds and accompanying wind hazards would not be caused by the Project, but simply reflect the overall wind environment of Treasure Island.

Of all 200 locations in the Project area that were tested in the wind tunnel, wind hazard conditions were detected at 49 of these locations (see map at Figure 4, page 29). In general, the relative incidence of wind hazards within the Project would be higher along the Project edges and wind speeds and the incidence of wind hazards generally would diminish in the interior of the Project.

Examples of locations where higher wind speeds and a higher incidence of wind hazards would occur primarily because they are located at an outer edge of the developed area include:

- *west*: along Cityside Avenue and the north end of the Waterfront Plaza;
- *north*: along 10th Street;
- *east*: along 4th Street, Eastside Avenue and the east end of 2nd Street; and,
- *south*: along the west end of 1st Street.

Within the interior of the developed area, wind hazards could be caused by local wind effects of the nearby individual high-rise towers and/or by strong incident winds that channel along street canyons, between the building masses. Examples of such locations include:

- the north end of Cityside Alley;
- along Avenue C, from 10th Street to 4th Street; and,
- along 3rd Street, between Eastside Avenue and Avenue D.

The relatively high incidence of wind hazards that would occur within the Project's central area, generally bounded by the Cultural Park, 4th Street, Avenue D, and California Avenue, may be due to several contributing causes. First, that area is open to the predominant winds from the west, which can enter through the Waterfront and Cultural Parks. Second, the Project and Job Corps buildings there are generally more widely spaced, thus offering less mass to block ground-level winds. Third, this area would have several high-rise buildings, including the tallest two towers in the Proposed Project, so adverse local wind effects caused by those high-rise towers would be expected to occur.

### *Comparison of Project and Existing Wind Hazards*

Evaluation of the Project's changes to existing wind conditions at the 23 comparable locations shows that the Project would reduce wind speeds or the occurrence of wind hazards at all but one location, a Job Corps building on Avenue C. Based on this information and further evaluation of the basic wind data, it is judged that for all of the above examples, the overall incidence and the durations of the wind hazards that would result from the Project would be similar to, or less than, those wind hazards that now occur on Treasure Island. The longer duration Project hazards, such as the approximately half-dozen hazards of 10 hours per year, or more, that would occur on Avenues C and D in the central area, are judged to be representative of the wind hazards that can be attributed to the Proposed Project, while the rest of the wind hazards identified for the Project may be considered to be equivalent to, or less than, the many unidentified existing wind hazards on Treasure Island.

### *Potential to Mitigate Wind Hazards*

Whatever the fundamental causes of the individual wind hazards, efforts should be made to reduce the wind hazards that would occur, or to limit the exposure to those hazards by residents and visitors, in the developed areas of the Proposed Project.

It may be the case that the wind hazards may be reduced, but likely not eliminated, by design measures adopted during development. Most of the short-duration wind hazards that would occur in mid-block locations could be effectively eliminated by simple design measures and a combination of street furniture and landscaping that would protect pedestrian walkways and building entrances.

Addressing the hazards at large intersections and in open spaces would be more difficult – even problematic; given the open nature of these spaces, there may be no practical way to eliminate all wind hazards in these locations without changing the character of these open areas.

Finally, wind hazards that occur at the outer edges of the Project are also problematic, since the Project must have edges where the buildings adjoin open space and are exposed to the full force of the existing winds. Considerable effort may be necessary to develop combinations of measures that would prove effective in reducing the occurrence of those particular hazards, which may prove intractable.

# II. Background

## Buildings and Wind

Tall buildings and large structures can strongly affect the wind environment for pedestrians. In cities, groups of structures tend to slow the winds near ground level, due to the friction and drag of the structures themselves. In general, the taller and the more densely spaced the buildings in a downtown area, the more they slow the winds near the ground.

However, a building that is much taller than the surrounding buildings, or that stands alone, can intercept and redirect winds that might otherwise flow overhead, and bring them down the vertical face of the building to ground level, where they create ground-level wind and turbulence. These redirected winds can be relatively strong and also relatively turbulent, and can be incompatible with the intended residential or commercial uses of nearby ground-level spaces. Moreover, high-rise structure designs that present tall flat surfaces that intercept strong winds can create ground-level winds that can be hazardous to pedestrians in the vicinity.

On one hand, clustered buildings can improve wind conditions at street level; on the other hand, tall buildings can cause wind problems for pedestrians. The result depends upon the specifics of the situation.

For development at Treasure Island, most of the proposed buildings would be more closely spaced, taller and much larger than the existing, scattered buildings they would replace. The Project would add clustered low-rise, mid-rise and high-rise development to the Island in the middle of the Bay. Among the new buildings would be approximately 19 proposed high-rise towers, each of which would be large enough to cause ground-level wind problems for pedestrians, even if these towers were to stand alone. Because the Project Area would be so large and because winds here are known to be strong, it is expected that the Project would result in substantial changes in street-level wind conditions over the developed area of the Island. Furthermore, because the existing winds here are known to be strong, the potential exists for the Project to result in adverse or hazardous street-level winds in pedestrian areas.

Wind tunnel testing was used to determine if unsuitably strong winds would occur if the Project is built.

## Wind Speed and Pedestrian Comfort[1]

The comfort of pedestrians varies under different conditions of sun exposure, temperature, clothing, and wind speed. Winds up to four miles per hour (mph) have no noticeable effect on pedestrian comfort. With speeds from 4 to 8 mph, wind is felt on the face. Winds from 8 to 13 mph will disturb hair, cause clothing to flap, and extend a light flag mounted on a pole. Winds from 13 to 19 mph will raise loose paper, dust, and dry soil, and will disarrange hair. For winds from 19 to 26 mph, the force of the wind will be felt on the body. With 26 to 34 mph winds, umbrellas are used with difficulty, hair is blown straight, there is

[1] Lawson, T.V. and A.D. Penwarden, "The Effects of Wind on People in the Vicinity of Buildings," Proceedings of the Fourth International Conference on Wind Effects on Buildings and Structures, London, 1975, Cambridge University Press, Cambridge, U.K., 605-622 1976.

difficulty in walking steadily, and wind noise is unpleasant. Winds over 34 mph increase difficulty with balance and gusts can blow people over.

## San Francisco Planning Code Requirements

San Francisco Planning Code Section 148, Reduction of Ground-Level Wind Currents, outlines wind reduction criteria for C-3 zoning districts. Although Treasure Island is not located in a C-3 district, the Section 148 requirements are used for evaluation of wind impacts for the purposes of CEQA in San Francisco. The analysis of the Proposed Project was performed using the wind testing analysis and evaluation methods used for Section 148, a copy of which is attached to this memorandum.

The Planning Code requires buildings to be shaped so as not to cause ground-level wind currents to exceed defined comfort and hazard criteria. The comfort criteria are that wind speeds will not exceed, more than 10% of the time year-round between the hours of 7 a.m. and 6 p.m., 11 mph in substantial pedestrian use areas, and 7 mph in public seating areas. The Planning Code defines these wind speeds in terms of equivalent wind speeds[2], an average wind speed (mean velocity), adjusted to include the level of gustiness and turbulence. Similarly, the hazard criterion of the Code requires that buildings not cause the equivalent wind speeds to reach or exceed the hazard level of 26 mph as averaged for a single full hour of the year. The comfort criteria are based on wind speeds that are measured and averaged for one minute; this is the same basis for the extensive wind speed data in the meteorological record for San Francisco. In contrast, the hazard criterion is based on winds that are measured and averaged for one hour; when stated on the same averaging time basis as the comfort criteria winds and the wind data in the meteorological record, the hazard criterion speed is restated as a one-minute average of 36 mph[3].

## Existing Climate and Wind Conditions

Treasure Island and Yerba Buena Island are located in the middle of the Bay, between San Francisco and Oakland. They are fully exposed to strong storm winds from every direction, and their direct exposure to the Golden Gate, approximately 6 miles to the west, also places them in the path of the strong regular afternoon winds generated by the combination of large-scale climatic, meteorological and topographic conditions in the Bay Area.

The speed and turbulence of winds that reach Treasure Island and Yerba Buena Island are affected by topography and features of the lands and the Bay that lie upwind. Winds that move over the water or over land encounter surface roughness and take on differing wind speed profiles due to differing topography, vegetation, and structures that all act to slow the wind near the ground and create turbulence. However, when those winds reach large areas of smooth, flat surfaces, such as open land or the open waters of the Bay, wind speeds near the surface of the ground or water will increase and the level of turbulence will decrease.

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2 Equivalent mean wind speed is defined as the mean wind speeds, multiplied by the quantity (one plus three times the turbulence intensity) divided by 1.45. This amplifies the equivalent mean wind speed values when turbulence intensity is greater than 15%.

3 Arens, E. *et al.*, "Developing the San Francisco Wind Ordinance and its Guidelines for Compliance," Building and Environment, Vol. 24, No. 4, p. 297-303, 1989.

Winds that reach Treasure Island first encounter the berms, ground-surfaces, and the low-rise development that occupies much of the Treasure Island; these features slow the winds close to the surface, but leave higher-velocity winds higher above the ground surface unaffected. Thus, conditions on the Island can be characterized as very windy.

## Existing wind conditions

Because there is existing development and vegetation on Treasure Island, street-level wind conditions on the Island will vary by location, according to the amount of wind sheltering that is provided by the various types and densities of buildings and vegetation that now exist. As shown by the numerical results of the wind testing, the west is the predominant wind direction; therefore, this review focuses on west wind access to the island and the development along the western (upwind) edge of the island:

- From the north end of the island to 9th Street and from Perimeter Road to approximately 500 yards inland, development consists primarily of 2-story buildings – most are multi-family residential buildings. Those closest the Bay are generally grouped and aligned to face the Bay, placing the long side parallel to the shoreline. This exposes the Bay side to the prevailing winds and provides wind sheltering on the island side of the building. The pattern of development provides street-width openings for winds from the Bay. Because these buildings are 1) grouped together in sixes and eights, 2) oriented long side to the shore, 3) all of similar height, and 4) have few straight-through streets, they likely provide reasonable wind sheltering within the overall area.

  There is less sheltering on the leeward of this area, with wind speeds increasing over vacant inland areas.

  Scattered industrial buildings up to three stories in height occupy locations within the street grid, north of 9th Street between Avenue E and the eastern shore. These appear to provide sheltering similar to that in the residential area to the west.

- Between 9th Street and 4th Street, the area west of Avenue B is open space, while the area between Avenue B and Avenue D is occupied by large 3- and 4-story buildings, including the two four-story star-shaped structures west of the Job Corps, as well as the major Job Corps buildings. These buildings are interspersed with trees with canopies that reach above the buildings. These buildings and trees should provide good wind sheltering within the central part of this area. However, along 9th Street and 4th Street, the frontages are open parking lots that each provide a 50-yard-wide openings for winds off the Bay, which can flow freely along these street corridors.

  The wind speed can increase as it passes over the baseball fields east of Avenue D.

  Scattered industrial buildings up to three stories are located between 5th and 4th Streets between Avenue D and the eastern shore. These appear to provide wind sheltering similar to the industrial area to the north.

- South of 4th Street, the southern portion of the island is occupied by scattered large buildings up to 5 stories in height and substantial plantings of mature trees. Included are Building 1 and the more-massive Buildings 2 and 3, all of which are approximately 60 to 80 feet high. Together, these buildings and trees provide substantive wind sheltering, however, there are open areas that are sufficiently large that they allow wind speeds to recover and increase.

- Due to topography and dense vegetative cover, winds affect primarily the windward side of Yerba Buena Island, but the primary effect is localized by the local topography and the substantial sheltering provided by the stands of mature trees.

Currently, the speed of the incident wind at street level is materially reduced by the two-story multi-family residential development as the wind reaches into the developed areas at the north end of Treasure Island. More-substantial wind speed reductions occur in the more protected areas in the central and southern parts of the island. The diminished winds then increase again as they pass over vacant or open areas on the island. Once winds reach the east shore of the Island and move over the water, wind speeds increase, until they reach the shore and low-lying areas of the East Bay. Regardless, the wind resistance (the surface roughness) of the existing development and vegetation on the island still reduces the speed of the wind to less than its speed over the open Bay and to less than its speed over the vacant areas of the Island.

The topography and dense vegetative cover of Yerba Buena Island determine ground level wind conditions in response to winds; any given wind will affect primarily the windward side of the island, but the major effect at pedestrian level will be localized and its magnitude determined by the sheltering provided by the local topography and stands of mature trees. Due to the structure of the winds in the atmosphere, the higher elevations on Yerba Buena Island are exposed to higher-speed winds than are lower elevations. Because the individual clusters of development proposed for Yerba Buena Island are not grossly different in size and scale from the existing development, few changes in wind conditions with respect to existing wind conditions are anticipated. Any differences in wind conditions before and after development would be highly localized and exclusively due to the size, shape and orientation of the individual buildings proposed for a given site.

### Available Wind Data - San Francisco

Average winds speeds in San Francisco, as in most of the Bay Area, are highest in the summer and lowest in winter. However, the strongest peak winds occur in winter. The highest average wind speeds occur in mid-afternoon and the lowest in the early morning. Westerly to northwesterly winds are the most frequent and strongest winds during all seasons. Of the 16 primary wind directions, four have the greatest frequency of occurrence and subsequently make up the majority of the strong winds that occur. These winds in Downtown include the northwest, west-northwest, west, and west-southwest winds.

Data describing the speed, direction, and frequency of occurrence of winds were gathered at the old San Francisco Federal Building at 50 United Nations Plaza (at a height of 132 ft.) during the six-year period, 1945 to 1950. Measurements taken hourly and averaged over one-minute periods have been tabulated for each month (averaged over the six years) in three-hour periods using seven classes of wind speed and 16 compass directions. Analysis of these data shows that during the hours from 6:00 a.m. to 8:00 p.m., about 70% of all winds blow from five of the 16 directions as follows: Northwest (NW), 10%; West-Northwest (WNW), 14%; West (W), 35%; West-Southwest (WSW), 2%; Southwest (SW), 9%; and all other winds, 28%. Calm conditions occur 2% of the time. More than 90% of measured winds over 13 mph blow from these directions.

### Available Wind Data - Naval Air Station, Alameda

The Islands lie within a climatological subregion of the San Francisco Bay Area Air Basin where the marine air that travels through the Golden Gate, as well as across San Francisco and the San Bruno Gap, is a dominant weather factor. The Oakland-Berkeley Hills to the east cause the westerly flow of marine air to split off to the north and south of Oakland; this phenomenon tends to diminish winds in Oakland itself.

Wind data from the Alameda Naval Air Station (now closed) meteorological station (at a height of 22 ft.) show that the predominant wind flow for the higher speed components of the wind is generally from the west; winds from the WSW, W and WNW account for nearly 40% of winds, each with mean wind speeds between 10.0 and 10.5 mph. Average wind speeds vary from season to season with the strongest average winds occurring during summer and the lightest average winds during winter. In addition to West winds, higher velocity winds from NNW and SSE are often associated with storms. Together, the W, NNW and SSE winds are the most frequent winds that exceed 25 mph.

## Application of Wind Data to Treasure Island

No satisfactory long-term wind data are available from a suitable meteorological station on Treasure Island. In the absence of a satisfactory wind record, data from a suitable substitute station can be used. The speed and the direction of winds at Treasure Island are expected to differ from the speed and the direction of the winds at the Civic Center of San Francisco (Downtown station), at Ft. Funston, and the San Francisco International Airport, all stations with qualified meteorological data. The winds in the Civic Center are affected by the topography and surface roughness of the City, which substantially alter the direction and slow the speed of the winds that reach Downtown. Winds at Ft. Funston reflect an open ocean exposure, with no shaping by the topography of the sea-level gap at the Golden Gate. Winds at San Francisco International Airport are strongly focused by the topography of the San Bruno Gap, which substantially alters the direction of those winds. These local effects are substantial enough to make these wind records unsuitable to represent wind conditions at Treasure Island.

The meteorological station nearest to Treasure Island was the Alameda Naval Air Station (NAS Alameda), located on the northern end of Alameda Island, some two miles southeast of the Bay Bridge. The NAS Alameda meteorological tower was located approximately 4 miles southeast of the center of Treasure Island. Similar to Treasure Island, NAS Alameda is at the edge of the Bay and has an open water exposure to the west. The distance from the meteorological tower west to the Bay shoreline was approximately 0.8 mile, which is more than the 0.7 mile east-west width of Treasure Island. The open-water distance from the ANAS shoreline west to San Francisco is 2.7 miles, whereas Treasure Island is directly open to the Golden Gate, nearly 6 miles to the west. Thus, NAS Alameda has: 1) less fetch over open water to the west, which tends to reduce wind speed reaching the shore; and; 2) more fetch over flat land to the west, which tends to further reduce speed reaching the tower. Although the magnitude of these reductions may not be large, these two factors tend to reduce the speed of the on-shore west winds that reach the meteorological tower at NAS Alameda. In addition to the potential speed differences, wind direction differences also can result, primarily as a result of Bay Area climatic and topographic factors, as discussed below, as well as the presence of Yerba Buena Island upwind of NAS Alameda.

Given the proximity to Treasure Island and the similar exposure to the Bay, the long-term wind record from NAS Alameda is judged to be a reasonable substitute for the unavailable Treasure Island wind record. However, it also appears that the winds at Treasure Island may have a higher velocity than those measured at NAS Alameda, due to the longer fetch of open waters of the Bay to the west, and a shorter fetch over flat land to the west. Each of these two factors tends to reduce the speed of the west winds that reached the NAS Alameda meteorological tower. However, a balancing factor is that the existing buildings and vegetation on Treasure Island combine to reduce wind speed as wind passes over the island; there is no similar development or vegetation at NAS Alameda. Considering these balancing factors, it is concluded that the NAS Alameda wind record indicates wind speeds that are similar to and possibly higher than the existing speeds at the Project sites on Treasure Island. Thus, the use of the NAS Alameda data should provide a conservatively high estimate of existing wind speeds on the Island.

The directional shift in west winds as the air mass flow diverges in the East Bay is likely to mean that winds that occur at Treasure Island are rotated somewhat to the north, compared to the direction of winds recorded at NAS Alameda. From an on-line review of historic wind direction data from the SF Bay Wind Archives[4], the magnitude of this shift appears to vary with wind direction, but appears to range from approximately 0 degrees to 10 degrees. For this study, which focuses primarily on the higher speed winds, this directional shift is judged to be significant enough to affect these results.

# Model and Wind Testing Protocols

A 1-inch to 50-foot scale model of the Treasure Island, as well as a substantial upwind and downwind reach into the Bay, was constructed in order to simulate the Project and its existing and future contexts. The scale model of the Project and surrounding area was provided by ESA. The Project test model was constructed by ESA from plans provided by the Project architects. The scale models were then tested in a boundary layer wind-tunnel facility at the University of California-Davis, under the direction of Bruce White, Ph.D. These wind tests, however, were performed independent of the University.

## Wind Directions

Wind directions on Treasure Island differ from those at the old Weather Bureau site Downtown (where wind speed distribution data most-frequently used for analysis under Planning Code Section 148 were gathered). For tests in the Downtown, typically three wind directions (W, NW and WNW) are tested, with SW wind tested only for locations with open upwind exposures to that direction, such as south of Market, Mission Bay and Candlestick. These are usually sufficient to establish conformance to both the comfort and the hazard criteria of Section 148. However, for purposes of hazard criterion evaluation alone, Treasure Island's exposures to strong northerly and possibly southerly winds are considered important, especially at open sites along the eastern waterfront, and site exposure to strong southerly winds could be important along the oceanfront and avenues.

Given the location and exposure of the Treasure Island site, the wind hazard evaluation requires consideration of NNW, NW, WNW, W and SSE winds. Although the island is exposed to SW winds over the Bay, the higher-speed component of the SW wind, which is important for wind tests of projects located at south of Market sites, is expected to be substantially reduced by the mass of the buildings in San Francisco's Downtown core, so wind testing for Treasure Island omitted the SW wind. To allow maximum flexibility in this test, the Project was tested for each of five major wind directions, W, NNW, SSE, NW and WNW. This considered all directions that have high-speed components that may interact with the proposed street grid and development bulks on the island, and also will provide enough directional information to allow comparison of the results with the typical outputs from the Section 148 analysis for north of Market buildings Downtown. The wind speed profile (wind velocity as a function of height above the ground) was measured on the Island for each wind direction.

[4] SF Bay Wind Archives, http://sfports.wr.usgs.gov/cgi-bin/wind/windarchive.cgi, accessed Sept. 2009

## Test Scenarios

Two development scenarios were modeled and tested in the wind tunnel. The scenarios are: 1) Existing Setting, and 2) Proposed Project.

Due to the isolation of the Island, the only cumulative development projects that could relate to the Proposed Project are: 1) proposed replacement of existing on/off ramps from the Bay Bridge to the east side of Yerba Buena Island; 2) construction and operation of a 400-berth marina in Clipper Cove, approved in 2006, but not yet built; and, 3) completion of the new eastern span of the Bay Bridge and removal of the existing bridge. It is not likely that these projects could result in measurable pedestrian wind effects on Treasure Island because the marina would consist of relatively low structures at the south end of Treasure Island and the Bay Bridge is about two thousand feet south of Treasure Island. Therefore, neither should have an appreciable effect on winds on Treasure Island. Therefore, a cumulative scenario was not included in the test scenarios for the Proposed Project.

## Test Procedure

The test procedure consisted of orienting the selected configuration of the model in the atmospheric boundary layer wind-tunnel and measuring the wind speed at each of the test locations with a hot-wire anemometer. Hot-wire measurements were taken at most of the same surface points for all test configurations and wind directions.

The wind tunnel allows testing of natural atmospheric boundary layer flow past surface objects such as buildings and other structures. The tunnel has an overall length of 22 meters (m) (72 feet), a test section of 1.22 m (4 feet) wide by 1.83 m (6 feet) high, and an adjustable false ceiling. The adjustable ceiling and turbulence generators allow speeds within the tunnel to vary from 1 meter per second (m/s) to 8 m/s, or 2.2 mph to 17.9 mph.

Wind-speed measurements at each test location were made with a hot-wire anemometer, an instrument that directly relates rates of heat transfer to wind speeds by electronic signals that are proportional to the magnitude and steadiness of the wind. The hot-wire probe was calibrated to an accuracy of within 2% before the test procedure was begun. The hot-wire probe measured the analog voltage for approximately 30 seconds at each test location. When converted to digital signals, this measurement provided approximately 30,000 individual voltage samples that were averaged and the root mean square calculated for each test location. These data, when converted to velocity using the calibration curves, provided the mean velocity and turbulence[5] values used to calculate the equivalent wind speed. By measuring both the mean wind speeds and corresponding turbulence intensities, high wind speeds and gustiness (changes in wind speeds over short periods of time) could be determined. The ratio of near-surface speed to reference wind speed was calculated from the hot-wire measurements. The inherent uncertainty of measurements made with the hot-wire anemometer close to the surface of the model is ±5% of the true values.

These values were compared with the free stream wind as measured in the wind tunnel. As a result, each wind-tunnel measurement resulted in a ratio (called a R-value) that relates the speed of ground-level wind

5 Turbulence Intensity = RMS/Mean Velocity

to the speed at the reference elevation, in this case the height of the NAS Alameda meteorological tower (22 feet). These ratios were the output data from the wind-tunnel tests.

## Wind Analysis Program

These output data were reduced using a computer program that evaluated the contribution from each tested wind direction to the total wind speed output ratios to account for the differences between the boundary layer profile in the wind-tunnel and the profile as measured at the meteorological station. To better match the directional and speed frequency distribution of the wind at Treasure Island, this protocol uses the wind record data from NAS Alameda as being more representative, and a computer program based on the NAS Alameda wind speed and direction distribution data and the data for W, NNW and SSE winds to determine Project compliance with the one-hour per year wind hazard criterion. The program then computed the equivalent wind speed that conforms to the selected criterion; either the wind speed exceeded 10% of the time or the wind speed exceeded one hour or more per year. The program also computed the percentage of time that the wind would exceed the speed criterion selected, and further computed the percentage contribution of each wind direction to the equivalent wind speed and to the excess of the criterion. In addition to the computations for each tested wind direction, the program computed an average ratio and used this to compute statistics for "Other" winds, which accounted for all remaining wind directions.

## Added Analysis

While it was the original intent to also calculate wind speeds from the test results using the San Francisco Downtown Station data to provide a familiar basis for comparison, ultimately, it was deemed not practical to do so, because the wind speed and direction relationships between the San Francisco Downtown Station meteorological data and winds on Treasure Island could not be established with sufficient certainty. However, it is very informative to compare the R-Values for the additional NW and WNW wind directions with the R-Values from the W, NNW and SSE wind directions, in order to evaluate the sensitivity of each of the 200 locations in the development to winds from these common high-speed wind directions; this fulfills an intent of the study to clearly indicate if difficult wind problems might occur for the NW or WNW wind directions. The output of the computer program is presented in the wind-tunnel test results tables for wind speeds that would be exceeded 10% of the time and for hazardous winds. These tables, appended to this Technical Memorandum, provide the detail of the data and of the intermediate results that are described above. The wind tunnel ratios were included in the program input, and the results evaluated in the discussions that follow.

## Wind Speed Profile Adjustments

The Section 148 wind test methodology implicitly assumes that the relationship between height above the ground and wind speed (referred to hereafter as the wind speed profile) is the same in the test area as at the reference weather station; for test sites in San Francisco, the reference is usually the Old Federal Building meteorological station at Civic Center. However, this test must reference the weather station at NAS Alameda, rather than the Civic Center station. The two stations are located in substantively different wind regimes.

A series of detailed measurements were made in the wind tunnel to determine the wind speed profiles to be used for each wind direction - NNW, NW, WNW, W, and SSE. Wind profile adjustment factors were estimated for each of those wind directions, based on the profile measurement and upon the standard method presented in the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook, Chapter 14. The ASHRAE methodology was applied to determine the parameters and calculate the profiles for the NAS Alameda; the parameters for Treasure Island were determined using data from wind speed profiles measured in the wind tunnel above the test model for the Treasure Island site. A category was considered for each of the wind directions at the NAS Alameda meteorological station and for each of the wind directions at the Project site; due to the open nature of the site, the values were the same for all directions. They yielded the values used for alpha, the power-law exponent, and delta, the boundary-layer thickness, and ultimately the factors for normalizing that NAS Alameda meteorological data to the wind speed at Treasure Island.

For Treasure Island, a power-law exponent (alpha) of 0.14 and a boundary layer height of 750 feet were used for all wind test directions. The resulting wind speed at pedestrian level on Treasure Island is about 1.25 times the pedestrian level wind speed measured at the NAS Alameda meteorological station. The wind test cases and study results reflect the use of these adjusted values.

## Wind Speed and Hazard Duration Uncertainties

Because Section 148 wind testing usually references the Old Federal Building meteorological station at Civic Center for test sites in San Francisco, the results of those many tests have much in common. The results of those wind tests for buildings in the Downtown are easily compared, and the values of wind speed and hazard duration for one building can be compared easily to those results from other building tests. A 15 mph wind speed at one Downtown building compares very well to a 15 mph wind speed at another Downtown building.

There are more uncertainties in precisely converting the testing results to wind speeds and hazard duration for this test at Treasure Island; these uncertainties may degrade the absolute accuracy of the numerical results when it comes to precisely establishing wind speed on the ground. Thus, although it may be close, a 15 mph wind speed reported in this test may not compare exactly to a 15 mph wind speed measured in a test for at a Downtown building. Whether the results match, whether they all may be slightly high, or whether they all may be slightly low, all of the values would trend the same way, and by the same percentage factor, because the uncertainty is a matter of scaling. The size of this uncertainty is expected to be of the order of ±1 mph for a reported 15 mph speed.

However for every point tested, the relative accuracy of this testing is exactly the same as for all other wind testing for San Francisco buildings. The net result is that the reported values of wind speed and hazard duration that are presented here have the same relative accuracy, one to another, as those found among the results of wind tests for buildings in the Downtown. All of the test values – wind speed and hazard duration – for the existing setting and the Proposed Project scenarios and for every point on Treasure Island are fully comparable.

# III. Test Cases and Study Results

## Introduction

Pedestrian-level wind-tunnel tests were conducted for the Existing Setting and for the Proposed Project scenario. Twenty-nine (29) test point locations were measured for the Existing Setting and 200 locations were measured for the Project scenario.

Each scenario was tested for five wind directions: NNW, NW, WNW, W, and SSE. These winds are the most representative for evaluation of the Proposed Project. Wind tunnel testing results are shown here as calculated wind speeds, where those are the equivalent wind speeds[6] that are exceeded 10% of the time, and these results are also shown as R-Values[7], to facilitate an understanding of the directional sensitivity of the results.

## Test Point Locations[8]

The test points on the premises of the Proposed Project site are scattered among all of the buildings and building clusters, with several points located on the perimeter of the Island (see Figures 3a and 3b). Twenty-nine (29) test point locations (points #1 - #29) were studied for the Existing Setting and 200 locations (points #7 – #206) were studied for the Project scenario. Six points (#1 - #6) were sited to indicate existing wind conditions around the existing star-shaped buildings[9]; since these buildings would be demolished, points #1 - #6 were not measured under the Project scenario. The remaining Existing Setting points (#7 - #29) were also measured for the Project scenario. All measurement points are color-keyed in Figures 3a and 3b as follows: 1) points #1 through #6 are in green numerals on a rectangular white fields; 2) points #7 through #29 are in white numerals on a rectangular green fields; and, 3) points #30 – 206 are black numerals on a rectangular white fields.

Special attention was paid in locating the test points to provide information about wind conditions in identified parks and open spaces, as well as along streets and pedestrian thoroughfares. For narrative purposes in identifying test point locations, Figures 3a and 3b show street names[10] for the proposed development. In the narratives, some of the test points are considered more than once, since this provides useful information about wind flows along streets.

The test points were selected because they are located in areas where measurable effects caused by the Proposed Project would reasonably be anticipated. Some points are located at building corners, and on roadways and pathways that run between the buildings. Care was taken to trace turbulent winds that could originate from the 19 high-rise towers that are a part of the Project.

6 Unless otherwise noted, throughout this discussion, "wind speed" refers to an "equivalent wind speed" that is exceeded 10% of the time. An "equivalent wind speed" is a metric defined as the mean wind speed multiplied by the quantity (1 + 3 x Turbulence Intensity) and divided by 1.45. Because high values of turbulence generally make winds much more unpleasant for people, this definition includes a factor that amplifies the calculated velocity whenever the turbulence is greater than 0.15 or 15%, a low value.

7 Each R-Value is the calculated ratio of the equivalent wind speed measured at the height of one surface point of interest (*i.e.*, pedestrian level) to the equivalent wind speed measured at the free stream or reference height (approximately 30 inches, or a scale height of 1,500 feet) in the wind tunnel. This ratio provides a way to relate all of the surface measurements made in the wind tunnel.

8 The test point (location) numbers were arbitrarily assigned, and thus hold no significance to the analysis of wind results.

9 These existing buildings are shown as outlines between Cityside Avenue, Avenue C, 5th Street and 7th Street, on Figures 1a and 1b.

10 Street names were arbitrarily applied in this analysis for convenience in discussing wind conditions throughout the Proposed Project area.


SOURCE: ESA

Treasure Island/Yerba Buena Island Redevelopment . 209672

**Figure 3a**
Test Point Locations - Proposed Project North Portion Detail


SOURCE: ESA

Treasure Island/Yerba Buena Island Redevelopment . 209672

**Figure 3b**

Test Point Locations - Proposed Project South Portion Detail

# Wind Evaluation and Criteria

Just as the wind tunnel testing was performed in accordance with the test protocols of Planning Code Section 148, as described earlier in the section Model and Wind Testing Protocols, the performance requirements of Code Section 148 were used to evaluate the results of the tests. Although compliance with the pedestrian-comfort criterion is not required, to inform the reader, the 10% exceeded wind speeds were compared to the Code's pedestrian-comfort criterion of 11 mph for areas of substantial pedestrian use.

Separate calculations evaluated compliance with the hazard criterion. As previously noted, the wind data upon which the criterion was based were not full hour average speeds as identified by the Code, so it is necessary to adjust the wind criterion speed to obtain a valid comparison with the available data and the equivalent wind speeds based on those data. When normalized to the equivalent wind speeds used here, the hazard criterion speed is equal to 36 mph, the value used in the tables.

Throughout the text, the wind speeds reported refer to the equivalent wind speeds that would be exceeded 10% of the time when referring to the Section 148 comfort criterion, and 1 hour per year when referring to the Section 148 hazard criterion.

# Test Output

The basic wind-tunnel test data and the detailed outputs of the computer program were presented in tables of comfort criteria and hazard criteria evaluations for each of the two test scenarios, Existing and Project. These output tables, appended to this Memorandum, provide the detail of the data and the intermediate results described above. The wind-tunnel ratios and the wind profile adjustment factors for each wind direction were included. The results were evaluated in the discussions that follow.

Figures 3a and 3b identify the measurement point locations for the wind tunnel test.

Summary information about the wind-tunnel test results and evaluations of compliance with the comfort and hazard criteria were presented for the Existing and Project scenarios in summary Tables 1 and 2.

Table 1 presents the wind comfort analysis results, namely the measured 10% exceeded speed and the percentage of time that the comfort criterion would be exceeded for each test location and test scenario.

Table 2 presents the wind hazard analyses results, the equivalent wind speed, and the number of hours per year that the hazard criterion would be exceeded for each test location and test scenario.

## TABLE 1
## WIND COMFORT ANALYSIS

| References | | Existing | | | Proposed Project | | | |
|---|---|---|---|---|---|---|---|---|
| Test Location Number | Wind Comfort Criterion Speed, miles/hour | Equivalent Wind Speed Exceeded 10% of Time, miles/hour | Percent of Time Wind Speed Exceeds Criterion | SOURCE | Equivalent Wind Speed Exceeded 10% of Time, miles/hour | Percent of Time Wind Speed Exceeds Criterion | Speed Change Relative to Existing, miles/hour | SOURCE |
| 1 | 11 | 18 | *35* | e | | | | |
| 2 | 11 | 16 | *26* | e | | | | |
| 3 | 11 | 19 | *29* | e | | | | |
| 4 | 11 | 16 | *24* | e | | | | |
| 5 | 11 | 12 | *14* | e | | | | |
| 6 | 11 | 16 | *27* | e | | | | |
| 7 | 11 | 19 | *35* | e | 15 | *24* | -4 | e |
| 8 | 11 | 16 | *27* | e | 10 | *8* | -5 | - |
| 9 | 11 | 18 | *30* | e | 14 | *19* | -4 | e |
| 10 | 11 | 19 | *34* | e | 15 | *24* | -4 | e |
| 11 | 11 | 18 | *33* | e | 10 | *6* | -8 | - |
| 12 | 11 | 16 | *29* | e | 19 | *32* | 4 | e |
| 13 | 11 | 20 | *32* | e | 9 | *6* | -10 | - |
| 14 | 11 | 17 | *26* | e | 12 | *16* | -4 | e |
| 15 | 11 | 16 | *24* | e | 9 | *3* | -7 | - |
| 16 | 11 | 16 | *30* | e | 10 | *8* | -6 | - |
| 17 | 11 | 14 | *21* | e | 8 | *2* | -6 | - |
| 18 | 11 | 15 | *24* | e | 15 | *27* | | e |
| 19 | 11 | 17 | *32* | e | 13 | *16* | -4 | e |
| 20 | 11 | 11 | *9* | | 10 | *7* | | |
| 21 | 11 | 19 | *36* | e | 11 | *11* | -8 | - |
| 22 | 11 | 14 | *21* | e | 10 | *7* | -5 | - |
| 23 | 11 | 16 | *25* | e | 11 | *9* | -6 | - |
| 24 | 11 | 17 | *33* | e | 15 | *28* | -2 | e |
| 25 | 11 | 18 | *33* | e | 16 | *27* | -3 | e |
| 26 | 11 | 16 | *27* | e | 14 | *23* | -2 | e |
| 27 | 11 | 17 | *33* | e | 12 | *12* | -6 | e |
| 28 | 11 | 15 | *28* | e | 12 | *13* | -3 | e |
| 29 | 11 | 10 | *6* | | 13 | *16* | 3 | p |
| **Ave. of 10%** | | **16.2 mph** | | | **12.3 mph** | | **-3.9 mph** | |
| | ***Percent:*** | | ***27%*** | | | ***15%*** | | |
| **Total Exceedances:** | | **Total** | **27** | | **Total** | | **13** | |
| *Subtotals by type:* | | *Existing* | **27** | e | *Existing* | | **12** | e |
| | | | | | *New, due to Proposed Project* | | **1** | p |
| | | | | | *New, at new location* | | **0** | n |
| | | | | | *Eliminated by Proposed Project* | | **9** | - |

SOURCE: Environmental Science Associates

## TABLE 2
## WIND HAZARD ANALYSIS

| References | | Existing | | | Proposed Project | | | |
|---|---|---|---|---|---|---|---|---|
| Test Location Number | Wind Hazard Criterion Speed, miles/hour | 1-hour/year Equivalent Wind Speed, miles/hour | Wind Hazard Criterion Exceeded, hours/year | SOURCE | 1-hour/year Equivalent Wind Speed, miles/hour | Wind Hazard Criterion Exceeded, hours/year | Hazard Hours Change Relative to Existing | SOURCE |
| 1 | 36 | 40 | *5* | e | | | | |
| 2 | 36 | 41 | *7* | e | | | | |
| 3 | 36 | 44 | *11* | e | | | | |
| 4 | 36 | 37 | *1* | e | | | | |
| 5 | 36 | 27 | | | | | | |
| 6 | 36 | 41 | *8* | e | | | | |
| 7 | 36 | 41 | *6* | e | 34 | | *-6* | - |
| 8 | 36 | 41 | *4* | e | 23 | | *-4* | - |
| 9 | 36 | 42 | *7* | e | 32 | | *-7* | - |
| 10 | 36 | 42 | *7* | e | 34 | | *-7* | - |
| 11 | 36 | 39 | *3* | e | 22 | | *-3* | - |
| 12 | 36 | 34 | | | 45 | *15* | *15* | p |
| 13 | 36 | 44 | *12* | e | 33 | | *-12* | - |
| 14 | 36 | 38 | *3* | e | 28 | | *-3* | - |
| 15 | 36 | 37 | *1* | e | 19 | | *-1* | - |
| 16 | 36 | 42 | *9* | e | 29 | | *-9* | - |
| 17 | 36 | 38 | *3* | e | 17 | | *-3* | - |
| 18 | 36 | 43 | *12* | e | 41 | *7* | *-5* | e |
| 19 | 36 | 37 | *1* | e | 29 | | *-1* | - |
| 20 | 36 | 24 | | | 23 | | | |
| 21 | 36 | 41 | *10* | e | 25 | | *-10* | - |
| 22 | 36 | 37 | *2* | e | 22 | | *-2* | - |
| 23 | 36 | 37 | *8* | e | 23 | | *-8* | - |
| 24 | 36 | 37 | *2* | e | 36 | | *-2* | - |
| 25 | 36 | 41 | *7* | e | 35 | | *-7* | - |
| 26 | 36 | 34 | | | 30 | | | |
| 27 | 36 | 38 | *2* | e | 28 | | *-2* | - |
| 28 | 36 | 33 | | | 26 | | | |
| 29 | 36 | 35 | | | 28 | | | |
| **Ave. 1-hr:** | | **38 mph** | | | **29 mph** | | | |
| | ***Total hrs:*** | | ***131 hr*** | | | ***22 hr*** | ***-77 hr*** | |
| **Total Exceedances:** | | **Total** | **23** | | | **Total** | **2** | |
| *Subtotals by type:* | | *Existing* | **23** | **e** | | *Existing* | **1** | **e** |
| | | | | | | *New or increased time* | **1** | **p** |
| | | | | | | *New, at new location* | **0** | **n** |
| | | | | | | *Eliminated by Proposed Project* | **17** | **-** |

SOURCE: Environmental Science Associates

As a result, what may appear to be discrepancies in the tabular results, such as in the column sums or the differences between values for Project and existing conditions, are simply due to the rounding of results. However, the rounded values of the differences in wind speeds and the differences in hours of exceedances that are shown in Tables 1 and 2 are the best available representation of the measured changes in those quantities.

Also, throughout the following discussion the wind speeds reported refer to the equivalent wind speeds that would be exceeded 10% of the time when referring to the pedestrian-comfort criterion, and winds exceeded 1 hour per year when referring to the wind hazard criterion.

## Test 1: Existing Setting

The north half of Treasure Island now contains primarily two-story buildings, the central part contains scattered buildings up to three and four stories in height, and the south end of the Island contains several five-story buildings and hangars that are the tallest structures on the island. Not all of these buildings were included in the test of the setting.

The existing setting consists of the existing major buildings on and in the vicinity of the Project site that would remain after site redevelopment. These include the existing elementary school in the north, the Job Corps buildings in the center, and Buildings 1, 2 and 3 in the south of the Island. In addition, the two existing four-story star-shaped structures west of the Job Corps site were also considered as part of the existing setting.

### Existing Comfort Criterion Conditions

Treasure Island is located in San Francisco Bay, where conditions are typically very windy. The average of the 10% exceeded wind speeds that were calculated from measurements at the 29 existing test points is over 16 mph; wind speeds range from 10 to 20 mph. The highest wind speed measured (20 mph) occurs at Test Point 13, which is at the south end of the southern-most Job Corps building. Two (2) of the 29 points meet the pedestrian-comfort criterion of 11 mph; one of these (#20) is located at the north entrance to Building 3 and one in the yard of the existing school (#29). See Table 1.

Although measurements for the existing setting were not made at many locations on the Island, it is assured that wind conditions are similar over most of the area of the island. The sparse low-rise development, flat topography, and location in the Bay all result in relatively little resistance to the movement of the wind. For these reasons, one must conclude that wind conditions sampled at the 29 test point locations well represent the relatively uniform, general wind conditions that occur over most of the area of the Island. The exceptions would be for those locations near the existing buildings, and within stands of trees and vegetation, where local wind accelerations or sheltering would occur to alter the wind speed.

### Existing Hazard Conditions

Under existing conditions, the Code's wind hazard criterion is exceeded at 23 of the 29 test locations, as shown in Table 2, which indicates a total duration of hazard of 131 hours per year. However, this statistic is misleading in that it is certain that the wind hazard criterion is exceeded at a large number of other locations on the Island, so this duration is most certainly a gross underestimate of the true total duration of wind hazards under existing conditions.

## Test 2: Project

The Project scenario consists of a representative massing for the Proposed Project added to the existing buildings that would remain after site redevelopment. These include the existing elementary school in the north, the Job Corps buildings in the center, and Buildings 1, 2 and 3 in the south of the Island. Most of the remaining existing buildings would be demolished. The Proposed Project would involve construction of many separate building clusters with buildings ranging in height from approximately 35 to 600 feet. The proposed Redevelopment Plan would include construction of approximately 19 high-rise towers, among a substantial base of low- and mid-rise buildings, on Treasure Island.

Because no specific building designs or park designs are available at this time, this study used a proposed representative height and massing design to determine the likely effects that the development as a whole would have on the wind conditions on the streets, in the identified existing recreation areas and in the proposed locations of planned parks and open spaces. A bulk model of this representative design was constructed and tested in the wind tunnel.

The Proposed Project would allow for some flexibility in the shape and precise location of the towers; the tower volumes may shift locations within a limited range, and the shapes of the low- and mid-rise buildings could change when the development program is implemented and specific building designs are proposed. Such changes would likely alter the wind speeds that would occur at nearby locations; in some cases, the changes in towers could cause wind hazards. However, as long as the design or location changes are not large, the general wind conditions that result from the proposed representative height and massing design should reasonably represent the wind conditions that would exist within and around the Proposed Project once the specific architectural designs of the buildings have been finalized.

## *Comparison With Existing Setting Measurements*

Wind speeds were measured at 200 locations within the Project and vicinity. Of these 200 test point locations, 23 were the same as measured for the existing scenario. The following comparisons can be made between the existing and Project wind conditions for winds measured at these 23 locations.

### Comfort Criterion Conditions

With the Project, wind conditions at the shoreline and at the exterior of the Project would remain very windy, essentially unchanged from the existing conditions, while wind speeds at locations within the interior of the development would generally decrease. As can be seen in Table 1, the average of the 10% exceeded wind speeds measured for the 23 common test points would be less than 12 mph, a decrease of nearly 5 mph. Wind speeds at the common test points would range from 8 to 19 mph, with 13 of the 23 points meeting the Planning Code's pedestrian-comfort criterion. Nine existing exceedances of the pedestrian-comfort criterion would be eliminated by the Project, one new one would be created, and 12 existing exceedances would remain.

### Hazard Conditions

Under existing conditions, the Code's wind hazard criterion is currently exceeded at 23 of the 29 test locations, as shown in Table 2, which indicates a total duration of hazard of 131 hours per year. With the Project in place, one new wind hazard would be introduced, one existing hazard would be reduced in duration and 22 existing wind hazards would be eliminated by the Project.

### Further Analysis and Comparison

During wind tunnel testing, each wind tunnel measurement generates a ratio that relates the speed of surface-level wind to the speed of the free-stream wind, which is measured in the wind tunnel at a scale height in excess of 1,500 feet, near the center of the wind tunnel. These wind speed ratios (referred to here

ESA

## TABLE 3
## MEASURED R-VALUES - EXISTING CONDITIONS

***Existing Wind Conditions - Measured R-Values*** / ***Calculated Wind Speeds***

| # | NNW | NW | WNW | W | SSE | R-Value Average | 10% Exceed | 1-hr/yr Wind Speed |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.5532 | 0.7168 | 0.7012 | 0.5830 | 0.4490 | 0.6125 | 18 | 40 |
| 2 | 0.6651 | 0.5287 | 0.4538 | 0.3970 | 0.5924 | 0.4930 | 16 | 41 |
| 3 | 0.3933 | 0.4246 | 0.4773 | 0.6384 | 0.1930 | 0.4333 | 19 | 44 |
| 4 | 0.3482 | 0.3949 | 0.5345 | 0.5437 | 0.1750 | 0.4120 | 16 | 37 |
| 5 | 0.2012 | 0.2324 | 0.2894 | 0.3906 | 0.3904 | 0.3257 | 12 | 27 |
| 6 | 0.6013 | 0.4873 | 0.3977 | 0.4094 | 0.6215 | 0.4790 | 16 | 41 |
| 7 | 0.5907 | 0.6676 | 0.6838 | 0.5895 | 0.4366 | 0.5944 | 19 | 41 |
| 8 | 0.6913 | 0.5948 | 0.4470 | 0.4093 | 0.4613 | 0.4781 | 16 | 41 |
| 9 | 0.3574 | 0.5262 | 0.5032 | 0.6125 | 0.3230 | 0.4912 | 18 | 42 |
| 10 | 0.4604 | 0.5128 | 0.6366 | 0.6088 | 0.4337 | 0.5480 | 19 | 42 |
| 11 | 0.4458 | 0.5203 | 0.5179 | 0.5697 | 0.5061 | 0.5285 | 18 | 39 |
| 12 | 0.4344 | 0.4671 | 0.6265 | 0.4861 | 0.4672 | 0.5117 | 16 | 34 |
| 13 | 0.1783 | 0.2829 | 0.4511 | 0.6434 | 0.5134 | 0.4727 | 20 | 44 |
| 14 | 0.3666 | 0.3951 | 0.4535 | 0.5644 | 0.2364 | 0.4124 | 17 | 38 |
| 15 | 0.3258 | 0.3231 | 0.5090 | 0.5353 | 0.2405 | 0.4020 | 16 | 37 |
| 16 | 0.4631 | 0.5188 | 0.4783 | 0.4540 | 0.6401 | 0.5228 | 16 | 42 |
| 17 | 0.4008 | 0.5454 | 0.3056 | 0.3978 | 0.5764 | 0.4563 | 14 | 38 |
| 18 | 0.5001 | 0.4609 | 0.2550 | 0.3967 | 0.6588 | 0.4429 | 15 | 43 |
| 19 | 0.5395 | 0.6192 | 0.5686 | 0.4998 | 0.5283 | 0.5540 | 17 | 37 |
| 20 | 0.2228 | 0.2484 | 0.3142 | 0.3600 | 0.2179 | 0.2851 | 11 | 24 |
| 21 | 0.5514 | 0.5739 | 0.6015 | 0.5836 | 0.5898 | 0.5872 | 19 | 41 |
| 22 | 0.6279 | 0.3535 | 0.2797 | 0.3659 | 0.4842 | 0.3708 | 14 | 37 |
| 23 | 0.1821 | 0.1786 | 0.3196 | 0.5388 | 0.3722 | 0.3523 | 16 | 37 |
| 24 | 0.5232 | 0.6966 | 0.6819 | 0.5399 | 0.4916 | 0.6025 | 17 | 37 |
| 25 | 0.4092 | 0.6619 | 0.6339 | 0.6045 | 0.4596 | 0.5900 | 18 | 41 |
| 26 | 0.3872 | 0.5534 | 0.5074 | 0.4937 | 0.4355 | 0.4975 | 16 | 34 |
| 27 | 0.6025 | 0.5997 | 0.5093 | 0.4977 | 0.5409 | 0.5369 | 17 | 38 |
| 28 | 0.4998 | 0.4846 | 0.4862 | 0.4559 | 0.4465 | 0.4683 | 15 | 33 |
| 29 | 0.2400 | 0.3539 | 0.3498 | 0.4176 | 0.5333 | 0.4137 | 10 | 35 |

**KEY**
GREEN: Values less than 0.3
BLACK: Values between 0.3 and 0.5
RED: Values greater than 0.5

Meets 11 mph pedestrian criterion: 10
Exceeds Wind Hazard critrion: 37

as R-values) are the primary output data of wind tunnel tests. R-values are usually substantially less than 1.0 because the speed of the lowest part of an air mass is slowed by friction as the air mass moves across buildings, vegetation, and the ground; as a result, wind speeds at pedestrian level are usually much less than the speed of the free-stream wind. In sheltered areas the R-values can be less than 0.1, indicating that wind near ground level is less than 10% of the wind high above the ground. Experience with wind testing of San Francisco buildings shows that R-values greater than 0.5 indicate very strong ground-level winds.

## TABLE 4
## MEASURED R-VALUES - PROJECT CONDITIONS

***Project Wind Conditions - Measured R-Values*** / ***Calculated Wind Speeds***

| # | NNW | NW | WNW | W | SSE | R-Value Average | 10% Exceed | 1-hr/yr Wind Speed |
|---|---|---|---|---|---|---|---|---|
| 1 | Existing locations covered by Project buildings. | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | 0.3246 | 0.3726 | 0.5364 | 0.4984 | 0.3489 | 0.4391 | 15 | 34 |
| 8 | 0.2183 | 0.3483 | 0.3639 | 0.3283 | 0.3470 | 0.3469 | 10 | 23 |
| 9 | 0.2119 | 0.2527 | 0.3399 | 0.4646 | 0.2185 | 0.3189 | 14 | 32 |
| 10 | 0.3787 | 0.5528 | 0.4990 | 0.4985 | 0.2571 | 0.4519 | 15 | 34 |
| 11 | 0.2783 | 0.2578 | 0.3775 | 0.2856 | 0.3333 | 0.3136 | 10 | 22 |
| 12 | 0.3262 | 0.4915 | 0.4476 | 0.6623 | 0.3724 | 0.4935 | 19 | 45 |
| 13 | 0.1529 | 0.1818 | 0.4474 | 0.2622 | 0.4967 | 0.3470 | 9 | 33 |
| 14 | 0.3226 | 0.2923 | 0.2811 | 0.4122 | 0.2354 | 0.3053 | 12 | 28 |
| 15 | 0.2988 | 0.3432 | 0.2318 | 0.2635 | 0.2468 | 0.2713 | 9 | 19 |
| 16 | 0.3679 | 0.3897 | 0.3873 | 0.2625 | 0.4469 | 0.3716 | 10 | 29 |
| 17 | 0.2757 | 0.2541 | 0.2969 | 0.2372 | 0.2101 | 0.2496 | 8 | 17 |
| 18 | 0.3556 | 0.5648 | 0.4667 | 0.4560 | 0.6229 | 0.5276 | 15 | 41 |
| 19 | 0.3688 | 0.4472 | 0.3956 | 0.3711 | 0.4405 | 0.4136 | 13 | 29 |
| 20 | 0.2618 | 0.3126 | 0.2501 | 0.3351 | 0.2284 | 0.2816 | 10 | 23 |
| 21 | 0.2686 | 0.2430 | 0.2603 | 0.3700 | 0.2582 | 0.2829 | 11 | 25 |
| 22 | 0.3402 | 0.2636 | 0.2889 | 0.3066 | 0.2358 | 0.2737 | 10 | 22 |
| 23 | 0.2023 | 0.1645 | 0.2807 | 0.3361 | 0.3230 | 0.2761 | 11 | 23 |
| 24 | 0.4395 | 0.5242 | 0.5387 | 0.4456 | 0.5373 | 0.5115 | 15 | 36 |
| 25 | 0.3647 | 0.5628 | 0.5684 | 0.5045 | 0.4332 | 0.5172 | 16 | 35 |
| 26 | 0.3220 | 0.4755 | 0.3841 | 0.4443 | 0.4148 | 0.4297 | 14 | 30 |
| 27 | 0.3979 | 0.3753 | 0.2654 | 0.3215 | 0.4322 | 0.3486 | 12 | 28 |
| 28 | 0.4188 | 0.3192 | 0.3217 | 0.3402 | 0.3758 | 0.3392 | 12 | 26 |
| 29 | 0.2222 | 0.3711 | 0.3498 | 0.4176 | 0.2936 | 0.3580 | 13 | 28 |

**KEY**
GREEN: Values less than 0.3
BLACK: Values between 0.3 and 0.5
RED: Values greater than 0.5

Meets 11 mph pedstrian criterion: 10
Exceeds Wind Hazard critrion: 37

To calculate the wind speeds, the R-values are correlated to the actual wind speeds measured at the meteorological station for each wind direction, and then converted into representative values of wind speed at the Project test location, in the same way as is done to compute wind speeds that are compared with wind comfort and safety criteria under the Planning Code. However, the R-values themselves are useful for making relative comparisons of the wind speeds among directions or at any two locations in a given wind test.

## TABLE 5
## COMPARISON OF PROJECT AND EXISTING CONDITIONS

*Project R-Values - as Percent of Existing* | *Calculated Wind Speed, as % of Existing*

| # | NNW | NW | WNW | W | SSE | R-Value Average | 10% Exceed | 1-hr/yr Wind Speed |
|---|---|---|---|---|---|---|---|---|
| 1 | Existing locations covered by Project buildings. | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | 55% | 56% | 78% | 85% | 80% | 75% | 81% | 83% |
| 8 | 32% | 59% | 81% | 80% | 75% | 74% | 66% | 57% |
| 9 | 59% | 48% | 68% | 76% | 68% | 65% | 75% | 76% |
| 10 | 82% | 108% | 78% | 82% | 59% | 82% | 80% | 82% |
| 11 | 62% | 50% | 73% | 50% | 66% | 60% | 54% | 56% |
| 12 | 75% | 105% | 71% | 136% | 80% | 98% | 124% | 133% |
| 13 | 86% | 64% | 99% | 41% | 97% | 75% | 48% | 74% |
| 14 | 88% | 74% | 62% | 73% | 100% | 77% | 75% | 73% |
| 15 | 92% | 106% | 46% | 49% | 103% | 76% | 56% | 52% |
| 16 | 79% | 75% | 81% | 58% | 70% | 71% | 64% | 70% |
| 17 | 69% | 47% | 97% | 60% | 36% | 60% | 56% | 46% |
| 18 | 71% | 123% | 183% | 115% | 95% | 129% | 102% | 95% |
| 19 | 68% | 72% | 70% | 74% | 83% | 75% | 75% | 80% |
| 20 | 118% | 126% | 80% | 93% | 105% | 101% | 96% | 93% |
| 21 | 49% | 42% | 43% | 63% | 44% | 48% | 59% | 61% |
| 22 | 54% | 75% | 103% | 84% | 49% | 78% | 69% | 58% |
| 23 | 111% | 92% | 88% | 62% | 87% | 82% | 65% | 63% |
| 24 | 84% | 75% | 79% | 83% | 109% | 87% | 86% | 96% |
| 25 | 89% | 85% | 90% | 83% | 94% | 88% | 85% | 84% |
| 26 | 83% | 86% | 76% | 90% | 95% | 87% | 90% | 90% |
| 27 | 66% | 63% | 52% | 65% | 80% | 65% | 68% | 74% |
| 28 | 84% | 66% | 66% | 75% | 84% | 73% | 78% | 80% |
| 29 | 93% | 105% | 100% | 100% | 55% | 90% | 130% | 81% |

**KEY**
GREEN: Values less than 30% of existing.
BLACK: Values between 30% and 50% of existing.
RED: Values greater than 110% of existing.
Less than 70% of existing: 60%
More than 110% of existing: 133%

The measured R-values and the calculated wind speed statistics (from Table 1 and Table 2) are combined in Tables 3 and 4, which present the R-Values for all five wind directions (NNW, NW, WNW, W and SSE) as well as the calculated wind speeds and statistics, which are based only on three of the wind directions – NNW, W and SSE. However, the R-values for NW and WNW winds can be compared to the R-values for W wind to understand the relative wind speeds that could result from those winds. Table 3 presents the measured R-values and the calculated wind speed information about the existing setting, while Table 4 presents the same information about the Project.

From inspection and comparison of Tables 3 and 4, it is evident that there are substantial differences in the wind conditions between the existing setting and the Project. Table 5 compares the percentage changes between measured R-values and the calculated wind speed statistics for the existing and Project scenarios. As is evident from Tables 1 through 5, general reductions in wind speed would occur at most of the 23 common wind measurement locations.

### *Analysis of Project Test Data*

For the remainder of the 200 test point locations, where there are no paired measurements of existing setting and Project data, the analysis of these data yields basic information about the general wind conditions that would occur within the proposed Redevelopment. Note that while the general wind conditions and trends discussed here result partly from the overall configuration of the massing of development under the Redevelopment Plan, the specific wind speed and/or hazard that occurs at any test location is strongly influenced by the nearby structures as part of the overall development. The details of these results come from wind-tunnel testing of a specific model design - the representative massing model of the Proposed Project, as illustrated in Figures 1 and 2. Thus, the wind test produced results that are specific to that design. However, the Proposed Project would allow for some flexibility in the shape and precise location of the towers; tower volumes may change as specific building designs are proposed. Although different building configurations will result in different ground-level wind effects, some changes in building configurations would produce minor differences in wind conditions while others could produce major differences in wind conditions. It would be necessary to evaluate the changes in building configurations carefully.

#### General Discussion

With the Proposed Project, wind speeds would vary widely across the development area. Of course, higher wind speeds would still occur in the shoreline parks and open spaces, which are now, and would remain fully exposed to the winds approaching over the Bay. The Project buildings would face the shoreline and, although set back from the Bay itself, would intercept the approaching winds that would reach the Project generally unabated. Therefore, wind speeds would be higher along the Project edges and generally would diminish in the interior of the developed neighborhoods of the Project. Although the wind speeds exceeded 10% of the time would be 12 mph or more at nearly 2/3 of the 200 test locations, wind speeds at 74 test point locations would be at or less than the 11 mph pedestrian-comfort criterion of the Planning Code.

Wind speeds that would occur within the interior of the Project would be similar to those found in a number of San Francisco's windier areas.

The strong existing winds and their accompanying higher incidence of wind hazards would still occur in the exposed shoreline parks and open spaces. Wind hazards would continue to occur in the new Project open spaces, including a number of locations along the Cityside Waterfront Park, Cultural Park and Waterfront Plaza. These strong winds and accompanying wind hazards would not be caused by the Project, but would simply reflect the overall wind environment of Treasure Island.

Of all 200 locations that were tested in the wind tunnel, wind hazard conditions were detected at 49 of these locations. The locations of the wind hazards are shown in Figure 4. The image clearly shows the overall distribution of the wind hazards around and within the Proposed Project development area. This overall perspective is helpful in understanding the discussions that follow.

In general, the incidence of wind hazards would be higher along the Project edges and the relative frequency of wind hazards generally would diminish in the interior of the Project, except for the particular wind effects of open exposures to winds from the Bay, of the effects of tall buildings or of the effects of strong incident winds channeling between the building masses and along the street canyons.

### *Potential to Mitigate Wind Hazards*

Whatever the fundamental causes of the individual wind hazards, substantive efforts should be made to reduce the wind hazards that would occur, or to limit the exposure to those hazardous winds by residents and visitors, in the developed areas of the Proposed Project.

Wind hazards due to Project towers or to wind channeling among the building masses and street canyons may be reduced, but may not be totally eliminated, by design measures adopted during development. Many of the smaller wind hazards that occur mid-block could be effectively eliminated by simple design measures and a combination of street furniture and landscaping that would protect pedestrian walkways and building entrances.

Addressing the hazards at large intersections and in open spaces would be more difficult – even problematic; given the open nature of these spaces, there may be no practical way to eliminate all wind hazards without completely changing the character of these open spaces.

Finally, wind hazards that occur at the developed edges of the Project are also problematic, since the Project must have edges where the buildings adjoin open space. Considerable effort may be necessary to develop an effective combination of measures that would reduce the occurrence of those hazards; they may prove intractable.

| | |
|---|---|
| 1 | Hours Of Wind Hazard per Year |
| — | Job Corps Boundary |

SOURCE: ESA

Treasure Island/Yerba Buena Island Redevelopment . 209672

**Figure 4**
Wind Hazard Locations and Hours Durations for Representative Massing of Proposed Project

### *Street-by-Street and Open Space Effects*

The following summarizes the wind conditions that would exist within the Project, given the specific design tested. Because no building designs exist at this stage of development planning, this study used a proposed representative height and massing design to represent the Project in the wind-tunnel; a bulk model of this representative design was tested to evaluate likely effects that the Project would have on the street-level wind conditions on streets and within pedestrian areas of the development, in existing recreation areas, and in the proposed locations of planned parks and open spaces. Given this, it is not necessary to discuss all of the test points in order to understand the overall wind performance of the representative design.

#### Review of Project Wind Conditions - Street by Street

A street-by-street summary of Project wind conditions starts with the westernmost street, Cityside Avenue, and moves eastward along the parallel avenues and alleys to Eastside Avenue, as follows:

- **Cityside Avenue** – (16 test points: # 78, 79, 88, 89, 90, 98, 99, 108, 109, 117, 118, 119, 127, 128, 129, 139). Along Cityside Avenue, wind speeds would range from 11 to 19 mph at these locations at the western edge of the Project and directly exposed to winds from the Bay. Winds at only one (#127) of the 16 locations would meet the Pedestrian Criterion. Winds at 4 of the 16 locations (#78, 79, 98, 99) would exceed the wind hazard criterion. Their hazard durations would range from 1 to 10 hours per year.

- **Cityside Alley** – (18 test points: 76, 77, 80, 81, 86, 87, 91, 92, 96, 97, 100, 101, 105, 106, 107, 110, 111, 112, 115, 116, 120, 130, 131, 135, 136, 137, 138). Along Cityside Alley, wind speeds would range from 8 to 17 mph, with wind speeds lower in mid-block sections. Wind speeds would be highest at 10th, near the north end of the development. The Cityside Neighborhood Parks at 5th Street (#115, 116), at 6th Street (#105, 106) and at 7th Street (#96, 97) would have 10% exceeded speeds ranging from 10 to 12 mph. Wind speeds would be 13 mph at the Cityside Neighborhood Park at 9th Street (#76, 77). Wind hazards would occur at 4 of the 18 locations along Cityside Alley (#80, 81, 135, 137); two wind hazards would occur at 10th Street, with durations 2 and 15 hours per year, and two would occur at the east side of Cultural Park, with durations of 1 and 10 hours per year.

- **Avenue C –** (38 test points: #7, 8, 10-12, 14, 18, 45, 46, 55-57, 65, 66, 72, 74, 75, 82-85, 93-95, 102-104, 113, 114, 121-124, 132-134, 145-147). Along Avenue C, wind speeds would range from 8 to 19 mph. Winds at 11 of the 38 locations (#8, 11, 45, 65, 83, 95, 122, 123, 124, 132, 133) would meet the Pedestrian Criterion. Wind speeds would be higher at 10th Street, at the north end of the development, and in the central area, near California Avenue. Wind speeds would remain higher in the Job Corps areas, where existing wind speeds are already higher. Wind hazards would occur at 12 of the 38 test points (#12, 18, 46, 82, 93, 102, 123, 132, 133, 134, 145, 147) along Avenue C. These wind hazards would occur with individual durations ranging from 1 to 56 hours per year.

- **Avenue C Alley –** (10 test points: #44, 47, 53, 54, 58, 63, 64, 67, 68, 69). Along Avenue C Alley, wind speeds would range from 7 to 14 mph. Winds at 6 of the 10 locations (#53, 58, 63, 64, 67, 68) would meet the Pedestrian Criterion. The two Cityside Neighborhood Parks located along this alley, one at 7th (#63, 64) and one at 8th Street (#53, 54) would have 10% exceeded speeds ranging from 8 to 12 mph. A single wind hazard, with a duration of 1 hour per year, would occur at 10th Street (#47).

- **Avenue D –** (23 test points: #18, 32, 33, 34, 40, 41, 43, 49, 50, 51, 52, 60, 61, 62, 70, 142, 143, 144, 149, 153, 154, 200, 203). Along Avenue D, wind speeds would range from 8 to 20 mph. Wind speeds would vary along this roadway, with the highest wind speeds occurring at the south end, between 1st to 3rd streets, and relatively lower wind speeds occurring between 3rd and 9th Streets. Winds at 10 locations (#32, 33, 40, 41, 43, 50, 51, 61, 62, 70) would meet the Pedestrian Criterion. Wind hazards would occur at 8 of 23 test points along Avenue D. One wind hazard, with a duration of 1 hours per year, would occur at 8th Street (#52), the other seven, with individual durations ranging from 2 to 50 hours per year, would occur between 1st Street and 4th Street (#18, 142, 149, 153, 154, 200, 203).

- **Avenue D Alley** – (4 test points: #35, 36, 39, 42). Along Avenue D Alley, wind speeds would range from 5 to 10 mph, so all locations would meet the Pedestrian Criterion. No wind hazard would occur.

- **Avenue E** – (13 test points: #19, 30, 31, 37, 38, 150, 151, 156, 157, 158, 160, 161, 201). Along Avenue E, wind speeds would range from 8 to 18 mph. Winds at 4 of the 13 test point locations (#31, 37, 38, 150) would meet the Pedestrian Criterion. Wind hazards would occur at two locations, one at 8th Street (#30) and one between 3rd and 4th Streets (#157), with individual durations of 6 and 2 hours per year, respectively.

- **Avenue H** – (8 test points: #20, 155, 159, 165, 166, 167, 170, 171). Along Avenue H, wind speeds would range from 10 to 15 mph. Winds at a total of 3 locations (#20, 167, 170) would meet the Pedestrian Criterion. Wind hazards would occur at 2 of the 8 test point locations on Avenue H, at 3rd Street, with individual durations of 1 hour per year (#165) and 17 hours per year (#171).

- **Avenue I** – (11 test points: #21, 22, 163, 164, 168, 169, 174, 175, 178, 179, 199). Along Avenue I, wind speeds would range from 10 to 17 mph. Winds at 7 of these locations (#21, 22, 164, 169, 174, 178, 199) would meet the Pedestrian Criterion. A wind hazard, with a duration of 2 hours per year, would occur at Avenue I and 4th Street (#163).

- **Avenue J** – (7 test points: #172, 173, 176, 177, 183, 184, 186, 187). Along Avenue J, wind speeds would range from 9 to 15 mph. Winds at 4 of the locations (#173, 176, 177, 186) would meet the Pedestrian Criterion. A wind hazard, with a duration of 1 hour per year, would occur on Avenue J between 3rd & 4th Streets (#184).

- **Avenue K** – (8 test points: #180, 181, 182, 185, 192, 196, 197, 198). Along Avenue K, wind speeds would range from 9 to 18 mph. Winds at 3 of the locations (#181, 185, 196) would meet the Pedestrian Criterion. Wind hazards would occur at 5 of the test point locations (180, 182, 192, 196, 198) along Avenue K between 2nd and 4th Streets, with individual durations of 1 to 6 hours per year.

- **Eastside Avenue – (**6 test points**:** #189, 190, 191, 193, 194, 195). Along Eastside Avenue, which is at the eastern edge of the Project and is directly exposed to winds from the north and south, wind speeds would range from 10 to 18 mph. Winds at 3 locations (#190, 191, 193) would meet the Pedestrian Criterion. Wind hazards would occur at the other 3 test point locations along Eastside Avenue, at both the north and the south ends of the street, with individual durations of 1, 4 and 4 hours per year. Specific measures should be developed to reduce or eliminate these wind hazards and to reduce wind speeds at both ends of Eastside Avenue.

### Review of Project Wind Conditions - Parks and Open Spaces

Since the strong existing winds and their accompanying higher incidence of wind hazards would still occur in the exposed shoreline parks and open spaces, only those parks and open spaces that are within the interior of the Project development area show any wind effect that can be attributed to the Project. The following summarizes wind conditions in some of the Parks and Open Spaces, as well as in the Job Corps area, with Project development:

- **Building 1 Plaza** – (3 test points: #26, 27, 141). The wind speeds exceeded 10% of the time at the 3 test points would range from 14 to 16 mph. No wind hazard would occur at these locations.
- **Building 2** – (3 test points: #18, 19, 203). Wind speeds at these 3 test points would range from 13 to 15 mph. Wind hazards would occur at 2 of the 3 locations, with individual durations of 7 hours per year (#18) and 50 hours per year (#203). Specific measures should be developed to reduce or eliminate these wind hazards.
- **Building 3** – (4 test points: #20, 21, 22, 23). Wind speeds at these 4 locations would range from 10 to 11 mph; winds at all of these locations would meet the Pedestrian Criterion. No wind hazards would occur.
- **Cityside Neighborhood Park** – (12 test points: # 53, 54, 63, 64, 76, 77, 96, 97, 105, 106, 115, 116). Wind speeds at these 12 test points would range from 8 to 13 mph. Winds at 5 of the 12 locations (#53, 63, 64, 97, 105) would meet the Pedestrian Criterion. No wind hazards would occur.
- **Cultural Park** – (4 test points: # 135, 136, 137, 138). Wind speeds at these 4 test points would range from 13 to 17 mph. Wind hazards would occur at 2 of the 4 locations, with durations of 1 hour per year (#135) and 10 hours per year (#137).
- **Cityside Waterfront Park** – (2 test points: #205, 206). The wind speeds exceeded 10% of the time would range from 16 to 17 mph. Winds at both locations would exceed the wind hazard criterion. The durations of the individual hazards would be 3 hours per year and 4 hours per year, at locations #206 and 205, respectively.
- **Clipper Cove Promenade** – (2 test points: #202, 204). Wind speeds would range from 11 to 15 mph. Wind at one of the two locations (#202) would meet the Pedestrian Criterion. No wind hazard would occur.
- **Eastside Commons –** (21 test points: #151-153, 156, 161, 162, 164-166, 168, 171, 173, 174, 176, 182, 183, 187, 191, 193, 198, 201). Wind speeds would range from 10 to 20 mph. Winds at 6 of the 21 locations would meet the Pedestrian Criterion (164, 173, 174, 176, 191, 193). Wind speeds would vary by block along the Eastside Commons – winds would be higher between Avenue D and Avenue H, lower between Avenues I and J, higher at Avenue K, and lower at Eastside Avenue.

Winds at 5 of the 21 test points (#153, 165, 171, 182, 198) in the Eastside Commons would exceed the wind hazard criterion. Hazards would occur: at two locations at Avenue H and 3rd for durations of 1 hours per year (#165) and 17 hours per year (#171); at two locations at Avenue K and 3rd (#182, 198) for durations of 2 hours per year each; and, at one location at 3rd, California Avenue and Avenue D (#153) for a duration of 14 hours per year.

- **Marina Plaza** – (2 test points: #24, 25). Wind speeds would range from 15 to 16 mph. No wind hazard would occur.
- **School Open Space** – (1 test point: #29). Wind speed would be 13 mph. No wind hazard would occur.
- **Waterfront Plaza** – (3 test points: #125, 126, 140). Wind speeds in this exposed waterfront location would range from 13 to 19 mph. Winds at all 3 test points would exceed the wind hazard criterion. The hazard durations would range from 1 to 10 hours per year.
- **Pier 1** – (1 test point: #188). Near the Pier, wind speed would be 11 mph, meeting the Pedestrian Criterion. No wind hazard would occur.
- **Job Corps** – (11 test points: #8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 28). Wind speeds would range from 7 to 19 mph; wind speeds at 6 of the 11 test points (#8, 11, 13, 15, 16, 17) would meet the Pedestrian Criterion. One wind hazard, with a duration of 15 hours per year, would occur (#12) on the east side of Avenue C.

  Compared to existing conditions, with the Project 10% exceeded wind speeds would be: reduced by 4 to 8 mph at the four test points (#8 – 11) at the two northern-most Job Corps buildings: increased by 4 mph at one test point (#12) at south end of the Job Corps building, at 5th Street and Avenue C; decreased by 4 to 10 mph at the five test points (#13 - 17) at the two southern-most Job Corps buildings; and, decreased by 3 mph at the one test point (#28) at the eastern-most Job Corps building. Overall, wind speeds would decrease by 3 to 10 mph at 10 of those 11 test points, and would increase by 4 mph at the one remaining test point.

  The Project would eliminate 9 existing wind hazards, with total duration of 49 hours per year, and create one new hazard, with a duration of 15 hours per year, at Job Corps test points. The Project would: eliminate existingwind hazards at the four test points (#8 – 11) at the two northern-most Job Corps buildings: create a new hazard at one test point (#12) at south end of the Job Corps building, at 5th Street and Avenue C; and, eliminate existing hazards at the five test points (#13 - 17) at the two southern-most Job Corps buildings. An existing wind hazard does not occur at test point (#28) at the eastern-most Job Corps building, and the Project would not create one there.

#### Point-by-Point - Project R-values and Wind Conditions

The wind test data for the 200 Project measurements are summarized in Table 6, which presents the measured R-values for all five tested wind directions (NNW, NW, WNW, W and SSE) as well as the calculated 10% exceeded wind speed and the hours per year duration of wind hazard. Note that the wind speeds and hazard durations are calculated only using three of the wind directions – NNW, W and SSE. However, the R-values for NW and WNW winds can be compared to the R-values for W wind to understand the relative wind speeds that could result from winds from those directions, as well.

**TABLE 6**
**SUMMARY OF MEASURED R-VALUES AND CALCULATED WINDS - PROJECT CONDITIONS**

| *Project Conditions - Measured R-Values* | | | | | | | *Calculated Wind Speeds* | | *Test Point Location - Narrative Description* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **#** | **NNW** | **NW** | **WNW** | **W** | **SSE** | **R-Value Average** | **10% Exceed** | **Hazard hr/yr** | **Avenues** | **Streets** | **California Avenue** | **Edges** | **Identifier or Name** |
| 1 | | | | | | | | | | | | open | Existing "star" |
| 2 | | | | | | | | | | | | open | Existing "star" |
| 3 | Existing locations covered by Project buildings. | | | | | | | | | | | open | Existing "star" |
| 4 | | | | | | | | | Avenue C | | | | Existing "star" |
| 5 | | | | | | | | | | | | open | Existing "star" |
| 6 | | | | | | | | | | | | open | Existing "star" |
| 7 | 0.32 | 0.37 | 0.54 | 0.50 | 0.35 | 0.42 | 15 | | Avenue C | | | | Existing "star" |
| 8 | 0.22 | 0.35 | 0.36 | 0.33 | 0.35 | 0.32 | 10 | | Avenue C | | | | Job Corps |
| 9 | 0.21 | 0.25 | 0.34 | 0.46 | 0.22 | 0.30 | 14 | | | | | open | Job Corps |
| 10 | 0.38 | 0.55 | 0.50 | 0.50 | 0.26 | 0.44 | 15 | | Avenue C | | | | Job Corps |
| 11 | 0.28 | 0.26 | 0.38 | 0.29 | 0.33 | 0.31 | 10 | | Avenue C | | | | Job Corps |
| 12 | 0.33 | 0.49 | 0.45 | 0.66 | 0.37 | 0.46 | 19 | 15 | Avenue C | | | | Job Corps |
| 13 | 0.15 | 0.18 | 0.45 | 0.26 | 0.50 | 0.31 | 9 | | | | | open | Job Corps |
| 14 | 0.32 | 0.29 | 0.28 | 0.41 | 0.24 | 0.31 | 12 | | Avenue C | | | | Job Corps |
| 15 | 0.30 | 0.34 | 0.23 | 0.26 | 0.25 | 0.28 | 9 | | | | | open | Job Corps |
| 16 | 0.37 | 0.39 | 0.39 | 0.26 | 0.45 | 0.37 | 10 | | | | | open | Job Corps |
| 17 | 0.28 | 0.25 | 0.30 | 0.24 | 0.21 | 0.25 | 8 | | | | | open | Job Corps |
| 18 | 0.36 | 0.56 | 0.47 | 0.46 | 0.62 | 0.49 | 15 | 7 | Avenue C | | California Avenue | | Building 2 |
| 19 | 0.37 | 0.45 | 0.40 | 0.37 | 0.44 | 0.40 | 13 | | Avenue E | | California Avenue | | Building 2 |
| 20 | 0.26 | 0.31 | 0.25 | 0.34 | 0.23 | 0.28 | 10 | | Avenue H | | California Avenue | | Building 3 |
| 21 | 0.27 | 0.24 | 0.26 | 0.37 | 0.26 | 0.28 | 11 | | Avenue I | | California Avenue | | Building 3 |
| 22 | 0.34 | 0.26 | 0.29 | 0.31 | 0.24 | 0.29 | 10 | | Avenue I | 02-03 alley | | | Building 3 |
| 23 | 0.20 | 0.16 | 0.28 | 0.34 | 0.32 | 0.26 | 11 | | Avenue E Alley | 02-03 alley | | | Building 3 |
| 24 | 0.44 | 0.52 | 0.54 | 0.45 | 0.54 | 0.50 | 15 | | | | | Shoreline | Marina Plaza |
| 25 | 0.36 | 0.56 | 0.57 | 0.50 | 0.43 | 0.49 | 16 | | | 1st | | Shoreline | Marina Plaza |
| 26 | 0.32 | 0.48 | 0.38 | 0.44 | 0.41 | 0.41 | 14 | | | | | open | Building 1 Plaza |
| 27 | 0.40 | 0.38 | 0.27 | 0.32 | 0.43 | 0.36 | 12 | | | | | open | Building 1 Plaza |
| 28 | 0.42 | 0.32 | 0.32 | 0.34 | 0.38 | 0.36 | 12 | | | | | open | Job Corps |
| 29 | 0.22 | 0.37 | 0.35 | 0.42 | 0.29 | 0.33 | 13 | | Avenue D - E | 8th - 9th | | | School Open Space |
| 30 | 0.40 | 0.46 | 0.78 | 0.60 | 0.11 | 0.47 | 18 | 6 | Avenue E | 8th | | | |
| 31 | 0.49 | 0.35 | 0.30 | 0.13 | 0.30 | 0.31 | 8 | | Avenue E | 7th | | | |
| 32 | 0.14 | 0.15 | 0.25 | 0.28 | 0.30 | 0.22 | 9 | | Avenue D | 7th | | | |
| 33 | 0.33 | 0.24 | 0.21 | 0.22 | 0.31 | 0.26 | 8 | | Avenue D | 7th - 8th | | | |
| 34 | 0.53 | 0.49 | 0.31 | 0.38 | 0.44 | 0.43 | 14 | | Avenue D | 8th | | | |
| 35 | 0.57 | 0.47 | 0.49 | 0.23 | 0.31 | 0.41 | 10 | | Avenue D Alley | 7th - 8th | | | |
| 36 | 0.12 | 0.17 | 0.33 | 0.15 | 0.14 | 0.18 | 5 | | Avenue D Alley | 7th - 8th | | | |
| 37 | 0.35 | 0.24 | 0.23 | 0.30 | 0.19 | 0.26 | 10 | | Avenue E | 7th | | | |
| 38 | 0.54 | 0.30 | 0.24 | 0.16 | 0.40 | 0.33 | 10 | | Avenue E | 6th - 7th | | | |
| 39 | 0.27 | 0.43 | 0.20 | 0.19 | 0.45 | 0.31 | 8 | | Avenue D Alley | 6th - 7th | | | |
| 40 | 0.33 | 0.41 | 0.30 | 0.20 | 0.39 | 0.33 | 8 | | Avenue D | 6th - 7th | | | |
| 41 | 0.31 | 0.24 | 0.30 | 0.28 | 0.42 | 0.31 | 10 | | Avenue D | 7th | | | |
| 42 | 0.29 | 0.24 | 0.24 | 0.29 | 0.21 | 0.25 | 9 | | Avenue D Alley | 7th | | | |
| 43 | 0.32 | 0.32 | 0.31 | 0.17 | 0.38 | 0.30 | 8 | | Avenue D | 9th | | | |
| 44 | 0.48 | 0.43 | 0.39 | 0.33 | 0.28 | 0.38 | 12 | | Avenue C Alley | 9th | | | |
| 45 | 0.35 | 0.47 | 0.40 | 0.31 | 0.30 | 0.36 | 10 | | Avenue C | 9th | | | |
| 46 | 0.68 | 0.70 | 0.68 | 0.33 | 0.42 | 0.56 | 14 | 3 | Avenue C | 9th - 10th | | | |
| 47 | 0.62 | 0.58 | 0.61 | 0.36 | 0.33 | 0.50 | 13 | 1 | Avenue C Alley | 10th | | | |
| 48 | 0.29 | 0.37 | 0.52 | 0.47 | 0.10 | 0.35 | 14 | | Avenue C - D | 10th | | | |
| 49 | 0.29 | 0.56 | 0.68 | 0.43 | 0.28 | 0.45 | 13 | | Avenue D | 9th | | | |
| 50 | 0.36 | 0.23 | 0.36 | 0.26 | 0.30 | 0.30 | 9 | | Avenue D | 8th - 9th | | | |
| 51 | 0.60 | 0.56 | 0.28 | 0.22 | 0.33 | 0.40 | 10 | | Avenue D | 8th - 9th | | | |
| 52 | 0.62 | 0.51 | 0.25 | 0.35 | 0.33 | 0.41 | 13 | 1 | Avenue D | 8th | | | |
| 53 | 0.39 | 0.43 | 0.25 | 0.36 | 0.26 | 0.34 | 11 | | Avenue C Alley | 8th | | | Cityside Neighborhood Park |
| 54 | 0.36 | 0.28 | 0.25 | 0.41 | 0.24 | 0.31 | 12 | | Avenue C Alley | 8th | | | Cityside Neighborhood Park |
| 55 | 0.41 | 0.55 | 0.50 | 0.38 | 0.35 | 0.44 | 12 | | Avenue C | 8th | | | |
| 56 | 0.37 | 0.42 | 0.34 | 0.37 | 0.38 | 0.38 | 12 | | Avenue C | 8th - 9th | | | |
| 57 | 0.31 | 0.25 | 0.26 | 0.45 | 0.32 | 0.32 | 14 | | Avenue C | 9th | | | |
| 58 | 0.25 | 0.32 | 0.41 | 0.16 | 0.38 | 0.30 | 7 | | Avenue C Alley | 8th - 9th | | | |
| 59 | 0.35 | 0.53 | 0.44 | 0.32 | 0.17 | 0.36 | 10 | | Avenue C - D | 9th | | | |
| 60 | 0.39 | 0.36 | 0.56 | 0.40 | 0.14 | 0.37 | 12 | | Avenue D | 8th | | | |
| 61 | 0.20 | 0.25 | 0.28 | 0.33 | 0.21 | 0.25 | 10 | | Avenue D | 7th - 8th | | | |
| 62 | 0.41 | 0.32 | 0.20 | 0.16 | 0.27 | 0.27 | 8 | | Avenue D | 7th | | | |
| 63 | 0.24 | 0.23 | 0.31 | 0.22 | 0.30 | 0.26 | 8 | | Avenue C Alley | 7th | | | Cityside Neighborhood Park |
| 64 | 0.28 | 0.30 | 0.29 | 0.22 | 0.29 | 0.28 | 8 | | Avenue C Alley | 7th | | | Cityside Neighborhood Park |
| 65 | 0.29 | 0.31 | 0.37 | 0.22 | 0.39 | 0.31 | 8 | | Avenue C | 7th - 8th | | | |
| 66 | 0.31 | 0.43 | 0.39 | 0.41 | 0.36 | 0.38 | 13 | | Avenue C | 8th | | | |
| 67 | 0.48 | 0.33 | 0.25 | 0.34 | 0.22 | 0.32 | 11 | | Avenue C Alley | 8th | | | |
| 68 | 0.33 | 0.45 | 0.34 | 0.33 | 0.39 | 0.37 | 11 | | Avenue C Alley | 7th - 8th | | | |
| 69 | 0.58 | 0.52 | 0.54 | 0.37 | 0.43 | 0.49 | 14 | | Avenue C Alley | 7th - 8th | | | |
| 70 | 0.25 | 0.20 | 0.23 | 0.29 | 0.12 | 0.22 | 9 | | Avenue D | 7th | | | |
| 71 | 0.11 | 0.11 | 0.16 | 0.22 | 0.24 | 0.17 | 7 | | | | | open | Job Corps |
| 72 | 0.26 | 0.41 | 0.20 | 0.43 | 0.23 | 0.31 | 13 | | Avenue C | | | | |
| 73 | 0.25 | 0.24 | 0.26 | 0.28 | 0.13 | 0.23 | 8 | | Avenue C - D | 7th | | | |
| 74 | 0.50 | 0.72 | 0.64 | 0.50 | 0.34 | 0.54 | 16 | | Avenue C | 10th | | | |
| 75 | 0.57 | 0.46 | 0.28 | 0.41 | 0.29 | 0.40 | 14 | | Avenue C | 9th | | | |

GREEN: Values less than 0.3
BLACK: Values between 0.3 and 0.5
RED: Values greater than 0.5

Meets 11 mph pedestrian criterion: 10
Hours per year that wind exceeds Wind Hazard critrion: 37

**Street name reference: Perkins + Will, Block and Street Name Map, 04 May 2009. Unmarked alleys are referenced to the avenue located immediately to the west.**

**Parks and Open Space Names reference: TIDA**

**TABLE 6**
**SUMMARY OF MEASURED R-VALUES AND CALCULATED WINDS - PROJECT CONDITIONS**

| *Project Conditions - Measured R-Values* | | | | | | | *Calculated Wind Speeds* | | *Test Point Location - Narrative Description* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **#** | **NNW** | **NW** | **WNW** | **W** | **SSE** | **R-Value Average** | **10% Exceed** | **Hazard hr/yr** | **Avenues** | **Streets** | **California Avenue** | **Edges** | **Identifier or Name** |
| 76 | 0.25 | 0.35 | 0.45 | 0.44 | 0.27 | 0.35 | 13 | | Cityside Alley | 9th | | | Cityside Neighborhood Park |
| 77 | 0.50 | 0.34 | 0.45 | 0.40 | 0.29 | 0.40 | 13 | | Cityside Alley | 9th | | | Cityside Neighborhood Park |
| 78 | 0.25 | 0.46 | 0.52 | 0.63 | 0.38 | 0.45 | 19 | 10 | Cityside Avenue | 9th | | | |
| 79 | 0.52 | 0.58 | 0.35 | 0.41 | 0.58 | 0.49 | 15 | 3 | Cityside Avenue | 10th | | | |
| 80 | 0.44 | 0.49 | 0.43 | 0.53 | 0.53 | 0.48 | 17 | 2 | Cityside Alley | 10th | | | |
| 81 | 0.78 | 0.71 | 0.59 | 0.43 | 0.59 | 0.62 | 17 | 15 | Cityside Alley | 8th - 9th | | | |
| 82 | 0.41 | 0.37 | 0.27 | 0.65 | 0.13 | 0.37 | 19 | 13 | Avenue C | 9th | | | |
| 83 | 0.51 | 0.54 | 0.18 | 0.21 | 0.30 | 0.35 | 9 | | Avenue C | 8th - 9th | | | |
| 84 | 0.44 | 0.41 | 0.40 | 0.50 | 0.28 | 0.41 | 15 | | Avenue C | 8th - 9th | | | |
| 85 | 0.52 | 0.41 | 0.31 | 0.35 | 0.29 | 0.37 | 12 | | Avenue C | 7th - 8th | | | |
| 86 | 0.38 | 0.28 | 0.43 | 0.35 | 0.19 | 0.33 | 11 | | Cityside Alley | 8th | | | |
| 87 | 0.35 | 0.29 | 0.52 | 0.40 | 0.22 | 0.36 | 12 | | Cityside Alley | 8th | | | |
| 88 | 0.23 | 0.56 | 0.56 | 0.51 | 0.52 | 0.48 | 16 | | Cityside Avenue | 8th | | | |
| 89 | 0.25 | 0.57 | 0.53 | 0.52 | 0.51 | 0.47 | 16 | | Cityside Avenue | 8th - 9th | | | |
| 90 | 0.37 | 0.63 | 0.46 | 0.39 | 0.49 | 0.47 | 13 | | Cityside Avenue | 9th | | | |
| 91 | 0.33 | 0.26 | 0.33 | 0.24 | 0.27 | 0.29 | 9 | | Cityside Alley | 8th - 9th | | | |
| 92 | 0.29 | 0.25 | 0.25 | 0.45 | 0.21 | 0.29 | 13 | | Cityside Alley | 9th | | | |
| 93 | 0.30 | 0.34 | 0.53 | 0.62 | 0.16 | 0.39 | 18 | 8 | Avenue C | 8th | | | |
| 94 | 0.24 | 0.22 | 0.37 | 0.50 | 0.25 | 0.32 | 14 | | Avenue C | 7th - 8th | | | |
| 95 | 0.36 | 0.40 | 0.35 | 0.31 | 0.28 | 0.34 | 10 | | Avenue C | 7th | | | |
| 96 | 0.22 | 0.53 | 0.44 | 0.39 | 0.26 | 0.37 | 12 | | Cityside Alley | 7th | | | Cityside Neighborhood Park |
| 97 | 0.33 | 0.42 | 0.45 | 0.35 | 0.29 | 0.37 | 11 | | Cityside Alley | 7th | | | Cityside Neighborhood Park |
| 98 | 0.52 | 0.53 | 0.41 | 0.29 | 0.59 | 0.47 | 13 | 4 | Cityside Avenue | 7th - 8th | | | |
| 99 | 0.40 | 0.52 | 0.42 | 0.33 | 0.56 | 0.44 | 12 | 1 | Cityside Avenue | 8th | | | |
| 100 | 0.36 | 0.28 | 0.31 | 0.53 | 0.19 | 0.33 | 15 | | Cityside Alley | 8th | | | |
| 101 | 0.30 | 0.27 | 0.35 | 0.41 | 0.39 | 0.34 | 13 | | Cityside Alley | 8th - 9th | | | |
| 102 | 0.28 | 0.36 | 0.28 | 0.54 | 0.23 | 0.34 | 16 | 1 | Avenue C | 7th | | | |
| 103 | 0.24 | 0.28 | 0.47 | 0.51 | 0.28 | 0.36 | 15 | | Avenue C | 6th - 7th | | | |
| 104 | 0.34 | 0.25 | 0.32 | 0.38 | 0.19 | 0.30 | 12 | | Avenue C | 6th | | | |
| 105 | 0.28 | 0.26 | 0.46 | 0.37 | 0.21 | 0.31 | 11 | | Cityside Alley | 6th | | | Cityside Neighborhood Park |
| 106 | 0.26 | 0.43 | 0.70 | 0.39 | 0.24 | 0.40 | 12 | | Cityside Alley | 6th | | | Cityside Neighborhood Park |
| 107 | 0.53 | 0.47 | 0.53 | 0.38 | 0.36 | 0.45 | 13 | | Cityside Alley | 6th - 7th | | | |
| 108 | 0.30 | 0.49 | 0.52 | 0.45 | 0.52 | 0.46 | 15 | | Cityside Avenue | 6th - 7th | | | |
| 109 | 0.39 | 0.51 | 0.41 | 0.41 | 0.49 | 0.44 | 14 | | Cityside Avenue | 7th | | | |
| 110 | 0.27 | 0.31 | 0.36 | 0.47 | 0.21 | 0.32 | 14 | | Cityside Alley | 7th | | | |
| 111 | 0.24 | 0.30 | 0.29 | 0.24 | 0.35 | 0.28 | 8 | | Cityside Alley | 6th - 7th | | | |
| 112 | 0.25 | 0.49 | 0.37 | 0.40 | 0.22 | 0.35 | 12 | | Cityside Alley | 6th | | | |
| 113 | 0.24 | 0.23 | 0.36 | 0.44 | 0.24 | 0.30 | 13 | | Avenue C | 5th - 6th | | | |
| 114 | 0.31 | 0.33 | 0.25 | 0.44 | 0.31 | 0.33 | 13 | | Avenue C | 5th | | | |
| 115 | 0.32 | 0.46 | 0.47 | 0.38 | 0.28 | 0.38 | 12 | | Cityside Alley | 5th | | | Cityside Neighborhood Park |
| 116 | 0.23 | 0.47 | 0.33 | 0.42 | 0.24 | 0.34 | 12 | | Cityside Alley | 5th | | | Cityside Neighborhood Park |
| 117 | 0.34 | 0.53 | 0.63 | 0.48 | 0.43 | 0.48 | 15 | | Cityside Avenue | 5th | | | |
| 118 | 0.34 | 0.38 | 0.41 | 0.42 | 0.57 | 0.42 | 14 | 2 | Cityside Avenue | 5th - 6th | | | |
| 119 | 0.33 | 0.44 | 0.39 | 0.39 | 0.54 | 0.42 | 13 | | Cityside Avenue | 6th | | | |
| 120 | 0.28 | 0.38 | 0.32 | 0.31 | 0.34 | 0.33 | 10 | | Cityside Alley | 5th - 6th | | | |
| 121 | 0.32 | 0.33 | 0.65 | 0.38 | 0.25 | 0.38 | 12 | | Avenue C | 5th | | | |
| 122 | 0.47 | 0.38 | 0.42 | 0.26 | 0.41 | 0.39 | 11 | | Avenue C | 4th - 5th | | | |
| 123 | 0.41 | 0.33 | 0.32 | 0.22 | 0.62 | 0.38 | 11 | 6 | Avenue C | 4th | | | |
| 124 | 0.42 | 0.37 | 0.49 | 0.28 | 0.51 | 0.41 | 11 | | Avenue C | 4th - 5th | | | |
| 125 | 0.45 | 0.65 | 0.68 | 0.61 | 0.47 | 0.57 | 19 | 7 | | 4th | | Shoreline | Waterfront Plaza |
| 126 | 0.54 | 0.52 | 0.43 | 0.31 | 0.55 | 0.47 | 13 | 1 | | 4th | | Shoreline | Waterfront Plaza |
| 127 | 0.31 | 0.32 | 0.31 | 0.37 | 0.23 | 0.31 | 11 | | Cityside Avenue | 4th - 5th | | | |
| 128 | 0.32 | 0.35 | 0.36 | 0.41 | 0.27 | 0.34 | 12 | | Cityside Avenue | 4th - 5th | | | |
| 129 | 0.33 | 0.48 | 0.41 | 0.35 | 0.49 | 0.41 | 12 | | Cityside Avenue | 5th | | | |
| 130 | 0.45 | 0.39 | 0.31 | 0.34 | 0.27 | 0.35 | 12 | | Cityside Alley | 5th | | | |
| 131 | 0.43 | 0.36 | 0.30 | 0.29 | 0.35 | 0.35 | 11 | | Cityside Alley | 4th - 5th | | | |
| 132 | 0.38 | 0.37 | 0.23 | 0.13 | 0.72 | 0.37 | 10 | 26 | Avenue C | 4th | California Avenue | | |
| 133 | 0.41 | 0.30 | 0.21 | 0.13 | 0.64 | 0.34 | 10 | 9 | Avenue C | 4th | California Avenue | | |
| 134 | 0.43 | 0.34 | 0.24 | 0.33 | 0.56 | 0.38 | 13 | 2 | Avenue C | | California Avenue | | |
| 135 | 0.34 | 0.29 | 0.50 | 0.54 | 0.43 | 0.42 | 17 | 1 | Cityside Alley | | | | Cultural Park |
| 136 | 0.59 | 0.44 | 0.40 | 0.43 | 0.45 | 0.46 | 15 | | Cityside Alley | | California Avenue | | Cultural Park |
| 137 | 0.48 | 0.36 | 0.40 | 0.32 | 0.65 | 0.44 | 13 | 10 | Cityside Alley | 4th | | | Cultural Park |
| 138 | 0.54 | 0.25 | 0.31 | 0.41 | 0.39 | 0.38 | 14 | | Cityside Alley | | | | Cultural Park |
| 139 | 0.22 | 0.29 | 0.37 | 0.53 | 0.29 | 0.34 | 15 | | Cityside Avenue | 4th | | | |
| 140 | 0.55 | 0.59 | 0.57 | 0.52 | 0.49 | 0.54 | 17 | 1 | | | | Shoreline | Waterfront Plaza |
| 141 | 0.38 | 0.50 | 0.61 | 0.51 | 0.40 | 0.48 | 16 | | | | | Shoreline | Building 1 Plaza |
| 142 | 0.33 | 0.52 | 0.49 | 0.58 | 0.60 | 0.50 | 18 | 9 | Avenue D | | California Avenue | | |
| 143 | 0.34 | 0.31 | 0.23 | 0.52 | 0.50 | 0.38 | 16 | | Avenue D | M1 | | | |
| 144 | 0.59 | 0.46 | 0.26 | 0.31 | 0.47 | 0.42 | 13 | | Avenue D | 1st | | | |
| 145 | 0.49 | 0.53 | 0.62 | 0.64 | 0.46 | 0.55 | 20 | 12 | Avenue C | 1st | | | |
| 146 | 0.43 | 0.57 | 0.40 | 0.49 | 0.43 | 0.47 | 16 | | Avenue C | M1 | | | |
| 147 | 0.49 | 0.40 | 0.31 | 0.42 | 0.80 | 0.48 | 16 | 56 | Avenue C | | California Avenue | | |
| 148 | 0.39 | 0.36 | 0.29 | 0.57 | 0.32 | 0.38 | 17 | 3 | Avenue C - D | | California Avenue | | |
| 149 | 0.44 | 0.57 | 0.41 | 0.31 | 0.56 | 0.46 | 12 | 2 | Avenue D | 1st | | | |
| 150 | 0.56 | 0.33 | 0.22 | 0.19 | 0.40 | 0.34 | 10 | | Avenue E | 3rd - 4th | | | |

GREEN: Values less than 0.3
BLACK: Values between 0.3 and 0.5
RED: Values greater than 0.5

Meets 11 mph pedstrian criterion: 10
Hours per year that wind exceeds Wind Hazard critrion: 37

**Street name reference: Perkins + Will, Block and Street Name Map, 04 May 2009. Unmarked alleys are referenced to the avenue located immediately to the west.**

**Parks and Open Space Names reference: TIDA**

ESA

TABLE 6
SUMMARY OF MEASURED R-VALUES AND CALCULATED WINDS - PROJECT CONDITIONS

| Project Conditions - Measured R-Values | | | | | | | Calculated Wind Speeds | | Test Point Location - Narrative Description | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | NNW | NW | WNW | W | SSE | R-Value Average | 10% Exceed | Hazard hr/yr | Avenues | Streets | California Avenue | Edges | Identifier or Name |
| 151 | 0.56 | 0.47 | 0.52 | 0.27 | 0.46 | 0.46 | 12 | | Avenue E | 3rd | | | Eastside Commons |
| 152 | 0.30 | 0.31 | 0.36 | 0.43 | 0.37 | 0.35 | 13 | | | 3rd | California Avenue | | Eastside Commons |
| 153 | 0.42 | 0.69 | 0.57 | 0.65 | 0.55 | 0.58 | 20 | 14 | Avenue D | 3rd | California Avenue | | Eastside Commons |
| 154 | 0.43 | 0.42 | 0.31 | 0.25 | 0.70 | 0.42 | 12 | 20 | Avenue D | 3rd - 4th | | | |
| 155 | 0.49 | 0.61 | 0.43 | 0.41 | 0.39 | 0.46 | 14 | | Avenue H | 4th | | | |
| 156 | 0.40 | 0.46 | 0.69 | 0.48 | 0.52 | 0.51 | 16 | | Avenue E | 3rd | | | Eastside Commons |
| 157 | 0.57 | 0.37 | 0.37 | 0.23 | 0.56 | 0.42 | 12 | 2 | Avenue E | 3rd - 4th | | | |
| 158 | 0.40 | 0.27 | 0.40 | 0.37 | 0.43 | 0.37 | 13 | | Avenue E | 4th | | | |
| 159 | 0.54 | 0.44 | 0.22 | 0.41 | 0.37 | 0.40 | 14 | | Avenue H | | California Avenue | | |
| 160 | 0.16 | 0.46 | 0.58 | 0.41 | 0.48 | 0.42 | 13 | | Avenue E | | California Avenue | | |
| 161 | 0.44 | 0.43 | 0.49 | 0.32 | 0.46 | 0.43 | 12 | | Avenue E | 3rd | | | Eastside Commons |
| 162 | 0.40 | 0.28 | 0.33 | 0.49 | 0.25 | 0.35 | 15 | | Avenue E - H | 3rd | | | Eastside Commons |
| 163 | 0.55 | 0.67 | 0.54 | 0.54 | 0.21 | 0.50 | 17 | 2 | Avenue I | 4th | | | |
| 164 | 0.53 | 0.48 | 0.37 | 0.23 | 0.47 | 0.42 | 11 | | Avenue I | 3rd | | | Eastside Commons |
| 165 | 0.43 | 0.47 | 0.44 | 0.46 | 0.55 | 0.47 | 15 | 1 | Avenue H | 3rd | | | Eastside Commons |
| 166 | 0.59 | 0.62 | 0.43 | 0.32 | 0.49 | 0.49 | 13 | | Avenue H | 3rd - 4th | | | Eastside Commons |
| 167 | 0.46 | 0.49 | 0.27 | 0.27 | 0.47 | 0.39 | 11 | | Avenue H | 4th | | | |
| 168 | 0.47 | 0.29 | 0.25 | 0.42 | 0.34 | 0.35 | 14 | | Avenue I | 3rd | | | Eastside Commons |
| 169 | 0.38 | 0.12 | 0.12 | 0.32 | 0.37 | 0.26 | 11 | | Avenue I | | California Avenue | | |
| 170 | 0.37 | 0.52 | 0.29 | 0.35 | 0.31 | 0.37 | 11 | | Avenue H | | California Avenue | | |
| 171 | 0.42 | 0.45 | 0.40 | 0.36 | 0.69 | 0.46 | 14 | 17 | Avenue H | 3rd | | | Eastside Commons |
| 172 | 0.43 | 0.52 | 0.54 | 0.47 | 0.14 | 0.42 | 14 | | Avenue J | 4th | | | |
| 173 | 0.51 | 0.41 | 0.43 | 0.28 | 0.40 | 0.41 | 11 | | Avenue J | 3rd | | | Eastside Commons |
| 174 | 0.33 | 0.47 | 0.38 | 0.27 | 0.39 | 0.37 | 10 | | Avenue I | 3rd | | | Eastside Commons |
| 175 | 0.60 | 0.62 | 0.50 | 0.31 | 0.39 | 0.49 | 13 | | Avenue I | 3rd - 4th | | | |
| 176 | 0.48 | 0.45 | 0.39 | 0.24 | 0.44 | 0.40 | 11 | | Avenue J | 3rd | | | Eastside Commons |
| 177 | 0.44 | 0.34 | 0.33 | 0.19 | 0.39 | 0.34 | 9 | | Avenue J | 2nd | | | |
| 178 | 0.21 | 0.21 | 0.31 | 0.18 | 0.52 | 0.29 | 8 | | Avenue I | 2nd | | | |
| 179 | 0.54 | 0.28 | 0.34 | 0.39 | 0.51 | 0.41 | 14 | | Avenue I | 3rd | | | |
| 180 | 0.53 | 0.63 | 0.62 | 0.59 | 0.19 | 0.51 | 18 | 6 | Avenue K | 4th | | | |
| 181 | 0.44 | 0.38 | 0.40 | 0.27 | 0.55 | 0.41 | 11 | | Avenue K | 3rd - 4th | | | |
| 182 | 0.57 | 0.53 | 0.44 | 0.37 | 0.55 | 0.49 | 15 | 2 | Avenue K | 3rd | | | Eastside Commons |
| 183 | 0.43 | 0.52 | 0.56 | 0.47 | 0.46 | 0.49 | 15 | | Avenue J | 3rd | | | Eastside Commons |
| 184 | 0.60 | 0.60 | 0.55 | 0.37 | 0.35 | 0.50 | 14 | 1 | Avenue J | 3rd - 4th | | | |
| 185 | 0.42 | 0.28 | 0.27 | 0.15 | 0.47 | 0.32 | 9 | | Avenue K | 2nd | | | |
| 186 | 0.30 | 0.23 | 0.32 | 0.27 | 0.51 | 0.33 | 10 | | Avenue J | 2nd | | | |
| 187 | 0.46 | 0.52 | 0.41 | 0.33 | 0.47 | 0.44 | 13 | | Avenue J | 3rd | | | Eastside Commons |
| 188 | 0.51 | 0.34 | 0.27 | 0.23 | 0.54 | 0.38 | 11 | | | | | Shoreline | Pier 1 |
| 189 | 0.47 | 0.48 | 0.57 | 0.58 | 0.33 | 0.49 | 17 | 4 | Eastside Avenue | 4th | | | |
| 190 | 0.49 | 0.39 | 0.29 | 0.18 | 0.47 | 0.36 | 10 | | Eastside Avenue | 3rd - 4th | | | |
| 191 | 0.55 | 0.44 | 0.35 | 0.16 | 0.46 | 0.39 | 11 | | Eastside Avenue | 3rd | | | Eastside Commons |
| 192 | 0.62 | 0.62 | 0.65 | 0.44 | 0.40 | 0.54 | 15 | 1 | Avenue K | 3rd - 4th | | | |
| 193 | 0.48 | 0.54 | 0.44 | 0.23 | 0.52 | 0.44 | 11 | | Eastside Avenue | 3rd | | | Eastside Commons |
| 194 | 0.62 | 0.48 | 0.33 | 0.22 | 0.58 | 0.45 | 13 | 4 | Eastside Avenue | 2nd - 3rd | | | |
| 195 | 0.61 | 0.44 | 0.17 | 0.21 | 0.47 | 0.38 | 12 | 1 | Eastside Avenue | 2nd | | | |
| 196 | 0.36 | 0.25 | 0.34 | 0.26 | 0.56 | 0.35 | 11 | 1 | Avenue K | 2nd | | | |
| 197 | 0.36 | 0.18 | 0.31 | 0.42 | 0.48 | 0.35 | 14 | | Avenue K | 2nd - 3rd | | | |
| 198 | 0.54 | 0.29 | 0.42 | 0.44 | 0.56 | 0.45 | 16 | 2 | Avenue K | 3rd | | | Eastside Commons |
| 199 | 0.51 | 0.38 | 0.25 | 0.23 | 0.51 | 0.37 | 11 | | Avenue I | 1st | | | |
| 200 | 0.50 | 0.49 | 0.28 | 0.30 | 0.73 | 0.46 | 13 | 29 | Avenue D | 3rd - 4th | | | |
| 201 | 0.36 | 0.31 | 0.24 | 0.45 | 0.33 | 0.34 | 14 | | Avenue E | 3rd | | | Eastside Commons |
| 202 | 0.30 | 0.23 | 0.47 | 0.34 | 0.42 | 0.35 | 11 | | | | | Shoreline | Clipper Cove Promenade |
| 203 | 0.38 | 0.57 | 0.33 | 0.42 | 0.78 | 0.50 | 15 | 50 | Avenue D | 1st - 2nd | | | Building 2 / Bus stop |
| 204 | 0.38 | 0.49 | 0.47 | 0.47 | 0.52 | 0.47 | 15 | | | | | Shoreline | Clipper Cove Promenade |
| 205 | 0.50 | 0.56 | 0.51 | 0.46 | 0.58 | 0.52 | 16 | 4 | | | | Shoreline | Cityside Waterfront Park |
| 206 | 0.61 | 0.57 | 0.53 | 0.48 | 0.55 | 0.55 | 17 | 3 | | | | Shoreline | Cityside Waterfront Park |
| Meets 11 mph pedestrian criterion: | | | | | | | 10 | | | | | | |
| Hours per year that wind exceeds Wind Hazard critrion: | | | | | | | | 37 | | | | | |

GREEN: Values less than 0.3
BLACK: Values between 0.3 and 0.5
RED: Values greater than 0.5

**Street name reference: Perkins + Will, Block and Street Name Map, 04 May 2009. Unmarked alleys are referenced to the avenue located immediately to the west.**

**Parks and Open Space Names reference: TIDA**

# Project plus Cumulative

Due to factors discussed earlier in the Model and Wind Testing Protocols, no wind interaction is anticipated between the Proposed Project and any cumulative development on Treasure Island. The Project plus cumulative scenario would result in wind conditions that could not be distinguished from those wind conditions under the Project.

# ATTACHMENT – PLANNING CODE SECTION 148

**San Francisco Planning Code Section 148,**
**Reduction of Ground-level Wind Currents in C-3 Districts**

(a) **Requirement and Exception.** In C-3 Districts, buildings and additions to existing buildings shall be shaped, or other wind-baffling measures shall be adopted, so that the developments will not cause ground-level wind currents to exceed, more than 10 percent of the time year round, between 7:00 a.m. and 6:00 p.m., the comfort level of 11 m.p.h. equivalent wind speed in areas of substantial pedestrian use and seven m.p.h. equivalent wind speed in public seating areas.

When preexisting ambient wind speeds exceed the comfort level, or when a proposed building or addition may cause ambient wind speeds to exceed the comfort level, the building shall be designed to reduce the ambient wind speeds to meet the requirements. An exception may be granted, in accordance with the provisions of Section 309, allowing the building or addition to add to the amount of time that the comfort level is exceeded by the least practical amount if (1) it can be shown that a building or addition cannot be shaped and other wind-baffling measures cannot be adopted to meet the foregoing requirements without creating an unattractive and ungainly building form and without unduly restricting the development potential of the building site in question, and (2) it is concluded that, because of the limited amount by which the comfort level is exceeded, the limited location in which the comfort level is exceeded, or the limited time during which the comfort level is exceeded, the addition is insubstantial.

No exception shall be granted and no building or addition shall be permitted that causes equivalent wind speeds to reach or exceed the hazard level of 26 miles per hour for a single hour of the year.

(b) **Definition.** The term "equivalent wind speed" shall mean an hourly mean wind speed adjusted to incorporate the effects of gustiness or turbulence on pedestrians.

(c) **Guidelines.** Procedures and Methodologies for implementing this section shall be specified by the Office of Environmental Review of the Department of City Planning. (Added by Ord. 414-85, App. 9/17/85)

# ATTACHMENT – LISTINGS OF WIND-TUNNEL DATA AND CALCULATED RESULTS

## Pedestrian Comfort Analysis

### 10% Exceeded Winds

In the following tables for the Comfort Criterion tests, the output for each location is presented in three-line groups. The ratios of pedestrian-level wind speeds to the 22-feet height reference wind speeds at the NAS Alameda meteorological station are shown in the first line of output for each location.

The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded 10% of the time for each measurement location. Section 148 of the Planning Code sets comfort criteria of 11 mph for areas of substantial public pedestrian use and 7 mph for public seating areas. These criteria are not to be exceeded more than 10% of the time.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedence from each wind direction. The SUMs are the equivalent number of events.

## Wind Hazard Analysis

### 1 Hour per Year Exceeded Winds

In the following tables for the Hazard Criterion tests, the output for each location is presented in three-line groups. The ratios of pedestrian-level wind speeds to the 22-feet height reference wind speeds at the NAS Alameda meteorological station are shown in the first line of output for each location.

The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded one hour per year (approximately 0.01141552512% of the time) for each measurement location tested. Section 148 of the Planning Code sets a wind hazard criterion that an hourly average speed of 26 mph for a full hour (a one-minute average speed of 36 mph) not be reached or exceeded one hour per year.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedence from each wind direction. The SUMs are the equivalent number of events.

The ratios of pedestrian-level wind speeds to the reference height wind speeds at the old Alameda NAS meteorological station are shown in the first line of output for each location.

The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded 10% of the time for each measurement location. This assumes wind comfort criteria of 11 mph for areas of substantial public pedestrian use and 7 mph for public seating areas. These criteria are not to be exceeded more than 10% of the time.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| Loca- tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Profile Ratios:* | *1.9610* | *1.9610* | *1.9610* | *1.9610* | |
| 1 | | | | RATIOS | 1.0848 | 1.1433 | 0.8805 | 1.0362 | |
| | 18.4 | | | CONTRIB | 9.93% | 73.58% | 9.89% | 6.60% | 4,380 |
| | | 11.0 | 34.63 | CONTRIB | 13.35% | 67.23% | 9.59% | 9.83% | 15,168 |
| 2 | | | | RATIOS | 1.3043 | 0.7785 | 1.1617 | 1.0815 | |
| | 15.9 | | | CONTRIB | 33.14% | 24.89% | 28.00% | 13.97% | 4,380 |
| | | 11.0 | 26.32 | CONTRIB | 24.54% | 44.94% | 16.63% | 13.89% | 11,528 |
| 3 | | | | RATIOS | 0.7713 | 1.2519 | 0.3785 | 0.8005 | |
| | 18.6 | | | CONTRIB | 0.95% | 97.22% | 0.00% | 1.84% | 4,380 |
| | | 11.0 | 29.29 | CONTRIB | 6.61% | 86.86% | 0.30% | 6.23% | 12,830 |
| 4 | | | | RATIOS | 0.6828 | 1.0662 | 0.3432 | 0.6974 | |
| | 15.9 | | | CONTRIB | 1.30% | 96.66% | 0.00% | 2.04% | 4,380 |
| | | 11.0 | 24.03 | CONTRIB | 5.01% | 90.51% | 0.11% | 4.37% | 10,524 |
| 5 | | | | RATIOS | 0.3946 | 0.7660 | 0.7656 | 0.6420 | |
| | 12.3 | | | CONTRIB | 0.09% | 74.67% | 20.33% | 4.90% | 4,380 |
| | | 11.0 | 14.45 | CONTRIB | 0.17% | 77.08% | 17.53% | 5.22% | 6,328 |
| 6 | | | | RATIOS | 1.1791 | 0.8028 | 1.2188 | 1.0669 | |
| | 15.9 | | | CONTRIB | 24.11% | 31.90% | 30.81% | 13.18% | 4,380 |
| | | 11.0 | 26.80 | CONTRIB | 20.07% | 49.46% | 17.13% | 13.34% | 11,737 |
| 7 | | | | RATIOS | 1.1584 | 1.1560 | 0.8562 | 1.0568 | |
| | 18.6 | | | CONTRIB | 12.18% | 72.97% | 8.08% | 6.77% | 4,380 |
| | | 11.0 | 35.44 | CONTRIB | 14.69% | 66.41% | 8.97% | 9.93% | 15,523 |
| 8 | | | | RATIOS | 1.3556 | 0.8026 | 0.9046 | 1.0210 | |
| | 15.7 | | | CONTRIB | 36.23% | 35.00% | 17.20% | 11.57% | 4,380 |
| | | 11.0 | 26.90 | CONTRIB | 25.75% | 49.22% | 12.68% | 12.34% | 11,784 |
| 9 | | | | RATIOS | 0.7009 | 1.2011 | 0.6334 | 0.8451 | |
| | 18.0 | | | CONTRIB | 0.54% | 95.46% | 1.09% | 2.90% | 4,380 |
| | | 11.0 | 29.76 | CONTRIB | 4.48% | 82.12% | 5.79% | 7.61% | 13,033 |
| 10 | | | | RATIOS | 0.9028 | 1.1939 | 0.8505 | 0.9824 | |
| | 18.5 | | | CONTRIB | 3.73% | 83.20% | 7.95% | 5.12% | 4,380 |
| | | 11.0 | 33.85 | CONTRIB | 9.78% | 71.75% | 9.26% | 9.20% | 14,827 |
| 11 | | | | RATIOS | 0.8742 | 1.1172 | 0.9925 | 0.9946 | |
| | 17.9 | | | CONTRIB | 3.82% | 74.07% | 15.93% | 6.18% | 4,380 |
| | | 11.0 | 32.81 | CONTRIB | 9.52% | 69.38% | 11.41% | 9.69% | 14,370 |
| 12 | | | | RATIOS | 0.8519 | 0.9532 | 0.9162 | 0.9071 | |
| | 15.7 | | | CONTRIB | 7.20% | 67.69% | 17.79% | 7.32% | 4,380 |
| | | 11.0 | 28.53 | CONTRIB | 10.01% | 68.32% | 12.11% | 9.55% | 12,495 |
| 13 | | | | RATIOS | 0.3496 | 1.2617 | 1.0068 | 0.8727 | |
| | 19.5 | | | CONTRIB | 0.00% | 84.04% | 13.73% | 2.24% | 4,380 |
| | | 11.0 | 32.00 | CONTRIB | 0.02% | 80.13% | 11.86% | 7.98% | 14,014 |
| 14 | | | | RATIOS | 0.7189 | 1.1068 | 0.4636 | 0.7631 | |
| | 16.5 | | | CONTRIB | 1.43% | 95.90% | 0.03% | 2.64% | 4,380 |
| | | 11.0 | 26.06 | CONTRIB | 5.65% | 86.55% | 2.02% | 5.78% | 11,415 |
| 15 | | | | RATIOS | 0.6389 | 1.0497 | 0.4716 | 0.7201 | |
| | 15.7 | | | CONTRIB | 0.83% | 96.45% | 0.13% | 2.59% | 4,380 |
| | | 11.0 | 24.11 | CONTRIB | 3.85% | 88.82% | 2.38% | 4.95% | 10,562 |

The ratios of pedestrian-level wind speeds to the reference height wind speeds at the old Alameda NAS meteorological station are shown in the first line of output for each location.

The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded 10% of the time for each measurement location. This assumes wind comfort criteria of 11 mph for areas of substantial public pedestrian use and 7 mph for public seating areas. These criteria are not to be exceeded more than 10% of the time.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| Location | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | RATIOS | 0.9081 | 0.8903 | 1.2552 | 1.0179 | |
| | 16.0 | | | CONTRIB | 8.50% | 48.54% | 32.31% | 10.65% | 4,380 |
| | | 11.0 | 29.61 | CONTRIB | 11.30% | 61.57% | 15.96% | 11.16% | 12,969 |
| 17 | | | | RATIOS | 0.7860 | 0.7801 | 1.1303 | 0.8988 | |
| | 14.1 | | | CONTRIB | 7.98% | 47.86% | 33.33% | 10.82% | 4,380 |
| | | 11.0 | 20.94 | CONTRIB | 9.96% | 56.89% | 20.34% | 12.81% | 9,173 |
| 18 | | | | RATIOS | 0.9807 | 0.7779 | 1.2919 | 1.0168 | |
| | 15.1 | | | CONTRIB | 14.43% | 36.62% | 35.53% | 13.43% | 4,380 |
| | | 11.0 | 23.81 | CONTRIB | 16.17% | 49.54% | 20.43% | 13.85% | 10,427 |
| 19 | | | | RATIOS | 1.0580 | 0.9801 | 1.0360 | 1.0247 | |
| | 16.8 | | | CONTRIB | 12.83% | 58.22% | 19.88% | 9.07% | 4,380 |
| | | 11.0 | 31.69 | CONTRIB | 13.94% | 63.20% | 12.32% | 10.54% | 13,881 |
| 20 | | | | RATIOS | 0.4369 | 0.7060 | 0.4273 | 0.5234 | |
| | 10.7 | | | CONTRIB | 0.86% | 92.00% | 3.54% | 3.59% | 4,380 |
| | | 11.0 | 8.87 | CONTRIB | 0.73% | 92.76% | 3.03% | 3.48% | 3,887 |
| 21 | | | | RATIOS | 1.0813 | 1.1444 | 1.1566 | 1.1274 | |
| | 19.1 | | | CONTRIB | 8.49% | 64.38% | 19.17% | 7.97% | 4,380 |
| | | 11.0 | 36.18 | CONTRIB | 12.70% | 64.42% | 12.04% | 10.83% | 15,846 |
| 22 | | | | RATIOS | 1.2313 | 0.7175 | 0.9495 | 0.9661 | |
| | 14.4 | | | CONTRIB | 35.66% | 28.51% | 22.68% | 13.16% | 4,380 |
| | | 11.0 | 21.17 | CONTRIB | 27.48% | 41.30% | 16.92% | 14.30% | 9,272 |
| 23 | | | | RATIOS | 0.3571 | 1.0566 | 0.7299 | 0.7145 | |
| | 16.1 | | | CONTRIB | 0.00% | 90.19% | 7.61% | 2.20% | 4,380 |
| | | 11.0 | 25.02 | CONTRIB | 0.04% | 86.15% | 9.19% | 4.63% | 10,959 |
| 24 | | | | RATIOS | 1.0260 | 1.0587 | 0.9640 | 1.0163 | |
| | 17.4 | | | CONTRIB | 9.76% | 66.92% | 15.84% | 7.49% | 4,380 |
| | | 11.0 | 32.71 | CONTRIB | 12.77% | 66.04% | 11.12% | 10.07% | 14,325 |
| 25 | | | | RATIOS | 0.8024 | 1.1854 | 0.9013 | 0.9630 | |
| | 18.4 | | | CONTRIB | 1.46% | 82.85% | 10.85% | 4.84% | 4,380 |
| | | 11.0 | 32.79 | CONTRIB | 6.90% | 73.55% | 10.37% | 9.18% | 14,364 |
| 26 | | | | RATIOS | 0.7593 | 0.9681 | 0.8540 | 0.8605 | |
| | 15.5 | | | CONTRIB | 3.91% | 74.22% | 15.72% | 6.16% | 4,380 |
| | | 11.0 | 27.21 | CONTRIB | 6.70% | 72.73% | 11.62% | 8.95% | 11,918 |
| 27 | | | | RATIOS | 1.1815 | 0.9760 | 1.0607 | 1.0727 | |
| | 17.2 | | | CONTRIB | 17.95% | 52.34% | 19.84% | 9.87% | 4,380 |
| | | 11.0 | 32.95 | CONTRIB | 16.38% | 60.54% | 12.13% | 10.95% | 14,431 |
| 28 | | | | RATIOS | 0.9801 | 0.8940 | 0.8756 | 0.9166 | |
| | 15.2 | | | CONTRIB | 14.07% | 59.98% | 17.30% | 8.66% | 4,380 |
| | | 11.0 | 28.23 | CONTRIB | 13.62% | 64.85% | 11.70% | 9.82% | 12,363 |
| 29 | | | | RATIOS | 0.4706 | 0.4942 | 1.0458 | 0.6702 | |
| | 9.6 | | | CONTRIB | 3.85% | 35.92% | 44.99% | 15.24% | 4,380 |
| | | 11.0 | 6.17 | CONTRIB | 2.04% | 19.58% | 63.86% | 14.52% | 2,704 |

**Treasure Island**
**SAN FRANCISCO, CALIFORNIA**

**Wind Hazard Analysis**

**Existing Scenario**
**Wind Test Date: Jan 2010**

The ratios of pedestrian-level wind speeds to the reference height wind speeds at the old Alameda NAS meteorological station are shown in the first line of output for each location.

The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded one hour per year (0.01141552512% of the time) for each measurement location. This assumes that a wind hazard occurs if a one-minute average speed of 36 mph is reached or exceeded a total of one hour per year.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| 0.011414% Exc. | | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca- tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| | | | | *Profile Ratios:* | *1.9610* | *1.9610* | *1.9610* | *1.9610* | |
| 1 | | | | RATIOS | 1.0848 | 1.1433 | 0.8805 | 1.0362 | |
| | 40.0 | | | CONTRIB | 5.25% | 91.05% | 0.27% | 3.43% | 5 |
| | | 36.0 | 0.0552249 | CONTRIB | 5.62% | 89.85% | 0.41% | 4.13% | 24 |
| 2 | | | | RATIOS | 1.3043 | 0.7785 | 1.1617 | 1.0815 | |
| | 41.3 | | | CONTRIB | 63.15% | 0.13% | 32.52% | 4.21% | 5 |
| | | 36.0 | 0.0811947 | CONTRIB | 33.82% | 0.16% | 60.12% | 5.89% | 36 |
| 3 | | | | RATIOS | 0.7713 | 1.2519 | 0.3785 | 0.8005 | |
| | 43.6 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.1244210 | CONTRIB | 0.01% | 99.97% | 0.00% | 0.02% | 54 |
| 4 | | | | RATIOS | 0.6828 | 1.0662 | 0.3432 | 0.6974 | |
| | 37.1 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0168619 | CONTRIB | 0.00% | 99.99% | 0.00% | 0.01% | 7 |
| 5 | | | | RATIOS | 0.3946 | 0.7660 | 0.7656 | 0.6420 | |
| | 27.1 | | | CONTRIB | 0.00% | 68.31% | 31.04% | 0.65% | 5 |
| | | 36.0 | 0.0001160 | CONTRIB | 0.00% | 87.28% | 12.72% | 0.00% | 0 |
| 6 | | | | RATIOS | 1.1791 | 0.8028 | 1.2188 | 1.0669 | |
| | 41.3 | | | CONTRIB | 12.44% | 0.24% | 83.95% | 3.37% | 5 |
| | | 36.0 | 0.0905760 | CONTRIB | 11.81% | 0.23% | 83.79% | 4.18% | 40 |
| 7 | | | | RATIOS | 1.1584 | 1.1560 | 0.8562 | 1.0568 | |
| | 40.7 | | | CONTRIB | 11.74% | 84.49% | 0.11% | 3.66% | 5 |
| | | 36.0 | 0.0712381 | CONTRIB | 12.63% | 82.68% | 0.18% | 4.50% | 31 |
| 8 | | | | RATIOS | 1.3556 | 0.8026 | 0.9046 | 1.0210 | |
| | 40.9 | | | CONTRIB | 97.92% | 0.24% | 0.26% | 1.58% | 5 |
| | | 36.0 | 0.0417683 | CONTRIB | 94.37% | 0.50% | 0.91% | 4.22% | 18 |
| 9 | | | | RATIOS | 0.7009 | 1.2011 | 0.6334 | 0.8451 | |
| | 41.8 | | | CONTRIB | 0.00% | 99.95% | 0.00% | 0.05% | 5 |
| | | 36.0 | 0.0852281 | CONTRIB | 0.00% | 99.92% | 0.00% | 0.08% | 37 |
| 10 | | | | RATIOS | 0.9028 | 1.1939 | 0.8505 | 0.9824 | |
| | 41.6 | | | CONTRIB | 0.14% | 99.09% | 0.07% | 0.70% | 4 |
| | | 36.0 | 0.0817441 | CONTRIB | 0.19% | 98.56% | 0.14% | 1.11% | 36 |
| 11 | | | | RATIOS | 0.8742 | 1.1172 | 0.9925 | 0.9946 | |
| | 39.0 | | | CONTRIB | 0.23% | 92.69% | 4.50% | 2.58% | 5 |
| | | 36.0 | 0.0382548 | CONTRIB | 0.24% | 90.77% | 6.06% | 2.93% | 17 |
| 12 | | | | RATIOS | 0.8519 | 0.9532 | 0.9162 | 0.9071 | |
| | 33.7 | | | CONTRIB | 1.63% | 75.74% | 16.11% | 6.51% | 5 |
| | | 36.0 | 0.0037591 | CONTRIB | 1.63% | 79.35% | 12.98% | 6.04% | 2 |
| 13 | | | | RATIOS | 0.3496 | 1.2617 | 1.0068 | 0.8727 | |
| | 43.9 | | | CONTRIB | 0.00% | 99.36% | 0.60% | 0.03% | 5 |
| | | 36.0 | 0.1367630 | CONTRIB | 0.00% | 97.67% | 2.24% | 0.08% | 60 |
| 14 | | | | RATIOS | 0.7189 | 1.1068 | 0.4636 | 0.7631 | |
| | 38.4 | | | CONTRIB | 0.00% | 99.97% | 0.00% | 0.03% | 5 |
| | | 36.0 | 0.0300644 | CONTRIB | 0.01% | 99.95% | 0.00% | 0.04% | 13 |
| 15 | | | | RATIOS | 0.6389 | 1.0497 | 0.4716 | 0.7201 | |
| | 36.5 | | | CONTRIB | 0.00% | 99.97% | 0.00% | 0.03% | 5 |
| | | 36.0 | 0.0132549 | CONTRIB | 0.00% | 99.97% | 0.00% | 0.03% | 6 |

The ratios of pedestrian-level wind speeds to the reference height wind speeds at the old Alameda NAS meteorological station are shown in the first line of output for each location.

The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded one hour per year (0.01141552512% of the time) for each measurement location. This assumes that a wind hazard occurs if a one-minute average speed of 36 mph is reached or exceeded a total of one hour per year.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| 0.011414% Exc. | | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca- tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 16 | | | | RATIOS | 0.9081 | 0.8903 | 1.2552 | 1.0179 | |
| | 42.2 | | | CONTRIB | 0.13% | 0.85% | 97.99% | 1.03% | 5 |
| | | 36.0 | 0.1024230 | CONTRIB | 0.17% | 1.01% | 97.18% | 1.63% | 45 |
| 17 | | | | RATIOS | 0.7860 | 0.7801 | 1.1303 | 0.8988 | |
| | 37.8 | | | CONTRIB | 0.07% | 0.55% | 98.65% | 0.73% | 5 |
| | | 36.0 | 0.0295639 | CONTRIB | 0.06% | 0.45% | 98.83% | 0.65% | 13 |
| 18 | | | | RATIOS | 0.9807 | 0.7779 | 1.2919 | 1.0168 | |
| | 43.3 | | | CONTRIB | 0.28% | 0.04% | 99.07% | 0.61% | 5 |
| | | 36.0 | 0.1321070 | CONTRIB | 0.46% | 0.10% | 98.20% | 1.24% | 58 |
| 19 | | | | RATIOS | 1.0580 | 0.9801 | 1.0360 | 1.0247 | |
| | 36.5 | | | CONTRIB | 15.12% | 33.94% | 37.41% | 13.54% | 5 |
| | | 36.0 | 0.0138783 | CONTRIB | 14.88% | 33.04% | 38.55% | 13.53% | 6 |
| 20 | | | | RATIOS | 0.4369 | 0.7060 | 0.4273 | 0.5234 | |
| | 24.4 | | | CONTRIB | 0.00% | 99.88% | 0.00% | 0.12% | 5 |
| | | 36.0 | 0.0000287 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 21 | | | | RATIOS | 1.0813 | 1.1444 | 1.1566 | 1.1274 | |
| | 41.3 | | | CONTRIB | 3.04% | 57.92% | 30.28% | 8.76% | 5 |
| | | 36.0 | 0.1089230 | CONTRIB | 2.70% | 46.28% | 41.98% | 9.04% | 48 |
| 22 | | | | RATIOS | 1.2313 | 0.7175 | 0.9495 | 0.9661 | |
| | 37.4 | | | CONTRIB | 93.12% | 0.16% | 3.84% | 2.89% | 5 |
| | | 36.0 | 0.0177240 | CONTRIB | 90.45% | 0.21% | 5.52% | 3.82% | 8 |
| 23 | | | | RATIOS | 0.3571 | 1.0566 | 0.7299 | 0.7145 | |
| | 36.8 | | | CONTRIB | 0.00% | 99.94% | 0.04% | 0.02% | 5 |
| | | 36.0 | 0.0146654 | CONTRIB | 0.00% | 99.94% | 0.04% | 0.02% | 6 |
| 24 | | | | RATIOS | 1.0260 | 1.0587 | 0.9640 | 1.0163 | |
| | 37.2 | | | CONTRIB | 6.42% | 79.51% | 6.04% | 8.03% | 5 |
| | | 36.0 | 0.0193240 | CONTRIB | 6.49% | 78.28% | 6.81% | 8.42% | 8 |
| 25 | | | | RATIOS | 0.8024 | 1.1854 | 0.9013 | 0.9630 | |
| | 41.2 | | | CONTRIB | 0.02% | 99.17% | 0.23% | 0.57% | 5 |
| | | 36.0 | 0.0765288 | CONTRIB | 0.03% | 98.67% | 0.46% | 0.84% | 34 |
| 26 | | | | RATIOS | 0.7593 | 0.9681 | 0.8540 | 0.8605 | |
| | 33.8 | | | CONTRIB | 0.24% | 93.29% | 3.94% | 2.52% | 5 |
| | | 36.0 | 0.0040162 | CONTRIB | 0.24% | 94.41% | 3.09% | 2.27% | 2 |
| 27 | | | | RATIOS | 1.1815 | 0.9760 | 1.0607 | 1.0727 | |
| | 38.2 | | | CONTRIB | 44.68% | 16.20% | 25.11% | 14.02% | 5 |
| | | 36.0 | 0.0278155 | CONTRIB | 39.17% | 15.44% | 30.45% | 14.94% | 12 |
| 28 | | | | RATIOS | 0.9801 | 0.8940 | 0.8756 | 0.9166 | |
| | 32.6 | | | CONTRIB | 27.09% | 46.50% | 12.65% | 13.76% | 5 |
| | | 36.0 | 0.0021766 | CONTRIB | 27.42% | 50.81% | 9.27% | 12.49% | 1 |
| 29 | | | | RATIOS | 0.4706 | 0.4942 | 1.0458 | 0.6702 | |
| | 35.1 | | | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 5 |
| | | 36.0 | 0.0064283 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 3 |

The ratios of pedestrian-level wind speeds to the reference height wind speeds at the old Alameda NAS meteorological station are shown in the first line of output for each location.

The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded 10% of the time for each measurement location. This assumes wind comfort criteria of 11 mph for areas of substantial public pedestrian use and 7 mph for public seating areas. These criteria are not to be exceeded more than 10% of the time.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| Loca- tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Profile Ratios:* | *1.9610* | *1.9610* | *1.9610* | *1.9610* | |
| 1 | | | | RATIOS | 1.0848 | 1.1433 | 0.8805 | 1.0362 | |
| | 18.4 | | | CONTRIB | 9.93% | 73.58% | 9.89% | 6.60% | 4,380 |
| | | 11.0 | 34.63 | CONTRIB | 13.35% | 67.23% | 9.59% | 9.83% | 15,168 |
| 2 | | | | RATIOS | 1.3043 | 0.7785 | 1.1617 | 1.0815 | |
| | 15.9 | | | CONTRIB | 33.14% | 24.89% | 28.00% | 13.97% | 4,380 |
| | | 11.0 | 26.32 | CONTRIB | 24.54% | 44.94% | 16.63% | 13.89% | 11,528 |
| 3 | | | | RATIOS | 0.7713 | 1.2519 | 0.3785 | 0.8005 | |
| | 18.6 | | | CONTRIB | 0.95% | 97.22% | 0.00% | 1.84% | 4,380 |
| | | 11.0 | 29.29 | CONTRIB | 6.61% | 86.86% | 0.30% | 6.23% | 12,830 |
| 4 | | | | RATIOS | 0.6828 | 1.0662 | 0.3432 | 0.6974 | |
| | 15.9 | | | CONTRIB | 1.30% | 96.66% | 0.00% | 2.04% | 4,380 |
| | | 11.0 | 24.03 | CONTRIB | 5.01% | 90.51% | 0.11% | 4.37% | 10,524 |
| 5 | | | | RATIOS | 0.3946 | 0.7660 | 0.7656 | 0.6420 | |
| | 12.3 | | | CONTRIB | 0.09% | 74.67% | 20.33% | 4.90% | 4,380 |
| | | 11.0 | 14.45 | CONTRIB | 0.17% | 77.08% | 17.53% | 5.22% | 6,328 |
| 6 | | | | RATIOS | 1.1791 | 0.8028 | 1.2188 | 1.0669 | |
| | 15.9 | | | CONTRIB | 24.11% | 31.90% | 30.81% | 13.18% | 4,380 |
| | | 11.0 | 26.80 | CONTRIB | 20.07% | 49.46% | 17.13% | 13.34% | 11,737 |
| 7 | | | | RATIOS | 1.1584 | 1.1560 | 0.8562 | 1.0568 | |
| | 18.6 | | | CONTRIB | 12.18% | 72.97% | 8.08% | 6.77% | 4,380 |
| | | 11.0 | 35.44 | CONTRIB | 14.69% | 66.41% | 8.97% | 9.93% | 15,523 |
| 8 | | | | RATIOS | 1.3556 | 0.8026 | 0.9046 | 1.0210 | |
| | 15.7 | | | CONTRIB | 36.23% | 35.00% | 17.20% | 11.57% | 4,380 |
| | | 11.0 | 26.90 | CONTRIB | 25.75% | 49.22% | 12.68% | 12.34% | 11,784 |
| 9 | | | | RATIOS | 0.7009 | 1.2011 | 0.6334 | 0.8451 | |
| | 18.0 | | | CONTRIB | 0.54% | 95.46% | 1.09% | 2.90% | 4,380 |
| | | 11.0 | 29.76 | CONTRIB | 4.48% | 82.12% | 5.79% | 7.61% | 13,033 |
| 10 | | | | RATIOS | 0.9028 | 1.1939 | 0.8505 | 0.9824 | |
| | 18.5 | | | CONTRIB | 3.73% | 83.20% | 7.95% | 5.12% | 4,380 |
| | | 11.0 | 33.85 | CONTRIB | 9.78% | 71.75% | 9.26% | 9.20% | 14,827 |
| 11 | | | | RATIOS | 0.8742 | 1.1172 | 0.9925 | 0.9946 | |
| | 17.9 | | | CONTRIB | 3.82% | 74.07% | 15.93% | 6.18% | 4,380 |
| | | 11.0 | 32.81 | CONTRIB | 9.52% | 69.38% | 11.41% | 9.69% | 14,370 |
| 12 | | | | RATIOS | 0.8519 | 0.9532 | 0.9162 | 0.9071 | |
| | 15.7 | | | CONTRIB | 7.20% | 67.69% | 17.79% | 7.32% | 4,380 |
| | | 11.0 | 28.53 | CONTRIB | 10.01% | 68.32% | 12.11% | 9.55% | 12,495 |
| 13 | | | | RATIOS | 0.3496 | 1.2617 | 1.0068 | 0.8727 | |
| | 19.5 | | | CONTRIB | 0.00% | 84.04% | 13.73% | 2.24% | 4,380 |
| | | 11.0 | 32.00 | CONTRIB | 0.02% | 80.13% | 11.86% | 7.98% | 14,014 |
| 14 | | | | RATIOS | 0.7189 | 1.1068 | 0.4636 | 0.7631 | |
| | 16.5 | | | CONTRIB | 1.43% | 95.90% | 0.03% | 2.64% | 4,380 |
| | | 11.0 | 26.06 | CONTRIB | 5.65% | 86.55% | 2.02% | 5.78% | 11,415 |
| 15 | | | | RATIOS | 0.6389 | 1.0497 | 0.4716 | 0.7201 | |
| | 15.7 | | | CONTRIB | 0.83% | 96.45% | 0.13% | 2.59% | 4,380 |
| | | 11.0 | 24.11 | CONTRIB | 3.85% | 88.82% | 2.38% | 4.95% | 10,562 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| Loca-tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | RATIOS | 0.9081 | 0.8903 | 1.2552 | 1.0179 | |
| | 16.0 | | | CONTRIB | 8.50% | 48.54% | 32.31% | 10.65% | 4,380 |
| | | 11.0 | 29.61 | CONTRIB | 11.30% | 61.57% | 15.96% | 11.16% | 12,969 |
| 17 | | | | RATIOS | 0.7860 | 0.7801 | 1.1303 | 0.8988 | |
| | 14.1 | | | CONTRIB | 7.98% | 47.86% | 33.33% | 10.82% | 4,380 |
| | | 11.0 | 20.94 | CONTRIB | 9.96% | 56.89% | 20.34% | 12.81% | 9,173 |
| 18 | | | | RATIOS | 0.9807 | 0.7779 | 1.2919 | 1.0168 | |
| | 15.1 | | | CONTRIB | 14.43% | 36.62% | 35.53% | 13.43% | 4,380 |
| | | 11.0 | 23.81 | CONTRIB | 16.17% | 49.54% | 20.43% | 13.85% | 10,427 |
| 19 | | | | RATIOS | 1.0580 | 0.9801 | 1.0360 | 1.0247 | |
| | 16.8 | | | CONTRIB | 12.83% | 58.22% | 19.88% | 9.07% | 4,380 |
| | | 11.0 | 31.69 | CONTRIB | 13.94% | 63.20% | 12.32% | 10.54% | 13,881 |
| 20 | | | | RATIOS | 0.4369 | 0.7060 | 0.4273 | 0.5234 | |
| | 10.7 | | | CONTRIB | 0.86% | 92.00% | 3.54% | 3.59% | 4,380 |
| | | 11.0 | 8.87 | CONTRIB | 0.73% | 92.76% | 3.03% | 3.48% | 3,887 |
| 21 | | | | RATIOS | 1.0813 | 1.1444 | 1.1566 | 1.1274 | |
| | 19.1 | | | CONTRIB | 8.49% | 64.38% | 19.17% | 7.97% | 4,380 |
| | | 11.0 | 36.18 | CONTRIB | 12.70% | 64.42% | 12.04% | 10.83% | 15,846 |
| 22 | | | | RATIOS | 1.2313 | 0.7175 | 0.9495 | 0.9661 | |
| | 14.4 | | | CONTRIB | 35.66% | 28.51% | 22.68% | 13.16% | 4,380 |
| | | 11.0 | 21.17 | CONTRIB | 27.48% | 41.30% | 16.92% | 14.30% | 9,272 |
| 23 | | | | RATIOS | 0.3571 | 1.0566 | 0.7299 | 0.7145 | |
| | 16.1 | | | CONTRIB | 0.00% | 90.19% | 7.61% | 2.20% | 4,380 |
| | | 11.0 | 25.02 | CONTRIB | 0.04% | 86.15% | 9.19% | 4.63% | 10,959 |
| 24 | | | | RATIOS | 1.0260 | 1.0587 | 0.9640 | 1.0163 | |
| | 17.4 | | | CONTRIB | 9.76% | 66.92% | 15.84% | 7.49% | 4,380 |
| | | 11.0 | 32.71 | CONTRIB | 12.77% | 66.04% | 11.12% | 10.07% | 14,325 |
| 25 | | | | RATIOS | 0.8024 | 1.1854 | 0.9013 | 0.9630 | |
| | 18.4 | | | CONTRIB | 1.46% | 82.85% | 10.85% | 4.84% | 4,380 |
| | | 11.0 | 32.79 | CONTRIB | 6.90% | 73.55% | 10.37% | 9.18% | 14,364 |
| 26 | | | | RATIOS | 0.7593 | 0.9681 | 0.8540 | 0.8605 | |
| | 15.5 | | | CONTRIB | 3.91% | 74.22% | 15.72% | 6.16% | 4,380 |
| | | 11.0 | 27.21 | CONTRIB | 6.70% | 72.73% | 11.62% | 8.95% | 11,918 |
| 27 | | | | RATIOS | 1.1815 | 0.9760 | 1.0607 | 1.0727 | |
| | 17.2 | | | CONTRIB | 17.95% | 52.34% | 19.84% | 9.87% | 4,380 |
| | | 11.0 | 32.95 | CONTRIB | 16.38% | 60.54% | 12.13% | 10.95% | 14,431 |
| 28 | | | | RATIOS | 0.9801 | 0.8940 | 0.8756 | 0.9166 | |
| | 15.2 | | | CONTRIB | 14.07% | 59.98% | 17.30% | 8.66% | 4,380 |
| | | 11.0 | 28.23 | CONTRIB | 13.62% | 64.85% | 11.70% | 9.82% | 12,363 |
| 29 | | | | RATIOS | 0.4706 | 0.4942 | 1.0458 | 0.6702 | |
| | 9.6 | | | CONTRIB | 3.85% | 35.92% | 44.99% | 15.24% | 4,380 |
| | | 11.0 | 6.17 | CONTRIB | 2.04% | 19.58% | 63.86% | 14.52% | 2,704 |

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The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded one hour per year (0.01141552512% of the time) for each measurement location. This assumes that a wind hazard occurs if a one-minute average speed of 36 mph is reached or exceeded a total of one hour per year.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| 0.011414% Exc. | | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca-tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| | | | | *Profile Ratios:* | *1.9610* | *1.9610* | *1.9610* | *1.9610* | |
| 1 | | | | RATIOS | 1.0848 | 1.1433 | 0.8805 | 1.0362 | |
| | 40.0 | | | CONTRIB | 5.25% | 91.05% | 0.27% | 3.43% | 5 |
| | | 36.0 | 0.0552249 | CONTRIB | 5.62% | 89.85% | 0.41% | 4.13% | 24 |
| 2 | | | | RATIOS | 1.3043 | 0.7785 | 1.1617 | 1.0815 | |
| | 41.3 | | | CONTRIB | 63.15% | 0.13% | 32.52% | 4.21% | 5 |
| | | 36.0 | 0.0811947 | CONTRIB | 33.82% | 0.16% | 60.12% | 5.89% | 36 |
| 3 | | | | RATIOS | 0.7713 | 1.2519 | 0.3785 | 0.8005 | |
| | 43.6 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.1244210 | CONTRIB | 0.01% | 99.97% | 0.00% | 0.02% | 54 |
| 4 | | | | RATIOS | 0.6828 | 1.0662 | 0.3432 | 0.6974 | |
| | 37.1 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0168619 | CONTRIB | 0.00% | 99.99% | 0.00% | 0.01% | 7 |
| 5 | | | | RATIOS | 0.3946 | 0.7660 | 0.7656 | 0.6420 | |
| | 27.1 | | | CONTRIB | 0.00% | 68.31% | 31.04% | 0.65% | 5 |
| | | 36.0 | 0.0001160 | CONTRIB | 0.00% | 87.28% | 12.72% | 0.00% | 0 |
| 6 | | | | RATIOS | 1.1791 | 0.8028 | 1.2188 | 1.0669 | |
| | 41.3 | | | CONTRIB | 12.44% | 0.24% | 83.95% | 3.37% | 5 |
| | | 36.0 | 0.0905760 | CONTRIB | 11.81% | 0.23% | 83.79% | 4.18% | 40 |
| 7 | | | | RATIOS | 1.1584 | 1.1560 | 0.8562 | 1.0568 | |
| | 40.7 | | | CONTRIB | 11.74% | 84.49% | 0.11% | 3.66% | 5 |
| | | 36.0 | 0.0712381 | CONTRIB | 12.63% | 82.68% | 0.18% | 4.50% | 31 |
| 8 | | | | RATIOS | 1.3556 | 0.8026 | 0.9046 | 1.0210 | |
| | 40.9 | | | CONTRIB | 97.92% | 0.24% | 0.26% | 1.58% | 5 |
| | | 36.0 | 0.0417683 | CONTRIB | 94.37% | 0.50% | 0.91% | 4.22% | 18 |
| 9 | | | | RATIOS | 0.7009 | 1.2011 | 0.6334 | 0.8451 | |
| | 41.8 | | | CONTRIB | 0.00% | 99.95% | 0.00% | 0.05% | 5 |
| | | 36.0 | 0.0852281 | CONTRIB | 0.00% | 99.92% | 0.00% | 0.08% | 37 |
| 10 | | | | RATIOS | 0.9028 | 1.1939 | 0.8505 | 0.9824 | |
| | 41.6 | | | CONTRIB | 0.14% | 99.09% | 0.07% | 0.70% | 4 |
| | | 36.0 | 0.0817441 | CONTRIB | 0.19% | 98.56% | 0.14% | 1.11% | 36 |
| 11 | | | | RATIOS | 0.8742 | 1.1172 | 0.9925 | 0.9946 | |
| | 39.0 | | | CONTRIB | 0.23% | 92.69% | 4.50% | 2.58% | 5 |
| | | 36.0 | 0.0382548 | CONTRIB | 0.24% | 90.77% | 6.06% | 2.93% | 17 |
| 12 | | | | RATIOS | 0.8519 | 0.9532 | 0.9162 | 0.9071 | |
| | 33.7 | | | CONTRIB | 1.63% | 75.74% | 16.11% | 6.51% | 5 |
| | | 36.0 | 0.0037591 | CONTRIB | 1.63% | 79.35% | 12.98% | 6.04% | 2 |
| 13 | | | | RATIOS | 0.3496 | 1.2617 | 1.0068 | 0.8727 | |
| | 43.9 | | | CONTRIB | 0.00% | 99.36% | 0.60% | 0.03% | 5 |
| | | 36.0 | 0.1367630 | CONTRIB | 0.00% | 97.67% | 2.24% | 0.08% | 60 |
| 14 | | | | RATIOS | 0.7189 | 1.1068 | 0.4636 | 0.7631 | |
| | 38.4 | | | CONTRIB | 0.00% | 99.97% | 0.00% | 0.03% | 5 |
| | | 36.0 | 0.0300644 | CONTRIB | 0.01% | 99.95% | 0.00% | 0.04% | 13 |
| 15 | | | | RATIOS | 0.6389 | 1.0497 | 0.4716 | 0.7201 | |
| | 36.5 | | | CONTRIB | 0.00% | 99.97% | 0.00% | 0.03% | 5 |
| | | 36.0 | 0.0132549 | CONTRIB | 0.00% | 99.97% | 0.00% | 0.03% | 6 |

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The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded one hour per year (0.01141552512% of the time) for each measurement location. This assumes that a wind hazard occurs if a one-minute average speed of 36 mph is reached or exceeded a total of one hour per year.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| 0.011414% Exc. | | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca- tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 16 | | | | RATIOS | 0.9081 | 0.8903 | 1.2552 | 1.0179 | |
| | 42.2 | | | CONTRIB | 0.13% | 0.85% | 97.99% | 1.03% | 5 |
| | | 36.0 | 0.1024230 | CONTRIB | 0.17% | 1.01% | 97.18% | 1.63% | 45 |
| 17 | | | | RATIOS | 0.7860 | 0.7801 | 1.1303 | 0.8988 | |
| | 37.8 | | | CONTRIB | 0.07% | 0.55% | 98.65% | 0.73% | 5 |
| | | 36.0 | 0.0295639 | CONTRIB | 0.06% | 0.45% | 98.83% | 0.65% | 13 |
| 18 | | | | RATIOS | 0.9807 | 0.7779 | 1.2919 | 1.0168 | |
| | 43.3 | | | CONTRIB | 0.28% | 0.04% | 99.07% | 0.61% | 5 |
| | | 36.0 | 0.1321070 | CONTRIB | 0.46% | 0.10% | 98.20% | 1.24% | 58 |
| 19 | | | | RATIOS | 1.0580 | 0.9801 | 1.0360 | 1.0247 | |
| | 36.5 | | | CONTRIB | 15.12% | 33.94% | 37.41% | 13.54% | 5 |
| | | 36.0 | 0.0138783 | CONTRIB | 14.88% | 33.04% | 38.55% | 13.53% | 6 |
| 20 | | | | RATIOS | 0.4369 | 0.7060 | 0.4273 | 0.5234 | |
| | 24.4 | | | CONTRIB | 0.00% | 99.88% | 0.00% | 0.12% | 5 |
| | | 36.0 | 0.0000287 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 21 | | | | RATIOS | 1.0813 | 1.1444 | 1.1566 | 1.1274 | |
| | 41.3 | | | CONTRIB | 3.04% | 57.92% | 30.28% | 8.76% | 5 |
| | | 36.0 | 0.1089230 | CONTRIB | 2.70% | 46.28% | 41.98% | 9.04% | 48 |
| 22 | | | | RATIOS | 1.2313 | 0.7175 | 0.9495 | 0.9661 | |
| | 37.4 | | | CONTRIB | 93.12% | 0.16% | 3.84% | 2.89% | 5 |
| | | 36.0 | 0.0177240 | CONTRIB | 90.45% | 0.21% | 5.52% | 3.82% | 8 |
| 23 | | | | RATIOS | 0.3571 | 1.0566 | 0.7299 | 0.7145 | |
| | 36.8 | | | CONTRIB | 0.00% | 99.94% | 0.04% | 0.02% | 5 |
| | | 36.0 | 0.0146654 | CONTRIB | 0.00% | 99.94% | 0.04% | 0.02% | 6 |
| 24 | | | | RATIOS | 1.0260 | 1.0587 | 0.9640 | 1.0163 | |
| | 37.2 | | | CONTRIB | 6.42% | 79.51% | 6.04% | 8.03% | 5 |
| | | 36.0 | 0.0193240 | CONTRIB | 6.49% | 78.28% | 6.81% | 8.42% | 8 |
| 25 | | | | RATIOS | 0.8024 | 1.1854 | 0.9013 | 0.9630 | |
| | 41.2 | | | CONTRIB | 0.02% | 99.17% | 0.23% | 0.57% | 5 |
| | | 36.0 | 0.0765288 | CONTRIB | 0.03% | 98.67% | 0.46% | 0.84% | 34 |
| 26 | | | | RATIOS | 0.7593 | 0.9681 | 0.8540 | 0.8605 | |
| | 33.8 | | | CONTRIB | 0.24% | 93.29% | 3.94% | 2.52% | 5 |
| | | 36.0 | 0.0040162 | CONTRIB | 0.24% | 94.41% | 3.09% | 2.27% | 2 |
| 27 | | | | RATIOS | 1.1815 | 0.9760 | 1.0607 | 1.0727 | |
| | 38.2 | | | CONTRIB | 44.68% | 16.20% | 25.11% | 14.02% | 5 |
| | | 36.0 | 0.0278155 | CONTRIB | 39.17% | 15.44% | 30.45% | 14.94% | 12 |
| 28 | | | | RATIOS | 0.9801 | 0.8940 | 0.8756 | 0.9166 | |
| | 32.6 | | | CONTRIB | 27.09% | 46.50% | 12.65% | 13.76% | 5 |
| | | 36.0 | 0.0021766 | CONTRIB | 27.42% | 50.81% | 9.27% | 12.49% | 1 |
| 29 | | | | RATIOS | 0.4706 | 0.4942 | 1.0458 | 0.6702 | |
| | 35.1 | | | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 5 |
| | | 36.0 | 0.0064283 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 3 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| Loca- tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Profile Ratios:* | *1.9610* | *1.9610* | *1.9610* | *1.9610* | |
| 7 | | | | RATIOS | 0.6365 | 0.9774 | 0.6842 | 0.7660 | |
| | 15.0 | | | CONTRIB | 1.17% | 86.73% | 7.71% | 4.39% | 4,380 |
| | | 11.0 | 24.43 | CONTRIB | 3.75% | 81.74% | 8.25% | 6.26% | 10,702 |
| 8 | | | | RATIOS | 0.4281 | 0.6438 | 0.6805 | 0.5841 | |
| | 10.5 | | | CONTRIB | 0.86% | 70.69% | 22.11% | 6.34% | 4,380 |
| | | 11.0 | 8.41 | CONTRIB | 0.64% | 69.53% | 23.68% | 6.14% | 3,686 |
| 9 | | | | RATIOS | 0.4155 | 0.9111 | 0.4285 | 0.5850 | |
| | 13.6 | | | CONTRIB | 0.04% | 97.74% | 0.33% | 1.89% | 4,380 |
| | | 11.0 | 19.48 | CONTRIB | 0.21% | 95.71% | 1.42% | 2.67% | 8,534 |
| 10 | | | | RATIOS | 0.7426 | 0.9776 | 0.5042 | 0.7415 | |
| | 14.8 | | | CONTRIB | 4.70% | 90.57% | 0.78% | 3.95% | 4,380 |
| | | 11.0 | 23.78 | CONTRIB | 7.03% | 83.99% | 3.34% | 5.64% | 10,417 |
| 11 | | | | RATIOS | 0.5457 | 0.5601 | 0.6536 | 0.5865 | |
| | 9.6 | | | CONTRIB | 8.58% | 58.05% | 24.27% | 9.10% | 4,380 |
| | | 11.0 | 6.22 | CONTRIB | 7.04% | 54.98% | 29.53% | 8.45% | 2,724 |
| 12 | | | | RATIOS | 0.6397 | 1.2988 | 0.7303 | 0.8896 | |
| | 19.4 | | | CONTRIB | 0.11% | 95.39% | 1.97% | 2.53% | 4,380 |
| | | 11.0 | 32.25 | CONTRIB | 2.90% | 81.79% | 7.13% | 8.18% | 14,124 |
| 13 | | | | RATIOS | 0.2998 | 0.5142 | 0.9740 | 0.5960 | |
| | 9.4 | | | CONTRIB | 0.08% | 46.15% | 43.10% | 10.66% | 4,380 |
| | | 11.0 | 5.91 | CONTRIB | 0.01% | 28.41% | 62.10% | 9.48% | 2,591 |
| 14 | | | | RATIOS | 0.6326 | 0.8083 | 0.4616 | 0.6342 | |
| | 12.4 | | | CONTRIB | 5.65% | 88.00% | 1.86% | 4.49% | 4,380 |
| | | 11.0 | 15.72 | CONTRIB | 5.69% | 86.46% | 3.29% | 4.57% | 6,887 |
| 15 | | | | RATIOS | 0.5859 | 0.5167 | 0.4840 | 0.5289 | |
| | 8.8 | | | CONTRIB | 15.97% | 59.71% | 15.76% | 8.56% | 4,380 |
| | | 11.0 | 3.39 | CONTRIB | 19.56% | 51.65% | 19.18% | 9.60% | 1,485 |

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| Loca-tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | RATIOS | 0.7215 | 0.5148 | 0.8764 | 0.7042 | |
| | 10.3 | | | CONTRIB | 19.64% | 30.43% | 35.46% | 14.47% | 4,380 |
| | | 11.0 | 7.59 | CONTRIB | 19.68% | 22.36% | 43.57% | 14.39% | 3,324 |
| 17 | | | | RATIOS | 0.5406 | 0.4651 | 0.4120 | 0.4726 | |
| | 7.9 | | | CONTRIB | 17.65% | 59.91% | 14.10% | 8.34% | 4,380 |
| | | 11.0 | 1.51 | CONTRIB | 26.76% | 48.34% | 12.71% | 12.19% | 662 |
| 18 | | | | RATIOS | 0.6973 | 0.8942 | 1.2215 | 0.9377 | |
| | 15.4 | | | CONTRIB | 1.99% | 56.32% | 32.84% | 8.85% | 4,380 |
| | | 11.0 | 27.10 | CONTRIB | 4.83% | 67.57% | 16.98% | 10.63% | 11,869 |
| 19 | | | | RATIOS | 0.7232 | 0.7277 | 0.8638 | 0.7716 | |
| | 12.5 | | | CONTRIB | 9.06% | 56.79% | 24.82% | 9.34% | 4,380 |
| | | 11.0 | 15.53 | CONTRIB | 9.71% | 59.32% | 20.84% | 10.14% | 6,803 |
| 20 | | | | RATIOS | 0.5134 | 0.6571 | 0.4479 | 0.5395 | |
| | 10.2 | | | CONTRIB | 4.95% | 83.52% | 6.44% | 5.09% | 4,380 |
| | | 11.0 | 7.35 | CONTRIB | 3.56% | 85.90% | 5.64% | 4.90% | 3,219 |
| 21 | | | | RATIOS | 0.5267 | 0.7256 | 0.5063 | 0.5862 | |
| | 11.2 | | | CONTRIB | 2.77% | 84.97% | 7.39% | 4.86% | 4,380 |
| | | 11.0 | 10.77 | CONTRIB | 3.02% | 84.59% | 7.52% | 4.87% | 4,718 |
| 22 | | | | RATIOS | 0.6671 | 0.6012 | 0.4624 | 0.5769 | |
| | 9.9 | | | CONTRIB | 16.61% | 67.17% | 8.71% | 7.51% | 4,380 |
| | | 11.0 | 6.65 | CONTRIB | 16.53% | 68.25% | 7.83% | 7.39% | 2,915 |
| 23 | | | | RATIOS | 0.3967 | 0.6591 | 0.6334 | 0.5631 | |
| | 10.5 | | | CONTRIB | 0.40% | 75.38% | 18.87% | 5.34% | 4,380 |
| | | 11.0 | 8.58 | CONTRIB | 0.31% | 74.41% | 20.08% | 5.20% | 3,757 |
| 24 | | | | RATIOS | 0.8619 | 0.8738 | 1.0536 | 0.9298 | |
| | 15.1 | | | CONTRIB | 8.72% | 56.36% | 25.52% | 9.39% | 4,380 |
| | | 11.0 | 27.70 | CONTRIB | 10.79% | 64.62% | 14.34% | 10.25% | 12,133 |
| 25 | | | | RATIOS | 0.7152 | 0.9893 | 0.8495 | 0.8513 | |
| | 15.7 | | | CONTRIB | 2.14% | 77.03% | 15.19% | 5.63% | 4,380 |
| | | 11.0 | 27.12 | CONTRIB | 5.32% | 74.54% | 11.54% | 8.60% | 11,877 |
| 26 | | | | RATIOS | 0.6314 | 0.8713 | 0.8134 | 0.7720 | |
| | 14.0 | | | CONTRIB | 2.01% | 74.25% | 17.65% | 6.08% | 4,380 |
| | | 11.0 | 23.18 | CONTRIB | 3.83% | 77.00% | 12.36% | 6.81% | 10,153 |
| 27 | | | | RATIOS | 0.7803 | 0.6305 | 0.8475 | 0.7528 | |
| | 11.6 | | | CONTRIB | 16.39% | 44.26% | 27.88% | 11.47% | 4,380 |
| | | 11.0 | 11.98 | CONTRIB | 16.92% | 45.19% | 25.99% | 11.90% | 5,248 |
| 28 | | | | RATIOS | 0.8213 | 0.6671 | 0.7369 | 0.7418 | |
| | 11.8 | | | CONTRIB | 18.66% | 51.05% | 20.23% | 10.06% | 4,380 |
| | | 11.0 | 12.84 | CONTRIB | 19.28% | 51.99% | 18.25% | 10.47% | 5,624 |
| 29 | | | | RATIOS | 0.4357 | 0.8189 | 0.5757 | 0.6101 | |
| | 12.5 | | | CONTRIB | 0.19% | 88.27% | 8.06% | 3.48% | 4,380 |
| | | 11.0 | 16.36 | CONTRIB | 0.39% | 87.18% | 8.67% | 3.76% | 7,167 |
| 30 | | | | RATIOS | 0.7869 | 1.1788 | 0.2190 | 0.7282 | |
| | 17.6 | | | CONTRIB | 1.84% | 96.63% | 0.00% | 1.53% | 4,380 |
| | | 11.0 | 27.33 | CONTRIB | 7.67% | 87.76% | 0.00% | 4.57% | 11,972 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| Loca-tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 31 | | | | RATIOS | 0.9538 | 0.2492 | 0.5793 | 0.5941 | |
| | 8.4 | | | CONTRIB | 59.23% | 0.16% | 24.63% | 15.98% | 4,380 |
| | | 11.0 | 5.65 | CONTRIB | 64.77% | 0.00% | 25.43% | 9.80% | 2,475 |
| 32 | | | | RATIOS | 0.2741 | 0.5420 | 0.5805 | 0.4655 | |
| | 8.8 | | | CONTRIB | 0.06% | 71.85% | 22.91% | 5.18% | 4,380 |
| | | 11.0 | 4.22 | CONTRIB | 0.00% | 61.75% | 34.20% | 4.05% | 1,848 |
| 33 | | | | RATIOS | 0.6442 | 0.4299 | 0.6167 | 0.5636 | |
| | 8.5 | | | CONTRIB | 26.52% | 33.05% | 27.72% | 12.71% | 4,380 |
| | | 11.0 | 3.40 | CONTRIB | 28.22% | 10.63% | 47.98% | 13.18% | 1,490 |
| 34 | | | | RATIOS | 1.0456 | 0.7507 | 0.8634 | 0.8866 | |
| | 13.9 | | | CONTRIB | 25.55% | 43.54% | 20.12% | 10.79% | 4,380 |
| | | 11.0 | 20.52 | CONTRIB | 21.08% | 50.38% | 15.76% | 12.78% | 8,986 |
| 35 | | | | RATIOS | 1.1193 | 0.4579 | 0.5983 | 0.7252 | |
| | 10.3 | | | CONTRIB | 55.23% | 11.16% | 17.57% | 16.04% | 4,380 |
| | | 11.0 | 8.30 | CONTRIB | 58.97% | 7.73% | 18.49% | 14.80% | 3,634 |
| 36 | | | | RATIOS | 0.2322 | 0.2883 | 0.2806 | 0.2670 | |
| | 4.7 | | | CONTRIB | 4.31% | 70.22% | 18.63% | 6.84% | 4,380 |
| | | 11.0 | 0.00 | CONTRIB | 0.30% | 79.88% | 16.08% | 3.74% | 1 |
| 37 | | | | RATIOS | 0.6958 | 0.5952 | 0.3720 | 0.5543 | |
| | 9.7 | | | CONTRIB | 21.13% | 69.57% | 2.38% | 6.92% | 4,380 |
| | | 11.0 | 6.16 | CONTRIB | 21.05% | 71.03% | 1.22% | 6.70% | 2,697 |
| 38 | | | | RATIOS | 1.0515 | 0.3079 | 0.7762 | 0.7118 | |
| | 10.0 | | | CONTRIB | 51.71% | 0.30% | 31.46% | 16.54% | 4,380 |
| | | 11.0 | 8.12 | CONTRIB | 53.80% | 0.09% | 32.07% | 14.04% | 3,556 |
| 39 | | | | RATIOS | 0.5330 | 0.3675 | 0.8758 | 0.5921 | |
| | 7.9 | | | CONTRIB | 16.82% | 16.45% | 46.03% | 20.70% | 4,380 |
| | | 11.0 | 4.30 | CONTRIB | 8.36% | 2.01% | 76.93% | 12.71% | 1,881 |
| 40 | | | | RATIOS | 0.6430 | 0.3934 | 0.7722 | 0.6029 | |
| | 8.4 | | | CONTRIB | 27.37% | 17.17% | 38.16% | 17.30% | 4,380 |
| | | 11.0 | 4.28 | CONTRIB | 22.28% | 3.76% | 60.25% | 13.72% | 1,874 |
| 41 | | | | RATIOS | 0.6112 | 0.5440 | 0.8205 | 0.6586 | |
| | 10.1 | | | CONTRIB | 11.00% | 43.35% | 33.79% | 11.86% | 4,380 |
| | | 11.0 | 7.22 | CONTRIB | 10.84% | 37.19% | 40.40% | 11.58% | 3,161 |
| 42 | | | | RATIOS | 0.5703 | 0.5707 | 0.4038 | 0.5149 | |
| | 9.1 | | | CONTRIB | 12.31% | 74.48% | 6.65% | 6.56% | 4,380 |
| | | 11.0 | 4.78 | CONTRIB | 12.47% | 78.25% | 3.34% | 5.94% | 2,095 |
| 43 | | | | RATIOS | 0.6244 | 0.3324 | 0.7475 | 0.5681 | |
| | 7.7 | | | CONTRIB | 32.26% | 8.50% | 40.16% | 19.08% | 4,380 |
| | | 11.0 | 3.75 | CONTRIB | 22.67% | 0.61% | 64.37% | 12.34% | 1,642 |
| 44 | | | | RATIOS | 0.9478 | 0.6461 | 0.5454 | 0.7131 | |
| | 11.6 | | | CONTRIB | 32.88% | 48.81% | 9.00% | 9.31% | 4,380 |
| | | 11.0 | 11.86 | CONTRIB | 30.50% | 50.01% | 9.81% | 9.68% | 5,194 |
| 45 | | | | RATIOS | 0.6893 | 0.6028 | 0.5826 | 0.6249 | |
| | 10.3 | | | CONTRIB | 16.14% | 58.45% | 16.61% | 8.80% | 4,380 |
| | | 11.0 | 7.97 | CONTRIB | 15.69% | 57.57% | 18.24% | 8.50% | 3,489 |

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| Location | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 46 | | | | RATIOS | 1.3405 | 0.6438 | 0.8201 | 0.9348 | |
| | 13.5 | | | CONTRIB | 46.61% | 19.47% | 19.11% | 14.81% | 4,380 |
| | | 11.0 | 18.42 | CONTRIB | 36.86% | 31.77% | 15.81% | 15.56% | 8,067 |
| 47 | | | | RATIOS | 1.2086 | 0.7154 | 0.6422 | 0.8554 | |
| | 13.5 | | | CONTRIB | 38.94% | 40.85% | 9.62% | 10.58% | 4,380 |
| | | 11.0 | 18.42 | CONTRIB | 30.53% | 46.94% | 9.62% | 12.91% | 8,068 |
| 48 | | | | RATIOS | 0.5605 | 0.9148 | 0.1961 | 0.5571 | |
| | 13.6 | | | CONTRIB | 0.91% | 97.71% | 0.00% | 1.38% | 4,380 |
| | | 11.0 | 19.69 | CONTRIB | 2.78% | 95.07% | 0.00% | 2.15% | 8,626 |
| 49 | | | | RATIOS | 0.5722 | 0.8487 | 0.5491 | 0.6567 | |
| | 13.0 | | | CONTRIB | 1.64% | 88.70% | 5.41% | 4.24% | 4,380 |
| | | 11.0 | 18.92 | CONTRIB | 3.20% | 86.08% | 6.35% | 4.37% | 8,286 |
| 50 | | | | RATIOS | 0.7101 | 0.5157 | 0.5820 | 0.6026 | |
| | 9.5 | | | CONTRIB | 25.08% | 44.66% | 19.63% | 10.62% | 4,380 |
| | | 11.0 | 5.16 | CONTRIB | 27.18% | 33.38% | 28.09% | 11.34% | 2,261 |
| 51 | | | | RATIOS | 1.1690 | 0.4263 | 0.6530 | 0.7494 | |
| | 10.5 | | | CONTRIB | 57.71% | 5.17% | 20.18% | 16.94% | 4,380 |
| | | 11.0 | 8.86 | CONTRIB | 59.73% | 3.78% | 20.68% | 15.81% | 3,882 |
| 52 | | | | RATIOS | 1.2211 | 0.6771 | 0.6454 | 0.8479 | |
| | 13.2 | | | CONTRIB | 41.40% | 36.34% | 11.04% | 11.21% | 4,380 |
| | | 11.0 | 16.87 | CONTRIB | 33.97% | 41.82% | 10.61% | 13.60% | 7,389 |
| 53 | | | | RATIOS | 0.7567 | 0.7079 | 0.5075 | 0.6574 | |
| | 11.5 | | | CONTRIB | 15.25% | 71.09% | 6.67% | 7.00% | 4,380 |
| | | 11.0 | 11.77 | CONTRIB | 15.29% | 70.69% | 6.96% | 7.05% | 5,153 |
| 54 | | | | RATIOS | 0.6967 | 0.8073 | 0.4755 | 0.6599 | |
| | 12.5 | | | CONTRIB | 7.96% | 84.72% | 2.25% | 5.08% | 4,380 |
| | | 11.0 | 16.27 | CONTRIB | 8.01% | 83.15% | 3.67% | 5.17% | 7,128 |
| 55 | | | | RATIOS | 0.8089 | 0.7407 | 0.6799 | 0.7432 | |
| | 12.5 | | | CONTRIB | 14.35% | 61.98% | 15.44% | 8.23% | 4,380 |
| | | 11.0 | 15.51 | CONTRIB | 15.04% | 63.40% | 12.83% | 8.73% | 6,794 |
| 56 | | | | RATIOS | 0.7293 | 0.7342 | 0.7499 | 0.7378 | |
| | 12.3 | | | CONTRIB | 9.98% | 62.41% | 19.26% | 8.34% | 4,380 |
| | | 11.0 | 14.82 | CONTRIB | 10.51% | 64.23% | 16.38% | 8.88% | 6,492 |
| 57 | | | | RATIOS | 0.6077 | 0.8877 | 0.6350 | 0.7101 | |
| | 13.7 | | | CONTRIB | 1.71% | 85.24% | 8.37% | 4.69% | 4,380 |
| | | 11.0 | 21.81 | CONTRIB | 3.51% | 83.37% | 7.94% | 5.18% | 9,551 |
| 58 | | | | RATIOS | 0.4983 | 0.3153 | 0.7387 | 0.5174 | |
| | 6.9 | | | CONTRIB | 21.58% | 13.72% | 44.28% | 20.41% | 4,380 |
| | | 11.0 | 2.86 | CONTRIB | 7.13% | 0.36% | 82.33% | 10.19% | 1,253 |
| 59 | | | | RATIOS | 0.6862 | 0.6310 | 0.3265 | 0.5479 | |
| | 10.0 | | | CONTRIB | 17.53% | 76.18% | 0.52% | 5.77% | 4,380 |
| | | 11.0 | 7.06 | CONTRIB | 17.39% | 76.96% | 0.14% | 5.51% | 3,092 |
| 60 | | | | RATIOS | 0.7579 | 0.7868 | 0.2698 | 0.6048 | |
| | 12.2 | | | CONTRIB | 12.12% | 84.06% | 0.00% | 3.82% | 4,380 |
| | | 11.0 | 14.70 | CONTRIB | 12.31% | 83.64% | 0.00% | 4.04% | 6,440 |

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| Loca- tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 61 | | | | RATIOS | 0.4014 | 0.6467 | 0.4020 | 0.4834 | |
| | 9.8 | | | CONTRIB | 0.86% | 91.04% | 4.41% | 3.69% | 4,380 |
| | | 11.0 | 6.34 | CONTRIB | 0.46% | 93.86% | 2.42% | 3.26% | 2,777 |
| 62 | | | | RATIOS | 0.8117 | 0.3059 | 0.5355 | 0.5510 | |
| | 7.7 | | | CONTRIB | 52.65% | 4.40% | 25.55% | 17.40% | 4,380 |
| | | 11.0 | 3.84 | CONTRIB | 61.64% | 0.17% | 27.75% | 10.44% | 1,680 |
| 63 | | | | RATIOS | 0.4799 | 0.4349 | 0.5803 | 0.4984 | |
| | 7.8 | | | CONTRIB | 11.58% | 48.70% | 28.93% | 10.79% | 4,380 |
| | | 11.0 | 2.23 | CONTRIB | 6.65% | 18.03% | 64.53% | 10.79% | 978 |
| 64 | | | | RATIOS | 0.5465 | 0.4302 | 0.5777 | 0.5182 | |
| | 8.0 | | | CONTRIB | 17.71% | 43.25% | 27.46% | 11.58% | 4,380 |
| | | 11.0 | 2.53 | CONTRIB | 17.52% | 14.41% | 56.47% | 11.60% | 1,108 |
| 65 | | | | RATIOS | 0.5624 | 0.4271 | 0.7595 | 0.5830 | |
| | 8.4 | | | CONTRIB | 15.81% | 32.18% | 37.28% | 14.73% | 4,380 |
| | | 11.0 | 3.91 | CONTRIB | 14.43% | 8.72% | 63.73% | 13.12% | 1,713 |
| 66 | | | | RATIOS | 0.6026 | 0.7979 | 0.7116 | 0.7041 | |
| | 12.8 | | | CONTRIB | 2.90% | 74.90% | 16.16% | 6.04% | 4,380 |
| | | 11.0 | 16.97 | CONTRIB | 4.36% | 76.35% | 12.86% | 6.43% | 7,434 |
| 67 | | | | RATIOS | 0.9354 | 0.6687 | 0.4336 | 0.6792 | |
| | 11.5 | | | CONTRIB | 32.65% | 57.34% | 2.06% | 7.95% | 4,380 |
| | | 11.0 | 11.52 | CONTRIB | 30.66% | 58.46% | 2.67% | 8.21% | 5,045 |
| 68 | | | | RATIOS | 0.6397 | 0.6463 | 0.7615 | 0.6825 | |
| | 11.1 | | | CONTRIB | 8.98% | 57.22% | 24.55% | 9.26% | 4,380 |
| | | 11.0 | 10.34 | CONTRIB | 9.03% | 57.42% | 24.23% | 9.32% | 4,529 |
| 69 | | | | RATIOS | 1.1442 | 0.7218 | 0.8428 | 0.9030 | |
| | 14.0 | | | CONTRIB | 32.96% | 36.80% | 18.92% | 11.32% | 4,380 |
| | | 11.0 | 19.82 | CONTRIB | 25.70% | 45.11% | 15.54% | 13.65% | 8,679 |
| 70 | | | | RATIOS | 0.4826 | 0.5601 | 0.2406 | 0.4278 | |
| | 8.6 | | | CONTRIB | 8.22% | 87.83% | 0.03% | 3.92% | 4,380 |
| | | 11.0 | 3.66 | CONTRIB | 4.25% | 93.37% | 0.00% | 2.38% | 1,604 |
| 71 | | | | RATIOS | 0.2175 | 0.4310 | 0.4802 | 0.3763 | |
| | 7.0 | | | CONTRIB | 0.05% | 70.07% | 24.49% | 5.38% | 4,380 |
| | | 11.0 | 1.02 | CONTRIB | 0.00% | 36.18% | 61.14% | 2.68% | 449 |
| 72 | | | | RATIOS | 0.5165 | 0.8507 | 0.4597 | 0.6090 | |
| | 12.8 | | | CONTRIB | 0.77% | 94.75% | 1.34% | 3.13% | 4,380 |
| | | 11.0 | 17.82 | CONTRIB | 1.55% | 92.18% | 2.84% | 3.43% | 7,804 |
| 73 | | | | RATIOS | 0.4920 | 0.5518 | 0.2524 | 0.4321 | |
| | 8.5 | | | CONTRIB | 9.22% | 86.34% | 0.10% | 4.34% | 4,380 |
| | | 11.0 | 3.30 | CONTRIB | 5.55% | 91.56% | 0.00% | 2.88% | 1,446 |
| 74 | | | | RATIOS | 0.9783 | 0.9772 | 0.6748 | 0.8768 | |
| | 15.6 | | | CONTRIB | 12.51% | 75.06% | 5.97% | 6.47% | 4,380 |
| | | 11.0 | 28.33 | CONTRIB | 13.52% | 70.48% | 6.91% | 9.09% | 12,410 |
| 75 | | | | RATIOS | 1.1213 | 0.7962 | 0.5701 | 0.8292 | |
| | 13.8 | | | CONTRIB | 32.31% | 54.75% | 4.58% | 8.36% | 4,380 |
| | | 11.0 | 21.25 | CONTRIB | 23.10% | 60.48% | 6.54% | 9.88% | 9,307 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| Location | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 76 | | | | RATIOS | 0.4816 | 0.8707 | 0.5314 | 0.6279 | |
| | 13.1 | | | CONTRIB | 0.31% | 92.64% | 3.89% | 3.16% | 4,380 |
| | | 11.0 | 19.71 | CONTRIB | 0.78% | 90.52% | 5.20% | 3.50% | 8,632 |
| 77 | | | | RATIOS | 0.9764 | 0.7785 | 0.5701 | 0.7750 | |
| | 13.1 | | | CONTRIB | 24.43% | 61.54% | 6.11% | 7.91% | 4,380 |
| | | 11.0 | 18.64 | CONTRIB | 20.49% | 63.46% | 7.46% | 8.60% | 8,163 |
| 78 | | | | RATIOS | 0.4863 | 1.2427 | 0.7473 | 0.8254 | |
| | 18.7 | | | CONTRIB | 0.00% | 94.31% | 3.55% | 2.13% | 4,380 |
| | | 11.0 | 29.90 | CONTRIB | 0.56% | 84.48% | 8.06% | 6.90% | 13,096 |
| 79 | | | | RATIOS | 1.0154 | 0.8126 | 1.1368 | 0.9883 | |
| | 15.1 | | | CONTRIB | 16.27% | 42.41% | 29.53% | 11.79% | 4,380 |
| | | 11.0 | 25.39 | CONTRIB | 16.15% | 54.60% | 16.87% | 12.39% | 11,122 |
| 80 | | | | RATIOS | 0.8560 | 1.0434 | 1.0364 | 0.9786 | |
| | 17.1 | | | CONTRIB | 4.82% | 68.92% | 19.21% | 7.04% | 4,380 |
| | | 11.0 | 31.20 | CONTRIB | 9.32% | 68.24% | 12.52% | 9.91% | 13,667 |
| 81 | | | | RATIOS | 1.5260 | 0.8513 | 1.1482 | 1.1752 | |
| | 17.3 | | | CONTRIB | 37.69% | 25.56% | 22.95% | 13.80% | 4,380 |
| | | 11.0 | 33.58 | CONTRIB | 25.58% | 49.03% | 12.88% | 12.51% | 14,710 |
| 82 | | | | RATIOS | 0.7968 | 1.2713 | 0.2569 | 0.7750 | |
| | 18.9 | | | CONTRIB | 1.10% | 97.51% | 0.00% | 1.39% | 4,380 |
| | | 11.0 | 29.63 | CONTRIB | 7.42% | 87.17% | 0.00% | 5.41% | 12,978 |
| 83 | | | | RATIOS | 1.0068 | 0.4130 | 0.5857 | 0.6685 | |
| | 9.4 | | | CONTRIB | 53.50% | 9.87% | 20.14% | 16.49% | 4,380 |
| | | 11.0 | 6.64 | CONTRIB | 60.76% | 3.77% | 22.12% | 13.35% | 2,910 |
| 84 | | | | RATIOS | 0.8573 | 0.9736 | 0.5587 | 0.7966 | |
| | 15.1 | | | CONTRIB | 8.59% | 84.56% | 1.76% | 5.09% | 4,380 |
| | | 11.0 | 25.92 | CONTRIB | 11.29% | 76.76% | 5.05% | 6.90% | 11,354 |
| 85 | | | | RATIOS | 1.0252 | 0.6779 | 0.5756 | 0.7596 | |
| | 12.3 | | | CONTRIB | 34.23% | 47.32% | 8.89% | 9.56% | 4,380 |
| | | 11.0 | 14.15 | CONTRIB | 29.48% | 50.06% | 10.02% | 10.44% | 6,199 |
| 86 | | | | RATIOS | 0.7413 | 0.6909 | 0.3814 | 0.6045 | |
| | 11.0 | | | CONTRIB | 16.69% | 76.39% | 0.96% | 5.97% | 4,380 |
| | | 11.0 | 9.95 | CONTRIB | 16.69% | 76.40% | 0.95% | 5.96% | 4,356 |
| 87 | | | | RATIOS | 0.6814 | 0.7897 | 0.4340 | 0.6350 | |
| | 12.2 | | | CONTRIB | 8.07% | 85.87% | 1.23% | 4.83% | 4,380 |
| | | 11.0 | 14.70 | CONTRIB | 8.13% | 84.84% | 2.11% | 4.91% | 6,437 |
| 88 | | | | RATIOS | 0.4514 | 1.0017 | 1.0248 | 0.8260 | |
| | 16.1 | | | CONTRIB | 0.01% | 74.18% | 21.25% | 4.56% | 4,380 |
| | | 11.0 | 26.48 | CONTRIB | 0.33% | 77.27% | 14.59% | 7.81% | 11,597 |
| 89 | | | | RATIOS | 0.4861 | 1.0136 | 1.0097 | 0.8365 | |
| | 16.2 | | | CONTRIB | 0.03% | 75.08% | 20.26% | 4.63% | 4,380 |
| | | 11.0 | 26.84 | CONTRIB | 0.62% | 77.10% | 14.18% | 8.10% | 11,758 |
| 90 | | | | RATIOS | 0.7328 | 0.7620 | 0.9527 | 0.8158 | |
| | 13.2 | | | CONTRIB | 7.78% | 55.52% | 27.24% | 9.47% | 4,380 |
| | | 11.0 | 18.07 | CONTRIB | 8.78% | 60.46% | 19.88% | 10.88% | 7,917 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| | 10.0% Exc. | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca-tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 91 | | | | RATIOS | 0.6430 | 0.4797 | 0.5355 | 0.5527 | |
| | 8.7 | | | CONTRIB | 23.53% | 46.39% | 19.61% | 10.47% | 4,380 |
| | | 11.0 | 3.37 | CONTRIB | 28.29% | 28.02% | 31.61% | 12.08% | 1,475 |
| 92 | | | | RATIOS | 0.5756 | 0.8750 | 0.4183 | 0.6229 | |
| | 13.1 | | | CONTRIB | 1.56% | 94.99% | 0.40% | 3.06% | 4,380 |
| | | 11.0 | 19.43 | CONTRIB | 3.18% | 92.24% | 1.14% | 3.44% | 8,512 |
| 93 | | | | RATIOS | 0.5840 | 1.2086 | 0.3089 | 0.7005 | |
| | 17.9 | | | CONTRIB | 0.10% | 98.99% | 0.00% | 0.91% | 4,380 |
| | | 11.0 | 26.31 | CONTRIB | 2.49% | 93.44% | 0.01% | 4.06% | 11,523 |
| 94 | | | | RATIOS | 0.4783 | 0.9709 | 0.4879 | 0.6457 | |
| | 14.5 | | | CONTRIB | 0.12% | 96.93% | 0.73% | 2.23% | 4,380 |
| | | 11.0 | 21.44 | CONTRIB | 0.67% | 92.57% | 3.16% | 3.60% | 9,389 |
| 95 | | | | RATIOS | 0.6977 | 0.5991 | 0.5505 | 0.6158 | |
| | 10.2 | | | CONTRIB | 17.48% | 58.90% | 15.05% | 8.58% | 4,380 |
| | | 11.0 | 7.65 | CONTRIB | 17.14% | 58.60% | 15.91% | 8.35% | 3,350 |
| 96 | | | | RATIOS | 0.4216 | 0.7677 | 0.5144 | 0.5679 | |
| | 11.7 | | | CONTRIB | 0.26% | 89.78% | 6.52% | 3.44% | 4,380 |
| | | 11.0 | 12.62 | CONTRIB | 0.37% | 89.03% | 6.93% | 3.66% | 5,525 |
| 97 | | | | RATIOS | 0.6511 | 0.6850 | 0.5722 | 0.6361 | |
| | 11.1 | | | CONTRIB | 9.49% | 70.00% | 13.63% | 6.89% | 4,380 |
| | | 11.0 | 10.49 | CONTRIB | 9.54% | 70.18% | 13.36% | 6.93% | 4,595 |
| 98 | | | | RATIOS | 1.0160 | 0.5644 | 1.1537 | 0.9113 | |
| | 12.6 | | | CONTRIB | 32.15% | 11.93% | 38.02% | 17.89% | 4,380 |
| | | 11.0 | 14.79 | CONTRIB | 27.75% | 24.29% | 29.39% | 18.57% | 6,478 |
| 99 | | | | RATIOS | 0.7881 | 0.6403 | 1.0913 | 0.8399 | |
| | 12.4 | | | CONTRIB | 13.17% | 36.69% | 36.48% | 13.65% | 4,380 |
| | | 11.0 | 14.16 | CONTRIB | 14.88% | 40.48% | 29.04% | 15.60% | 6,204 |
| 100 | | | | RATIOS | 0.7105 | 1.0325 | 0.3795 | 0.7075 | |
| | 15.5 | | | CONTRIB | 2.29% | 95.18% | 0.00% | 2.53% | 4,380 |
| | | 11.0 | 23.68 | CONTRIB | 5.94% | 88.98% | 0.38% | 4.70% | 10,373 |
| 101 | | | | RATIOS | 0.5975 | 0.7981 | 0.7626 | 0.7194 | |
| | 12.9 | | | CONTRIB | 2.53% | 72.79% | 18.30% | 6.38% | 4,380 |
| | | 11.0 | 17.39 | CONTRIB | 4.12% | 74.59% | 14.45% | 6.84% | 7,616 |
| 102 | | | | RATIOS | 0.5461 | 1.0629 | 0.4561 | 0.6884 | |
| | 15.8 | | | CONTRIB | 0.18% | 97.79% | 0.06% | 1.97% | 4,380 |
| | | 11.0 | 23.61 | CONTRIB | 1.87% | 91.84% | 2.06% | 4.22% | 10,339 |
| 103 | | | | RATIOS | 0.4761 | 0.9958 | 0.5493 | 0.6737 | |
| | 14.9 | | | CONTRIB | 0.08% | 95.85% | 1.67% | 2.39% | 4,380 |
| | | 11.0 | 22.60 | CONTRIB | 0.62% | 90.01% | 5.33% | 4.05% | 9,899 |
| 104 | | | | RATIOS | 0.6697 | 0.7479 | 0.3818 | 0.5998 | |
| | 11.5 | | | CONTRIB | 9.26% | 85.38% | 0.61% | 4.75% | 4,380 |
| | | 11.0 | 11.98 | CONTRIB | 9.32% | 85.09% | 0.80% | 4.80% | 5,248 |
| 105 | | | | RATIOS | 0.5430 | 0.7193 | 0.4191 | 0.5605 | |
| | 11.0 | | | CONTRIB | 4.28% | 89.00% | 2.30% | 4.42% | 4,380 |
| | | 11.0 | 9.90 | CONTRIB | 4.24% | 89.08% | 2.27% | 4.41% | 4,338 |

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| Loca-tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 106 | | | | RATIOS | 0.5075 | 0.7652 | 0.4695 | 0.5807 | |
| | 11.6 | | | CONTRIB | 1.50% | 90.66% | 3.87% | 3.96% | 4,380 |
| | | 11.0 | 12.40 | CONTRIB | 1.92% | 89.48% | 4.52% | 4.07% | 5,430 |
| 107 | | | | RATIOS | 1.0389 | 0.7354 | 0.7036 | 0.8260 | |
| | 13.3 | | | CONTRIB | 29.18% | 46.86% | 14.41% | 9.55% | 4,380 |
| | | 11.0 | 18.05 | CONTRIB | 23.68% | 53.05% | 11.82% | 11.45% | 7,906 |
| 108 | | | | RATIOS | 0.5967 | 0.8823 | 1.0274 | 0.8354 | |
| | 14.6 | | | CONTRIB | 0.86% | 66.17% | 25.96% | 7.01% | 4,380 |
| | | 11.0 | 24.82 | CONTRIB | 2.87% | 72.81% | 15.61% | 8.72% | 10,871 |
| 109 | | | | RATIOS | 0.7593 | 0.8105 | 0.9646 | 0.8448 | |
| | 13.9 | | | CONTRIB | 7.40% | 58.31% | 25.32% | 8.97% | 4,380 |
| | | 11.0 | 21.45 | CONTRIB | 8.50% | 64.00% | 16.96% | 10.54% | 9,395 |
| 110 | | | | RATIOS | 0.5301 | 0.9270 | 0.4051 | 0.6207 | |
| | 13.8 | | | CONTRIB | 0.47% | 97.14% | 0.08% | 2.31% | 4,380 |
| | | 11.0 | 20.13 | CONTRIB | 1.70% | 94.20% | 0.82% | 3.28% | 8,818 |
| 111 | | | | RATIOS | 0.4624 | 0.4691 | 0.6895 | 0.5403 | |
| | 8.5 | | | CONTRIB | 7.35% | 47.97% | 33.84% | 10.84% | 4,380 |
| | | 11.0 | 3.30 | CONTRIB | 3.29% | 23.74% | 61.99% | 10.98% | 1,446 |
| 112 | | | | RATIOS | 0.4893 | 0.7938 | 0.4240 | 0.5690 | |
| | 11.9 | | | CONTRIB | 0.89% | 94.75% | 1.21% | 3.16% | 4,380 |
| | | 11.0 | 13.60 | CONTRIB | 1.29% | 93.45% | 1.84% | 3.42% | 5,958 |
| 113 | | | | RATIOS | 0.4685 | 0.8695 | 0.4706 | 0.6029 | |
| | 13.0 | | | CONTRIB | 0.26% | 95.64% | 1.40% | 2.70% | 4,380 |
| | | 11.0 | 19.09 | CONTRIB | 0.64% | 93.32% | 2.97% | 3.07% | 8,360 |
| 114 | | | | RATIOS | 0.6003 | 0.8689 | 0.6048 | 0.6913 | |
| | 13.4 | | | CONTRIB | 1.88% | 86.06% | 7.42% | 4.64% | 4,380 |
| | | 11.0 | 21.08 | CONTRIB | 3.46% | 84.29% | 7.44% | 4.81% | 9,232 |
| 115 | | | | RATIOS | 0.6234 | 0.7530 | 0.5585 | 0.6450 | |
| | 11.9 | | | CONTRIB | 6.29% | 79.00% | 9.04% | 5.68% | 4,380 |
| | | 11.0 | 13.37 | CONTRIB | 6.31% | 78.17% | 9.76% | 5.75% | 5,858 |
| 116 | | | | RATIOS | 0.4522 | 0.8232 | 0.4646 | 0.5800 | |
| | 12.3 | | | CONTRIB | 0.30% | 94.80% | 2.00% | 2.89% | 4,380 |
| | | 11.0 | 15.67 | CONTRIB | 0.57% | 92.82% | 3.40% | 3.21% | 6,864 |
| 117 | | | | RATIOS | 0.6673 | 0.9403 | 0.8517 | 0.8198 | |
| | 15.0 | | | CONTRIB | 1.76% | 75.66% | 16.76% | 5.82% | 4,380 |
| | | 11.0 | 25.48 | CONTRIB | 4.32% | 75.47% | 12.34% | 7.87% | 11,162 |
| 118 | | | | RATIOS | 0.6603 | 0.8219 | 1.1180 | 0.8667 | |
| | 14.2 | | | CONTRIB | 2.52% | 55.99% | 32.49% | 9.00% | 4,380 |
| | | 11.0 | 22.23 | CONTRIB | 4.75% | 65.03% | 18.95% | 11.27% | 9,737 |
| 119 | | | | RATIOS | 0.6540 | 0.7554 | 1.0517 | 0.8204 | |
| | 13.2 | | | CONTRIB | 4.22% | 53.23% | 32.96% | 9.58% | 4,380 |
| | | 11.0 | 17.57 | CONTRIB | 5.79% | 60.20% | 22.56% | 11.45% | 7,696 |
| 120 | | | | RATIOS | 0.5463 | 0.6110 | 0.6591 | 0.6055 | |
| | 10.2 | | | CONTRIB | 6.74% | 63.50% | 21.72% | 8.04% | 4,380 |
| | | 11.0 | 7.73 | CONTRIB | 5.72% | 62.39% | 24.16% | 7.72% | 3,385 |

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| Location | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 121 | | | | RATIOS | 0.6197 | 0.7428 | 0.4806 | 0.6144 | |
| | 11.5 | | | CONTRIB | 6.82% | 83.01% | 4.96% | 5.21% | 4,380 |
| | | 11.0 | 12.03 | CONTRIB | 6.86% | 82.65% | 5.23% | 5.26% | 5,268 |
| 122 | | | | RATIOS | 0.9268 | 0.5140 | 0.8126 | 0.7511 | |
| | 10.8 | | | CONTRIB | 35.85% | 19.36% | 29.63% | 15.16% | 4,380 |
| | | 11.0 | 9.42 | CONTRIB | 36.87% | 17.78% | 30.35% | 15.01% | 4,126 |
| 123 | | | | RATIOS | 0.7948 | 0.4263 | 1.2152 | 0.8121 | |
| | 10.6 | | | CONTRIB | 25.25% | 4.74% | 47.53% | 22.48% | 4,379 |
| | | 11.0 | 9.02 | CONTRIB | 24.14% | 3.72% | 50.73% | 21.41% | 3,952 |
| 124 | | | | RATIOS | 0.8303 | 0.5522 | 0.9930 | 0.7919 | |
| | 11.3 | | | CONTRIB | 23.33% | 24.46% | 36.48% | 15.73% | 4,380 |
| | | 11.0 | 11.11 | CONTRIB | 23.24% | 27.36% | 33.69% | 15.71% | 4,868 |
| 125 | | | | RATIOS | 0.8750 | 1.1974 | 0.9236 | 0.9987 | |
| | 18.7 | | | CONTRIB | 2.62% | 80.86% | 11.28% | 5.24% | 4,380 |
| | | 11.0 | 34.17 | CONTRIB | 9.16% | 71.28% | 10.19% | 9.36% | 14,968 |
| 126 | | | | RATIOS | 1.0497 | 0.6022 | 1.0764 | 0.9094 | |
| | 12.9 | | | CONTRIB | 32.62% | 16.67% | 34.63% | 16.08% | 4,380 |
| | | 11.0 | 15.72 | CONTRIB | 27.71% | 29.07% | 25.81% | 17.41% | 6,884 |
| 127 | | | | RATIOS | 0.6059 | 0.7260 | 0.4463 | 0.5927 | |
| | 11.2 | | | CONTRIB | 6.98% | 84.64% | 3.33% | 5.05% | 4,379 |
| | | 11.0 | 10.84 | CONTRIB | 6.98% | 84.26% | 3.71% | 5.06% | 4,746 |
| 128 | | | | RATIOS | 0.6214 | 0.8022 | 0.5328 | 0.6522 | |
| | 12.4 | | | CONTRIB | 4.73% | 84.54% | 5.77% | 4.96% | 4,380 |
| | | 11.0 | 15.89 | CONTRIB | 5.25% | 83.16% | 6.53% | 5.05% | 6,962 |
| 129 | | | | RATIOS | 0.6438 | 0.6809 | 0.9656 | 0.7634 | |
| | 12.1 | | | CONTRIB | 6.55% | 50.19% | 33.05% | 10.22% | 4,380 |
| | | 11.0 | 13.31 | CONTRIB | 7.20% | 54.10% | 27.37% | 11.34% | 5,828 |
| 130 | | | | RATIOS | 0.8907 | 0.6695 | 0.5224 | 0.6942 | |
| | 11.6 | | | CONTRIB | 27.95% | 56.20% | 7.40% | 8.45% | 4,380 |
| | | 11.0 | 11.97 | CONTRIB | 27.00% | 56.51% | 7.88% | 8.62% | 5,243 |
| 131 | | | | RATIOS | 0.8438 | 0.5644 | 0.6901 | 0.6994 | |
| | 10.8 | | | CONTRIB | 29.31% | 38.15% | 21.19% | 11.34% | 4,380 |
| | | 11.0 | 9.46 | CONTRIB | 29.09% | 37.99% | 21.68% | 11.24% | 4,142 |
| 132 | | | | RATIOS | 0.7495 | 0.2528 | 1.4139 | 0.8054 | |
| | 10.5 | | | CONTRIB | 21.13% | 0.01% | 55.97% | 22.89% | 4,380 |
| | | 11.0 | 8.92 | CONTRIB | 19.42% | 0.00% | 59.64% | 20.94% | 3,908 |
| 133 | | | | RATIOS | 0.8044 | 0.2592 | 1.2554 | 0.7730 | |
| | 10.3 | | | CONTRIB | 29.22% | 0.01% | 50.35% | 20.42% | 4,380 |
| | | 11.0 | 8.60 | CONTRIB | 26.55% | 0.01% | 54.99% | 18.45% | 3,766 |
| 134 | | | | RATIOS | 0.8381 | 0.6473 | 1.1015 | 0.8623 | |
| | 12.7 | | | CONTRIB | 15.35% | 34.77% | 36.01% | 13.87% | 4,380 |
| | | 11.0 | 15.26 | CONTRIB | 17.56% | 39.14% | 27.21% | 16.09% | 6,683 |
| 135 | | | | RATIOS | 0.6652 | 1.0660 | 0.8501 | 0.8604 | |
| | 16.7 | | | CONTRIB | 0.68% | 81.33% | 13.36% | 4.62% | 4,380 |
| | | 11.0 | 28.40 | CONTRIB | 3.83% | 76.57% | 11.03% | 8.57% | 12,438 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| | 10.0% Exc. | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca-tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 136 | | | | RATIOS | 1.1648 | 0.8338 | 0.8856 | 0.9614 | |
| | 15.3 | | | CONTRIB | 26.96% | 45.32% | 17.49% | 10.23% | 4,380 |
| | | 11.0 | 26.86 | CONTRIB | 19.59% | 56.79% | 12.44% | 11.18% | 11,763 |
| 137 | | | | RATIOS | 0.9436 | 0.6293 | 1.2797 | 0.9509 | |
| | 13.1 | | | CONTRIB | 21.26% | 20.54% | 40.37% | 17.82% | 4,380 |
| | | 11.0 | 16.73 | CONTRIB | 21.45% | 32.14% | 28.80% | 17.62% | 7,329 |
| 138 | | | | RATIOS | 1.0566 | 0.7977 | 0.7677 | 0.8740 | |
| | 14.2 | | | CONTRIB | 24.65% | 50.71% | 15.23% | 9.42% | 4,380 |
| | | 11.0 | 22.46 | CONTRIB | 19.62% | 57.64% | 11.34% | 11.40% | 9,837 |
| 139 | | | | RATIOS | 0.4344 | 1.0366 | 0.5726 | 0.6812 | |
| | 15.5 | | | CONTRIB | 0.01% | 96.21% | 1.71% | 2.08% | 4,380 |
| | | 11.0 | 23.58 | CONTRIB | 0.26% | 89.73% | 5.95% | 4.06% | 10,327 |
| 140 | | | | RATIOS | 1.0756 | 1.0101 | 0.9666 | 1.0174 | |
| | 17.0 | | | CONTRIB | 12.98% | 61.89% | 16.79% | 8.34% | 4,380 |
| | | 11.0 | 32.13 | CONTRIB | 14.17% | 64.21% | 11.35% | 10.28% | 14,071 |
| 141 | | | | RATIOS | 0.7467 | 0.9968 | 0.7940 | 0.8458 | |
| | 15.7 | | | CONTRIB | 3.04% | 78.76% | 12.74% | 5.45% | 4,380 |
| | | 11.0 | 27.07 | CONTRIB | 6.31% | 75.22% | 10.08% | 8.40% | 11,856 |
| 142 | | | | RATIOS | 0.6511 | 1.1421 | 1.1799 | 0.9910 | |
| | 18.4 | | | CONTRIB | 0.22% | 72.84% | 21.46% | 5.48% | 4,380 |
| | | 11.0 | 31.86 | CONTRIB | 3.14% | 73.00% | 13.95% | 9.92% | 13,956 |
| 143 | | | | RATIOS | 0.6660 | 1.0242 | 0.9819 | 0.8907 | |
| | 16.4 | | | CONTRIB | 0.81% | 74.80% | 18.70% | 5.69% | 4,380 |
| | | 11.0 | 28.35 | CONTRIB | 3.85% | 73.76% | 13.06% | 9.32% | 12,416 |
| 144 | | | | RATIOS | 1.1611 | 0.6142 | 0.9170 | 0.8974 | |
| | 12.9 | | | CONTRIB | 39.08% | 19.39% | 26.37% | 15.16% | 4,380 |
| | | 11.0 | 16.28 | CONTRIB | 32.12% | 30.19% | 21.25% | 16.44% | 7,131 |
| 145 | | | | RATIOS | 0.9548 | 1.2609 | 0.8999 | 1.0385 | |
| | 19.6 | | | CONTRIB | 3.76% | 83.10% | 8.01% | 5.13% | 4,380 |
| | | 11.0 | 36.10 | CONTRIB | 10.16% | 70.98% | 9.40% | 9.46% | 15,812 |
| 146 | | | | RATIOS | 0.8517 | 0.9638 | 0.8505 | 0.8887 | |
| | 15.6 | | | CONTRIB | 7.21% | 70.70% | 15.32% | 6.76% | 4,380 |
| | | 11.0 | 28.32 | CONTRIB | 10.07% | 69.56% | 11.07% | 9.30% | 12,406 |
| 147 | | | | RATIOS | 0.9676 | 0.8175 | 1.5733 | 1.1195 | |
| | 16.1 | | | CONTRIB | 10.64% | 33.59% | 40.53% | 15.23% | 4,380 |
| | | 11.0 | 27.72 | CONTRIB | 13.55% | 51.14% | 21.35% | 13.97% | 12,143 |
| 148 | | | | RATIOS | 0.7618 | 1.1213 | 0.6209 | 0.8347 | |
| | 16.9 | | | CONTRIB | 1.94% | 92.76% | 1.59% | 3.71% | 4,380 |
| | | 11.0 | 28.50 | CONTRIB | 6.48% | 80.15% | 5.80% | 7.56% | 12,483 |
| 149 | | | | RATIOS | 0.8556 | 0.6012 | 1.1036 | 0.8535 | |
| | 12.2 | | | CONTRIB | 19.67% | 26.88% | 37.65% | 15.80% | 4,380 |
| | | 11.0 | 13.96 | CONTRIB | 20.80% | 32.53% | 29.79% | 16.88% | 6,115 |
| 150 | | | | RATIOS | 1.0987 | 0.3765 | 0.7783 | 0.7512 | |
| | 10.5 | | | CONTRIB | 51.90% | 1.71% | 29.05% | 17.34% | 4,380 |
| | | 11.0 | 8.87 | CONTRIB | 53.33% | 1.21% | 29.52% | 15.94% | 3,886 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| Loca- tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 151 | | | | RATIOS | 1.1036 | 0.5275 | 0.9048 | 0.8453 | |
| | 11.9 | | | CONTRIB | 41.59% | 11.12% | 30.52% | 16.77% | 4,380 |
| | | 11.0 | 12.53 | CONTRIB | 38.07% | 16.59% | 27.24% | 18.10% | 5,488 |
| 152 | | | | RATIOS | 0.5859 | 0.8368 | 0.7238 | 0.7155 | |
| | 13.3 | | | CONTRIB | 1.66% | 77.37% | 15.46% | 5.52% | 4,380 |
| | | 11.0 | 19.54 | CONTRIB | 3.39% | 79.08% | 11.56% | 5.96% | 8,557 |
| 153 | | | | RATIOS | 0.8262 | 1.2756 | 1.0811 | 1.0610 | |
| | 20.1 | | | CONTRIB | 0.90% | 79.05% | 15.00% | 5.05% | 4,380 |
| | | 11.0 | 36.06 | CONTRIB | 7.03% | 71.86% | 11.30% | 9.82% | 15,796 |
| 154 | | | | RATIOS | 0.8411 | 0.4920 | 1.3737 | 0.9023 | |
| | 11.7 | | | CONTRIB | 21.37% | 6.99% | 48.63% | 23.01% | 4,380 |
| | | 11.0 | 11.75 | CONTRIB | 23.11% | 9.92% | 43.99% | 22.98% | 5,148 |
| 155 | | | | RATIOS | 0.9536 | 0.7985 | 0.7577 | 0.8366 | |
| | 13.8 | | | CONTRIB | 18.55% | 56.80% | 15.75% | 8.90% | 4,380 |
| | | 11.0 | 21.31 | CONTRIB | 17.17% | 60.98% | 11.64% | 10.21% | 9,332 |
| 156 | | | | RATIOS | 0.7920 | 0.9358 | 1.0221 | 0.9166 | |
| | 15.6 | | | CONTRIB | 5.37% | 64.39% | 22.45% | 7.79% | 4,380 |
| | | 11.0 | 27.92 | CONTRIB | 7.70% | 68.57% | 13.80% | 9.93% | 12,228 |
| 157 | | | | RATIOS | 1.1158 | 0.4571 | 1.0940 | 0.8890 | |
| | 12.1 | | | CONTRIB | 40.91% | 2.65% | 37.50% | 18.94% | 4,380 |
| | | 11.0 | 12.26 | CONTRIB | 39.70% | 5.16% | 33.64% | 21.50% | 5,368 |
| 158 | | | | RATIOS | 0.7811 | 0.7316 | 0.8371 | 0.7833 | |
| | 12.7 | | | CONTRIB | 11.77% | 55.87% | 22.83% | 9.53% | 4,380 |
| | | 11.0 | 16.14 | CONTRIB | 12.61% | 58.22% | 18.82% | 10.36% | 7,070 |
| 159 | | | | RATIOS | 1.0544 | 0.7969 | 0.7344 | 0.8619 | |
| | 14.1 | | | CONTRIB | 25.06% | 51.71% | 14.09% | 9.14% | 4,380 |
| | | 11.0 | 22.07 | CONTRIB | 19.90% | 58.45% | 10.55% | 11.11% | 9,665 |
| 160 | | | | RATIOS | 0.3159 | 0.8032 | 0.9483 | 0.6892 | |
| | 13.2 | | | CONTRIB | 0.00% | 68.02% | 27.11% | 4.87% | 4,380 |
| | | 11.0 | 17.86 | CONTRIB | 0.01% | 74.35% | 20.03% | 5.61% | 7,822 |
| 161 | | | | RATIOS | 0.8632 | 0.6285 | 0.9107 | 0.8008 | |
| | 12.1 | | | CONTRIB | 20.61% | 37.39% | 29.60% | 12.40% | 4,380 |
| | | 11.0 | 13.62 | CONTRIB | 22.07% | 39.30% | 25.22% | 13.41% | 5,966 |
| 162 | | | | RATIOS | 0.7799 | 0.9572 | 0.4879 | 0.7416 | |
| | 14.6 | | | CONTRIB | 6.65% | 88.43% | 0.66% | 4.26% | 4,380 |
| | | 11.0 | 23.61 | CONTRIB | 8.57% | 82.88% | 2.86% | 5.69% | 10,342 |
| 163 | | | | RATIOS | 1.0699 | 1.0564 | 0.4208 | 0.8490 | |
| | 16.5 | | | CONTRIB | 14.22% | 81.24% | 0.00% | 4.54% | 4,380 |
| | | 11.0 | 28.60 | CONTRIB | 15.76% | 75.35% | 0.82% | 8.07% | 12,527 |
| 164 | | | | RATIOS | 1.0472 | 0.4573 | 0.9248 | 0.8098 | |
| | 11.2 | | | CONTRIB | 42.16% | 5.53% | 34.36% | 17.95% | 4,380 |
| | | 11.0 | 10.37 | CONTRIB | 41.82% | 6.12% | 33.65% | 18.42% | 4,541 |
| 165 | | | | RATIOS | 0.8487 | 0.8923 | 1.0697 | 0.9369 | |
| | 15.3 | | | CONTRIB | 7.75% | 57.60% | 25.53% | 9.12% | 4,380 |
| | | 11.0 | 27.99 | CONTRIB | 10.05% | 65.27% | 14.40% | 10.27% | 12,261 |

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| Loca- tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 166 | | | | RATIOS | 1.1560 | 0.6309 | 0.9572 | 0.9147 | |
| | 13.2 | | | CONTRIB | 37.26% | 20.22% | 27.53% | 14.99% | 4,380 |
| | | 11.0 | 16.99 | CONTRIB | 30.54% | 31.95% | 21.25% | 16.26% | 7,441 |
| 167 | | | | RATIOS | 0.8926 | 0.5244 | 0.9177 | 0.7783 | |
| | 11.1 | | | CONTRIB | 31.86% | 18.21% | 34.28% | 15.65% | 4,380 |
| | | 11.0 | 10.31 | CONTRIB | 31.46% | 19.18% | 33.57% | 15.80% | 4,517 |
| 168 | | | | RATIOS | 0.9136 | 0.8281 | 0.6640 | 0.8019 | |
| | 13.7 | | | CONTRIB | 15.95% | 65.99% | 10.42% | 7.64% | 4,380 |
| | | 11.0 | 21.99 | CONTRIB | 15.39% | 67.63% | 8.62% | 8.35% | 9,630 |
| 169 | | | | RATIOS | 0.7354 | 0.6285 | 0.7173 | 0.6937 | |
| | 11.1 | | | CONTRIB | 15.71% | 52.33% | 21.91% | 10.04% | 4,380 |
| | | 11.0 | 10.21 | CONTRIB | 15.76% | 52.43% | 21.73% | 10.08% | 4,471 |
| 170 | | | | RATIOS | 0.7336 | 0.6775 | 0.6128 | 0.6746 | |
| | 11.4 | | | CONTRIB | 14.06% | 62.76% | 15.09% | 8.09% | 4,380 |
| | | 11.0 | 11.19 | CONTRIB | 14.24% | 63.15% | 14.39% | 8.22% | 4,903 |
| 171 | | | | RATIOS | 0.8152 | 0.6983 | 1.3464 | 0.9533 | |
| | 13.7 | | | CONTRIB | 10.15% | 34.04% | 40.67% | 15.14% | 4,380 |
| | | 11.0 | 18.34 | CONTRIB | 13.11% | 43.11% | 27.63% | 16.14% | 8,033 |
| 172 | | | | RATIOS | 0.8413 | 0.9313 | 0.2806 | 0.6844 | |
| | 14.3 | | | CONTRIB | 9.78% | 87.03% | 0.00% | 3.19% | 4,380 |
| | | 11.0 | 22.75 | CONTRIB | 11.95% | 83.76% | 0.00% | 4.28% | 9,963 |
| 173 | | | | RATIOS | 0.9976 | 0.5471 | 0.7883 | 0.7777 | |
| | 11.3 | | | CONTRIB | 37.74% | 22.33% | 25.40% | 14.53% | 4,380 |
| | | 11.0 | 11.10 | CONTRIB | 35.77% | 25.37% | 24.22% | 14.64% | 4,861 |
| 174 | | | | RATIOS | 0.6460 | 0.5293 | 0.7693 | 0.6482 | |
| | 9.9 | | | CONTRIB | 14.61% | 41.79% | 31.66% | 11.93% | 4,380 |
| | | 11.0 | 6.45 | CONTRIB | 15.04% | 33.14% | 39.66% | 12.16% | 2,825 |
| 175 | | | | RATIOS | 1.1756 | 0.6163 | 0.7668 | 0.8529 | |
| | 12.6 | | | CONTRIB | 41.95% | 24.93% | 19.35% | 13.76% | 4,380 |
| | | 11.0 | 15.22 | CONTRIB | 35.15% | 32.72% | 16.69% | 15.44% | 6,666 |
| 176 | | | | RATIOS | 0.9468 | 0.4708 | 0.8664 | 0.7613 | |
| | 10.6 | | | CONTRIB | 38.39% | 10.71% | 33.81% | 17.08% | 4,380 |
| | | 11.0 | 9.17 | CONTRIB | 39.38% | 8.82% | 35.52% | 16.27% | 4,015 |
| 177 | | | | RATIOS | 0.8695 | 0.3775 | 0.7701 | 0.6724 | |
| | 9.3 | | | CONTRIB | 42.23% | 5.28% | 34.48% | 18.01% | 4,380 |
| | | 11.0 | 6.67 | CONTRIB | 46.34% | 1.65% | 38.40% | 13.60% | 2,923 |
| 178 | | | | RATIOS | 0.4165 | 0.3559 | 1.0187 | 0.5971 | |
| | 7.7 | | | CONTRIB | 6.98% | 15.05% | 54.65% | 23.31% | 4,380 |
| | | 11.0 | 4.51 | CONTRIB | 0.92% | 1.43% | 85.14% | 12.51% | 1,976 |
| 179 | | | | RATIOS | 1.0495 | 0.7717 | 0.9936 | 0.9383 | |
| | 14.5 | | | CONTRIB | 22.19% | 41.59% | 24.69% | 11.54% | 4,380 |
| | | 11.0 | 22.43 | CONTRIB | 19.41% | 51.03% | 16.70% | 12.86% | 9,824 |
| 180 | | | | RATIOS | 1.0438 | 1.1666 | 0.3661 | 0.8589 | |
| | 17.9 | | | CONTRIB | 9.46% | 87.31% | 0.00% | 3.23% | 4,380 |
| | | 11.0 | 30.54 | CONTRIB | 14.11% | 77.76% | 0.21% | 7.91% | 13,376 |

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| Loca-tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 181 | | | | RATIOS | 0.8677 | 0.5379 | 1.0750 | 0.8269 | |
| | 11.5 | | | CONTRIB | 26.13% | 17.37% | 38.89% | 17.61% | 4,380 |
| | | 11.0 | 11.64 | CONTRIB | 26.36% | 21.00% | 34.81% | 17.83% | 5,099 |
| 182 | | | | RATIOS | 1.1170 | 0.7271 | 1.0825 | 0.9755 | |
| | 14.5 | | | CONTRIB | 27.82% | 29.80% | 29.13% | 13.25% | 4,380 |
| | | 11.0 | 21.22 | CONTRIB | 22.98% | 43.29% | 19.23% | 14.50% | 9,293 |
| 183 | | | | RATIOS | 0.8456 | 0.9293 | 0.8977 | 0.8909 | |
| | 15.3 | | | CONTRIB | 7.64% | 67.02% | 17.88% | 7.46% | 4,380 |
| | | 11.0 | 27.82 | CONTRIB | 9.97% | 68.35% | 12.18% | 9.50% | 12,184 |
| 184 | | | | RATIOS | 1.1858 | 0.7277 | 0.6891 | 0.8675 | |
| | 13.7 | | | CONTRIB | 36.42% | 40.73% | 12.43% | 10.42% | 4,380 |
| | | 11.0 | 19.21 | CONTRIB | 28.29% | 47.97% | 10.65% | 13.10% | 8,412 |
| 185 | | | | RATIOS | 0.8187 | 0.3032 | 0.9152 | 0.6790 | |
| | 9.2 | | | CONTRIB | 38.48% | 0.77% | 41.31% | 19.43% | 4,380 |
| | | 11.0 | 6.85 | CONTRIB | 35.71% | 0.08% | 50.42% | 13.79% | 2,999 |
| 186 | | | | RATIOS | 0.5834 | 0.5238 | 1.0015 | 0.7029 | |
| | 10.2 | | | CONTRIB | 8.73% | 35.96% | 40.68% | 14.63% | 4,380 |
| | | 11.0 | 7.47 | CONTRIB | 8.73% | 26.23% | 50.54% | 14.51% | 3,273 |
| 187 | | | | RATIOS | 0.9105 | 0.6538 | 0.9219 | 0.8287 | |
| | 12.6 | | | CONTRIB | 21.93% | 37.69% | 28.13% | 12.25% | 4,380 |
| | | 11.0 | 15.13 | CONTRIB | 22.23% | 40.94% | 22.98% | 13.84% | 6,627 |
| 188 | | | | RATIOS | 1.0017 | 0.4516 | 1.0633 | 0.8389 | |
| | 11.4 | | | CONTRIB | 37.69% | 4.21% | 38.80% | 19.30% | 4,380 |
| | | 11.0 | 10.77 | CONTRIB | 37.12% | 5.27% | 37.20% | 20.41% | 4,719 |
| 189 | | | | RATIOS | 0.9291 | 1.1309 | 0.6497 | 0.9032 | |
| | 17.4 | | | CONTRIB | 6.73% | 86.64% | 1.89% | 4.74% | 4,380 |
| | | 11.0 | 31.04 | CONTRIB | 11.24% | 74.20% | 5.84% | 8.71% | 13,598 |
| 190 | | | | RATIOS | 0.9605 | 0.3585 | 0.9168 | 0.7452 | |
| | 10.2 | | | CONTRIB | 42.63% | 1.39% | 37.34% | 18.64% | 4,380 |
| | | 11.0 | 8.60 | CONTRIB | 43.08% | 0.80% | 40.20% | 15.92% | 3,768 |
| 191 | | | | RATIOS | 1.0784 | 0.3114 | 0.8999 | 0.7632 | |
| | 10.7 | | | CONTRIB | 48.11% | 0.13% | 34.91% | 16.85% | 4,380 |
| | | 11.0 | 9.48 | CONTRIB | 48.22% | 0.09% | 35.80% | 15.89% | 4,154 |
| 192 | | | | RATIOS | 1.2068 | 0.8572 | 0.7771 | 0.9470 | |
| | 15.4 | | | CONTRIB | 29.77% | 48.37% | 12.61% | 9.26% | 4,380 |
| | | 11.0 | 28.04 | CONTRIB | 20.00% | 60.24% | 9.31% | 10.44% | 12,282 |
| 193 | | | | RATIOS | 0.9374 | 0.4481 | 1.0146 | 0.8000 | |
| | 10.9 | | | CONTRIB | 36.26% | 5.91% | 38.72% | 19.11% | 4,380 |
| | | 11.0 | 9.72 | CONTRIB | 36.48% | 5.44% | 39.36% | 18.72% | 4,257 |
| 194 | | | | RATIOS | 1.2225 | 0.4271 | 1.1280 | 0.9259 | |
| | 12.7 | | | CONTRIB | 44.09% | 0.90% | 36.77% | 18.23% | 4,380 |
| | | 11.0 | 13.15 | CONTRIB | 43.66% | 2.59% | 32.31% | 21.44% | 5,761 |
| 195 | | | | RATIOS | 1.1895 | 0.4061 | 0.9211 | 0.8389 | |
| | 11.7 | | | CONTRIB | 48.93% | 1.23% | 32.59% | 17.25% | 4,380 |
| | | 11.0 | 11.35 | CONTRIB | 48.13% | 1.89% | 30.60% | 19.37% | 4,973 |

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| Loca- tion | 10.0% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 196 | | | | RATIOS | 0.7103 | 0.5148 | 1.0986 | 0.7745 | |
| | 10.6 | | | CONTRIB | 16.10% | 22.67% | 42.86% | 18.37% | 4,380 |
| | | 11.0 | 8.84 | CONTRIB | 15.89% | 19.19% | 46.83% | 18.08% | 3,872 |
| 197 | | | | RATIOS | 0.7001 | 0.8217 | 0.9470 | 0.8229 | |
| | 13.8 | | | CONTRIB | 5.22% | 62.05% | 24.54% | 8.18% | 4,380 |
| | | 11.0 | 21.38 | CONTRIB | 6.21% | 67.56% | 16.71% | 9.53% | 9,364 |
| 198 | | | | RATIOS | 1.0584 | 0.8672 | 1.1029 | 1.0095 | |
| | 15.7 | | | CONTRIB | 16.47% | 46.82% | 25.69% | 11.01% | 4,380 |
| | | 11.0 | 29.47 | CONTRIB | 15.00% | 59.84% | 14.10% | 11.06% | 12,907 |
| 199 | | | | RATIOS | 1.0042 | 0.4546 | 0.9905 | 0.8164 | |
| | 11.2 | | | CONTRIB | 39.18% | 5.31% | 36.84% | 18.67% | 4,380 |
| | | 11.0 | 10.33 | CONTRIB | 38.90% | 5.84% | 36.16% | 19.10% | 4,524 |
| 200 | | | | RATIOS | 0.9764 | 0.5869 | 1.4274 | 0.9969 | |
| | 13.2 | | | CONTRIB | 23.60% | 10.83% | 44.67% | 20.90% | 4,380 |
| | | 11.0 | 16.53 | CONTRIB | 23.09% | 25.12% | 32.49% | 19.30% | 7,242 |
| 201 | | | | RATIOS | 0.7124 | 0.8785 | 0.6395 | 0.7435 | |
| | 13.8 | | | CONTRIB | 5.89% | 80.19% | 8.41% | 5.50% | 4,380 |
| | | 11.0 | 22.53 | CONTRIB | 6.31% | 79.87% | 7.80% | 6.02% | 9,868 |
| 202 | | | | RATIOS | 0.5852 | 0.6646 | 0.8248 | 0.6915 | |
| | 11.4 | | | CONTRIB | 5.77% | 57.92% | 27.47% | 8.85% | 4,380 |
| | | 11.0 | 11.20 | CONTRIB | 5.89% | 58.75% | 26.30% | 9.06% | 4,907 |
| 203 | | | | RATIOS | 0.7540 | 0.8250 | 1.5388 | 1.0393 | |
| | 15.5 | | | CONTRIB | 3.81% | 41.62% | 41.27% | 13.30% | 4,380 |
| | | 11.0 | 25.64 | CONTRIB | 6.92% | 57.17% | 22.57% | 13.34% | 11,232 |
| 204 | | | | RATIOS | 0.7397 | 0.9301 | 1.0172 | 0.8957 | |
| | 15.4 | | | CONTRIB | 3.39% | 66.24% | 22.86% | 7.50% | 4,380 |
| | | 11.0 | 27.18 | CONTRIB | 6.06% | 70.02% | 14.11% | 9.82% | 11,903 |
| 205 | | | | RATIOS | 0.9854 | 0.9015 | 1.1448 | 1.0106 | |
| | 16.0 | | | CONTRIB | 11.73% | 51.03% | 26.85% | 10.39% | 4,380 |
| | | 11.0 | 29.92 | CONTRIB | 12.98% | 61.69% | 14.42% | 10.91% | 13,103 |
| 206 | | | | RATIOS | 1.1899 | 0.9338 | 1.0854 | 1.0697 | |
| | 16.8 | | | CONTRIB | 19.94% | 47.84% | 21.65% | 10.57% | 4,380 |
| | | 11.0 | 32.25 | CONTRIB | 16.95% | 59.23% | 12.68% | 11.13% | 14,126 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| Location | 0.011414% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Profile Ratios:* | *1.9610* | *1.9610* | *1.9610* | *1.9610* | |
| 7 | | | | RATIOS | 0.6365 | 0.9774 | 0.6842 | 0.7660 | |
| | 34.0 | | | CONTRIB | 0.00% | 99.65% | 0.05% | 0.31% | 5 |
| | | 36.0 | 0.0044021 | CONTRIB | 0.00% | 99.72% | 0.00% | 0.28% | 2 |
| 8 | | | | RATIOS | 0.4281 | 0.6438 | 0.6805 | 0.5841 | |
| | 23.4 | | | CONTRIB | 0.00% | 44.39% | 54.02% | 1.59% | 5 |
| | | 36.0 | 0.0000042 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 9 | | | | RATIOS | 0.4155 | 0.9111 | 0.4285 | 0.5850 | |
| | 31.6 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0014816 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 1 |
| 10 | | | | RATIOS | 0.7426 | 0.9776 | 0.5042 | 0.7415 | |
| | 34.0 | | | CONTRIB | 0.16% | 99.67% | 0.00% | 0.17% | 5 |
| | | 36.0 | 0.0044172 | CONTRIB | 0.15% | 99.69% | 0.00% | 0.16% | 2 |
| 11 | | | | RATIOS | 0.5457 | 0.5601 | 0.6536 | 0.5865 | |
| | 22.0 | | | CONTRIB | 1.07% | 13.19% | 80.84% | 4.90% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 12 | | | | RATIOS | 0.6397 | 1.2988 | 0.7303 | 0.8896 | |
| | 45.0 | | | CONTRIB | 0.00% | 99.97% | 0.00% | 0.03% | 5 |
| | | 36.0 | 0.1742570 | CONTRIB | 0.00% | 99.90% | 0.00% | 0.09% | 76 |
| 13 | | | | RATIOS | 0.2998 | 0.5142 | 0.9740 | 0.5960 | |
| | 32.6 | | | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 5 |
| | | 36.0 | 0.0016088 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 1 |
| 14 | | | | RATIOS | 0.6326 | 0.8083 | 0.4616 | 0.6342 | |
| | 28.0 | | | CONTRIB | 0.25% | 99.43% | 0.00% | 0.31% | 5 |
| | | 36.0 | 0.0002328 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 15 | | | | RATIOS | 0.5859 | 0.5167 | 0.4840 | 0.5289 | |
| | 18.9 | | | CONTRIB | 41.83% | 41.67% | 4.64% | 11.86% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |

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| 0.011414% Exc. Location | Ground Speed | Criterion Speed Exc. | Criterion % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | RATIOS | 0.7215 | 0.5148 | 0.8764 | 0.7042 | |
| | 29.4 | | | CONTRIB | 1.02% | 0.02% | 98.09% | 0.87% | 5 |
| | | 36.0 | 0.0002123 | CONTRIB | 1.94% | 0.00% | 96.73% | 1.33% | 0 |
| 17 | | | | RATIOS | 0.5406 | 0.4651 | 0.4120 | 0.4726 | |
| | 17.3 | | | CONTRIB | 53.68% | 36.21% | 1.28% | 8.83% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 18 | | | | RATIOS | 0.6973 | 0.8942 | 1.2215 | 0.9377 | |
| | 41.0 | | | CONTRIB | 0.00% | 1.39% | 98.22% | 0.40% | 5 |
| | | 36.0 | 0.0789927 | CONTRIB | 0.00% | 1.40% | 98.08% | 0.51% | 35 |
| 19 | | | | RATIOS | 0.7232 | 0.7277 | 0.8638 | 0.7716 | |
| | 29.0 | | | CONTRIB | 1.15% | 10.45% | 83.72% | 4.68% | 5 |
| | | 36.0 | 0.0002190 | CONTRIB | 1.96% | 20.94% | 70.82% | 6.28% | 0 |
| 20 | | | | RATIOS | 0.5134 | 0.6571 | 0.4479 | 0.5395 | |
| | 22.7 | | | CONTRIB | 0.25% | 99.04% | 0.03% | 0.69% | 5 |
| | | 36.0 | 0.0000066 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 21 | | | | RATIOS | 0.5267 | 0.7256 | 0.5063 | 0.5862 | |
| | 25.1 | | | CONTRIB | 0.07% | 99.36% | 0.05% | 0.52% | 5 |
| | | 36.0 | 0.0000438 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 22 | | | | RATIOS | 0.6671 | 0.6012 | 0.4624 | 0.5769 | |
| | 21.5 | | | CONTRIB | 39.51% | 55.00% | 0.14% | 5.34% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 23 | | | | RATIOS | 0.3967 | 0.6591 | 0.6334 | 0.5631 | |
| | 23.2 | | | CONTRIB | 0.00% | 81.35% | 17.56% | 1.09% | 5 |
| | | 36.0 | 0.0000070 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 24 | | | | RATIOS | 0.8619 | 0.8738 | 1.0536 | 0.9298 | |
| | 35.7 | | | CONTRIB | 0.83% | 8.70% | 86.50% | 3.97% | 5 |
| | | 36.0 | 0.0086347 | CONTRIB | 0.86% | 9.00% | 86.11% | 4.04% | 4 |
| 25 | | | | RATIOS | 0.7152 | 0.9893 | 0.8495 | 0.8513 | |
| | 34.5 | | | CONTRIB | 0.07% | 96.05% | 2.40% | 1.48% | 5 |
| | | 36.0 | 0.0054900 | CONTRIB | 0.07% | 96.52% | 2.04% | 1.38% | 2 |
| 26 | | | | RATIOS | 0.6314 | 0.8713 | 0.8134 | 0.7720 | |
| | 30.5 | | | CONTRIB | 0.06% | 86.73% | 10.99% | 2.22% | 5 |
| | | 36.0 | 0.0008044 | CONTRIB | 0.00% | 92.30% | 5.98% | 1.73% | 0 |
| 27 | | | | RATIOS | 0.7803 | 0.6305 | 0.8475 | 0.7528 | |
| | 28.4 | | | CONTRIB | 5.63% | 1.59% | 88.33% | 4.44% | 5 |
| | | 36.0 | 0.0001334 | CONTRIB | 11.04% | 1.99% | 80.25% | 6.72% | 0 |
| 28 | | | | RATIOS | 0.8213 | 0.6671 | 0.7369 | 0.7418 | |
| | 26.2 | | | CONTRIB | 46.54% | 12.89% | 27.04% | 13.53% | 5 |
| | | 36.0 | 0.0000569 | CONTRIB | 59.40% | 16.07% | 12.33% | 12.20% | 0 |
| 29 | | | | RATIOS | 0.4357 | 0.8189 | 0.5757 | 0.6101 | |
| | 28.3 | | | CONTRIB | 0.00% | 99.82% | 0.05% | 0.13% | 5 |
| | | 36.0 | 0.0002847 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 30 | | | | RATIOS | 0.7869 | 1.1788 | 0.2190 | 0.7282 | |
| | 41.0 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0717368 | CONTRIB | 0.02% | 99.97% | 0.00% | 0.01% | 31 |

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| 0.011414% Exc. Location | Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 31 | | | | RATIOS | 0.9538 | 0.2492 | 0.5793 | 0.5941 | |
| | 28.7 | | | CONTRIB | 99.90% | 0.00% | 0.04% | 0.06% | 5 |
| | | 36.0 | 0.0003839 | CONTRIB | 100.00% | 0.00% | 0.00% | 0.00% | 0 |
| 32 | | | | RATIOS | 0.2741 | 0.5420 | 0.5805 | 0.4655 | |
| | 19.8 | | | CONTRIB | 0.00% | 39.42% | 60.04% | 0.54% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 33 | | | | RATIOS | 0.6442 | 0.4299 | 0.6167 | 0.5636 | |
| | 21.3 | | | CONTRIB | 33.11% | 0.45% | 61.10% | 5.35% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 34 | | | | RATIOS | 1.0456 | 0.7507 | 0.8634 | 0.8866 | |
| | 32.6 | | | CONTRIB | 79.08% | 3.18% | 9.84% | 7.89% | 5 |
| | | 36.0 | 0.0020867 | CONTRIB | 81.76% | 3.55% | 7.37% | 7.32% | 1 |
| 35 | | | | RATIOS | 1.1193 | 0.4579 | 0.5983 | 0.7252 | |
| | 34.3 | | | CONTRIB | 99.89% | 0.00% | 0.00% | 0.11% | 5 |
| | | 36.0 | 0.0051630 | CONTRIB | 99.91% | 0.00% | 0.00% | 0.09% | 2 |
| 36 | | | | RATIOS | 0.2322 | 0.2883 | 0.2806 | 0.2670 | |
| | 10.1 | | | CONTRIB | 0.30% | 74.70% | 20.93% | 4.08% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 37 | | | | RATIOS | 0.6958 | 0.5952 | 0.3720 | 0.5543 | |
| | 22.0 | | | CONTRIB | 60.77% | 37.20% | 0.00% | 2.03% | 5 |
| | | 36.0 | 0.0000023 | CONTRIB | 100.00% | 0.00% | 0.00% | 0.00% | 0 |
| 38 | | | | RATIOS | 1.0515 | 0.3079 | 0.7762 | 0.7118 | |
| | 32.2 | | | CONTRIB | 98.20% | 0.00% | 1.58% | 0.22% | 5 |
| | | 36.0 | 0.0018916 | CONTRIB | 98.80% | 0.00% | 1.02% | 0.18% | 1 |
| 39 | | | | RATIOS | 0.5330 | 0.3675 | 0.8758 | 0.5921 | |
| | 29.1 | | | CONTRIB | 0.00% | 0.00% | 99.96% | 0.04% | 5 |
| | | 36.0 | 0.0002027 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 0 |
| 40 | | | | RATIOS | 0.6430 | 0.3934 | 0.7722 | 0.6029 | |
| | 25.8 | | | CONTRIB | 1.21% | 0.00% | 98.27% | 0.52% | 5 |
| | | 36.0 | 0.0000175 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 0 |
| 41 | | | | RATIOS | 0.6112 | 0.5440 | 0.8205 | 0.6586 | |
| | 27.4 | | | CONTRIB | 0.20% | 0.29% | 98.66% | 0.85% | 5 |
| | | 36.0 | 0.0000569 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 0 |
| 42 | | | | RATIOS | 0.5703 | 0.5707 | 0.4038 | 0.5149 | |
| | 19.8 | | | CONTRIB | 11.47% | 85.46% | 0.05% | 3.02% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 43 | | | | RATIOS | 0.6244 | 0.3324 | 0.7475 | 0.5681 | |
| | 25.0 | | | CONTRIB | 1.28% | 0.00% | 98.39% | 0.33% | 5 |
| | | 36.0 | 0.0000093 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 0 |
| 44 | | | | RATIOS | 0.9478 | 0.6461 | 0.5454 | 0.7131 | |
| | 28.7 | | | CONTRIB | 96.52% | 2.01% | 0.00% | 1.47% | 5 |
| | | 36.0 | 0.0003541 | CONTRIB | 97.73% | 1.28% | 0.00% | 0.99% | 0 |
| 45 | | | | RATIOS | 0.6893 | 0.6028 | 0.5826 | 0.6249 | |
| | 22.3 | | | CONTRIB | 42.46% | 37.22% | 7.35% | 12.97% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |

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| | 0.011414% Exc. | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca-tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 46 | | | | RATIOS | 1.3405 | 0.6438 | 0.8201 | 0.9348 | |
| | 41.1 | | | CONTRIB | 99.59% | 0.00% | 0.04% | 0.37% | 5 |
| | | 36.0 | 0.0359381 | CONTRIB | 98.77% | 0.01% | 0.16% | 1.06% | 16 |
| 47 | | | | RATIOS | 1.2086 | 0.7154 | 0.6422 | 0.8554 | |
| | 37.1 | | | CONTRIB | 99.30% | 0.22% | 0.00% | 0.48% | 5 |
| | | 36.0 | 0.0135821 | CONTRIB | 99.14% | 0.26% | 0.00% | 0.60% | 6 |
| 48 | | | | RATIOS | 0.5605 | 0.9148 | 0.1961 | 0.5571 | |
| | 31.7 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0015781 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 1 |
| 49 | | | | RATIOS | 0.5722 | 0.8487 | 0.5491 | 0.6567 | |
| | 29.4 | | | CONTRIB | 0.02% | 99.73% | 0.00% | 0.25% | 5 |
| | | 36.0 | 0.0004948 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 50 | | | | RATIOS | 0.7101 | 0.5157 | 0.5820 | 0.6026 | |
| | 21.9 | | | CONTRIB | 78.51% | 3.92% | 9.15% | 8.42% | 5 |
| | | 36.0 | 0.0000032 | CONTRIB | 100.00% | 0.00% | 0.00% | 0.00% | 0 |
| 51 | | | | RATIOS | 1.1690 | 0.4263 | 0.6530 | 0.7494 | |
| | 35.7 | | | CONTRIB | 99.91% | 0.00% | 0.00% | 0.09% | 5 |
| | | 36.0 | 0.0098676 | CONTRIB | 99.92% | 0.00% | 0.00% | 0.08% | 4 |
| 52 | | | | RATIOS | 1.2211 | 0.6771 | 0.6454 | 0.8479 | |
| | 37.4 | | | CONTRIB | 99.60% | 0.05% | 0.00% | 0.35% | 5 |
| | | 36.0 | 0.0149143 | CONTRIB | 99.44% | 0.08% | 0.00% | 0.47% | 7 |
| 53 | | | | RATIOS | 0.7567 | 0.7079 | 0.5075 | 0.6574 | |
| | 25.1 | | | CONTRIB | 27.23% | 68.85% | 0.05% | 3.87% | 5 |
| | | 36.0 | 0.0000389 | CONTRIB | 23.04% | 76.96% | 0.00% | 0.00% | 0 |
| 54 | | | | RATIOS | 0.6967 | 0.8073 | 0.4755 | 0.6599 | |
| | 28.0 | | | CONTRIB | 1.22% | 98.15% | 0.00% | 0.63% | 5 |
| | | 36.0 | 0.0002308 | CONTRIB | 1.01% | 98.98% | 0.00% | 0.00% | 0 |
| 55 | | | | RATIOS | 0.8089 | 0.7407 | 0.6799 | 0.7432 | |
| | 26.6 | | | CONTRIB | 30.03% | 54.18% | 4.44% | 11.36% | 5 |
| | | 36.0 | 0.0000938 | CONTRIB | 28.17% | 64.18% | 0.00% | 7.65% | 0 |
| 56 | | | | RATIOS | 0.7293 | 0.7342 | 0.7499 | 0.7378 | |
| | 26.4 | | | CONTRIB | 5.99% | 50.49% | 32.71% | 10.81% | 5 |
| | | 36.0 | 0.0000737 | CONTRIB | 6.67% | 71.36% | 13.38% | 8.59% | 0 |
| 57 | | | | RATIOS | 0.6077 | 0.8877 | 0.6350 | 0.7101 | |
| | 30.8 | | | CONTRIB | 0.03% | 99.46% | 0.07% | 0.44% | 5 |
| | | 36.0 | 0.0009951 | CONTRIB | 0.00% | 99.67% | 0.00% | 0.33% | 0 |
| 58 | | | | RATIOS | 0.4983 | 0.3153 | 0.7387 | 0.5174 | |
| | 24.8 | | | CONTRIB | 0.04% | 0.00% | 99.88% | 0.08% | 5 |
| | | 36.0 | 0.0000074 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 0 |
| 59 | | | | RATIOS | 0.6862 | 0.6310 | 0.3265 | 0.5479 | |
| | 22.4 | | | CONTRIB | 33.87% | 64.99% | 0.00% | 1.14% | 5 |
| | | 36.0 | 0.0000027 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 60 | | | | RATIOS | 0.7579 | 0.7868 | 0.2698 | 0.6048 | |
| | 27.5 | | | CONTRIB | 6.85% | 92.95% | 0.00% | 0.20% | 5 |
| | | 36.0 | 0.0001624 | CONTRIB | 5.66% | 94.34% | 0.00% | 0.00% | 0 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| 0.011414% Exc. Location | Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 61 | | | | RATIOS | 0.4014 | 0.6467 | 0.4020 | 0.4834 | |
| | 22.3 | | | CONTRIB | 0.00% | 99.86% | 0.00% | 0.14% | 5 |
| | | 36.0 | 0.0000046 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 62 | | | | RATIOS | 0.8117 | 0.3059 | 0.5355 | 0.5510 | |
| | 24.8 | | | CONTRIB | 99.57% | 0.00% | 0.19% | 0.24% | 5 |
| | | 36.0 | 0.0000279 | CONTRIB | 100.00% | 0.00% | 0.00% | 0.00% | 0 |
| 63 | | | | RATIOS | 0.4799 | 0.4349 | 0.5803 | 0.4984 | |
| | 19.4 | | | CONTRIB | 1.04% | 1.89% | 94.43% | 2.64% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 64 | | | | RATIOS | 0.5465 | 0.4302 | 0.5777 | 0.5182 | |
| | 19.4 | | | CONTRIB | 8.50% | 1.57% | 84.84% | 5.09% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 65 | | | | RATIOS | 0.5624 | 0.4271 | 0.7595 | 0.5830 | |
| | 25.5 | | | CONTRIB | 0.19% | 0.00% | 99.41% | 0.40% | 5 |
| | | 36.0 | 0.0000126 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 0 |
| 66 | | | | RATIOS | 0.6026 | 0.7979 | 0.7116 | 0.7041 | |
| | 27.8 | | | CONTRIB | 0.13% | 92.75% | 4.90% | 2.22% | 5 |
| | | 36.0 | 0.0001969 | CONTRIB | 0.00% | 96.77% | 1.81% | 1.43% | 0 |
| 67 | | | | RATIOS | 0.9354 | 0.6687 | 0.4336 | 0.6792 | |
| | 28.7 | | | CONTRIB | 95.48% | 3.82% | 0.00% | 0.71% | 5 |
| | | 36.0 | 0.0002893 | CONTRIB | 96.67% | 3.33% | 0.00% | 0.00% | 0 |
| 68 | | | | RATIOS | 0.6397 | 0.6463 | 0.7615 | 0.6825 | |
| | 25.8 | | | CONTRIB | 1.23% | 11.89% | 81.93% | 4.95% | 5 |
| | | 36.0 | 0.0000179 | CONTRIB | 0.00% | 25.64% | 74.36% | 0.00% | 0 |
| 69 | | | | RATIOS | 1.1442 | 0.7218 | 0.8428 | 0.9030 | |
| | 35.3 | | | CONTRIB | 95.14% | 0.54% | 1.40% | 2.92% | 5 |
| | | 36.0 | 0.0077199 | CONTRIB | 95.51% | 0.52% | 1.24% | 2.72% | 3 |
| 70 | | | | RATIOS | 0.4826 | 0.5601 | 0.2406 | 0.4278 | |
| | 19.3 | | | CONTRIB | 1.20% | 98.60% | 0.00% | 0.20% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 71 | | | | RATIOS | 0.2175 | 0.4310 | 0.4802 | 0.3763 | |
| | 16.4 | | | CONTRIB | 0.00% | 25.97% | 73.59% | 0.44% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 72 | | | | RATIOS | 0.5165 | 0.8507 | 0.4597 | 0.6090 | |
| | 29.4 | | | CONTRIB | 0.00% | 99.94% | 0.00% | 0.06% | 5 |
| | | 36.0 | 0.0005128 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 73 | | | | RATIOS | 0.4920 | 0.5518 | 0.2524 | 0.4321 | |
| | 19.1 | | | CONTRIB | 2.06% | 97.64% | 0.00% | 0.30% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 74 | | | | RATIOS | 0.9783 | 0.9772 | 0.6748 | 0.8768 | |
| | 34.3 | | | CONTRIB | 11.76% | 85.52% | 0.03% | 2.69% | 5 |
| | | 36.0 | 0.0050820 | CONTRIB | 11.41% | 86.12% | 0.00% | 2.48% | 2 |
| 75 | | | | RATIOS | 1.1213 | 0.7962 | 0.5701 | 0.8292 | |
| | 34.5 | | | CONTRIB | 95.59% | 3.44% | 0.00% | 0.97% | 5 |
| | | 36.0 | 0.0055390 | CONTRIB | 95.81% | 3.32% | 0.00% | 0.86% | 2 |

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| Loca- tion | 0.011414% Exc. Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 76 | | | | RATIOS | 0.4816 | 0.8707 | 0.5314 | 0.6279 | |
| | 30.3 | | | CONTRIB | 0.00% | 99.93% | 0.00% | 0.07% | 5 |
| | | 36.0 | 0.0007347 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 77 | | | | RATIOS | 0.9764 | 0.7785 | 0.5701 | 0.7750 | |
| | 30.5 | | | CONTRIB | 80.92% | 16.51% | 0.00% | 2.57% | 5 |
| | | 36.0 | 0.0007061 | CONTRIB | 79.46% | 18.44% | 0.00% | 2.10% | 0 |
| 78 | | | | RATIOS | 0.4863 | 1.2427 | 0.7473 | 0.8254 | |
| | 43.2 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.1163090 | CONTRIB | 0.00% | 99.95% | 0.01% | 0.04% | 51 |
| 79 | | | | RATIOS | 1.0154 | 0.8126 | 1.1368 | 0.9883 | |
| | 38.2 | | | CONTRIB | 3.64% | 0.91% | 92.23% | 3.22% | 5 |
| | | 36.0 | 0.0349742 | CONTRIB | 3.03% | 0.72% | 93.38% | 2.87% | 15 |
| 80 | | | | RATIOS | 0.8560 | 1.0434 | 1.0364 | 0.9786 | |
| | 37.3 | | | CONTRIB | 0.37% | 68.52% | 26.61% | 4.50% | 5 |
| | | 36.0 | 0.0183797 | CONTRIB | 0.36% | 65.71% | 29.33% | 4.60% | 8 |
| 81 | | | | RATIOS | 1.5260 | 0.8513 | 1.1482 | 1.1752 | |
| | 46.9 | | | CONTRIB | 95.80% | 0.06% | 2.18% | 1.96% | 5 |
| | | 36.0 | 0.1748840 | CONTRIB | 66.72% | 0.30% | 22.67% | 10.32% | 77 |
| 82 | | | | RATIOS | 0.7968 | 1.2713 | 0.2569 | 0.7750 | |
| | 44.3 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.1432210 | CONTRIB | 0.01% | 99.98% | 0.00% | 0.01% | 63 |
| 83 | | | | RATIOS | 1.0068 | 0.4130 | 0.5857 | 0.6685 | |
| | 30.5 | | | CONTRIB | 99.82% | 0.00% | 0.00% | 0.18% | 5 |
| | | 36.0 | 0.0009229 | CONTRIB | 100.00% | 0.00% | 0.00% | 0.00% | 0 |
| 84 | | | | RATIOS | 0.8573 | 0.9736 | 0.5587 | 0.7966 | |
| | 33.9 | | | CONTRIB | 1.68% | 97.69% | 0.00% | 0.63% | 5 |
| | | 36.0 | 0.0042301 | CONTRIB | 1.61% | 97.83% | 0.00% | 0.56% | 2 |
| 85 | | | | RATIOS | 1.0252 | 0.6779 | 0.5756 | 0.7596 | |
| | 31.4 | | | CONTRIB | 97.76% | 1.19% | 0.00% | 1.05% | 5 |
| | | 36.0 | 0.0012626 | CONTRIB | 98.14% | 1.03% | 0.00% | 0.83% | 1 |
| 86 | | | | RATIOS | 0.7413 | 0.6909 | 0.3814 | 0.6045 | |
| | 24.4 | | | CONTRIB | 29.19% | 69.41% | 0.00% | 1.40% | 5 |
| | | 36.0 | 0.0000260 | CONTRIB | 24.59% | 75.41% | 0.00% | 0.00% | 0 |
| 87 | | | | RATIOS | 0.6814 | 0.7897 | 0.4340 | 0.6350 | |
| | 27.5 | | | CONTRIB | 1.22% | 98.31% | 0.00% | 0.47% | 5 |
| | | 36.0 | 0.0001623 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 88 | | | | RATIOS | 0.4514 | 1.0017 | 1.0248 | 0.8260 | |
| | 36.1 | | | CONTRIB | 0.00% | 59.66% | 39.92% | 0.41% | 5 |
| | | 36.0 | 0.0107961 | CONTRIB | 0.00% | 59.47% | 40.12% | 0.41% | 5 |
| 89 | | | | RATIOS | 0.4861 | 1.0136 | 1.0097 | 0.8365 | |
| | 36.1 | | | CONTRIB | 0.00% | 70.17% | 29.32% | 0.51% | 5 |
| | | 36.0 | 0.0110134 | CONTRIB | 0.00% | 70.04% | 29.45% | 0.51% | 5 |
| 90 | | | | RATIOS | 0.7328 | 0.7620 | 0.9527 | 0.8158 | |
| | 32.0 | | | CONTRIB | 0.32% | 5.14% | 92.06% | 2.48% | 5 |
| | | 36.0 | 0.0011791 | CONTRIB | 0.45% | 7.93% | 88.55% | 3.07% | 1 |

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| 0.011414% Exc. | | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca-tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 91 | | | | RATIOS | 0.6430 | 0.4797 | 0.5355 | 0.5527 | |
| | 20.1 | | | CONTRIB | 74.40% | 5.43% | 10.79% | 9.38% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 92 | | | | RATIOS | 0.5756 | 0.8750 | 0.4183 | 0.6229 | |
| | 30.3 | | | CONTRIB | 0.00% | 99.94% | 0.00% | 0.06% | 5 |
| | | 36.0 | 0.0007930 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 93 | | | | RATIOS | 0.5840 | 1.2086 | 0.3089 | 0.7005 | |
| | 42.1 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0901180 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 39 |
| 94 | | | | RATIOS | 0.4783 | 0.9709 | 0.4879 | 0.6457 | |
| | 33.8 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0039613 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 2 |
| 95 | | | | RATIOS | 0.6977 | 0.5991 | 0.5505 | 0.6158 | |
| | 22.3 | | | CONTRIB | 52.78% | 34.47% | 2.49% | 10.26% | 5 |
| | | 36.0 | 0.0000024 | CONTRIB | 100.00% | 0.00% | 0.00% | 0.00% | 0 |
| 96 | | | | RATIOS | 0.4216 | 0.7677 | 0.5144 | 0.5679 | |
| | 26.5 | | | CONTRIB | 0.00% | 99.86% | 0.02% | 0.11% | 5 |
| | | 36.0 | 0.0001049 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 97 | | | | RATIOS | 0.6511 | 0.6850 | 0.5722 | 0.6361 | |
| | 23.9 | | | CONTRIB | 5.25% | 88.33% | 1.30% | 5.12% | 5 |
| | | 36.0 | 0.0000163 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 98 | | | | RATIOS | 1.0160 | 0.5644 | 1.1537 | 0.9113 | |
| | 38.7 | | | CONTRIB | 2.99% | 0.00% | 96.38% | 0.64% | 5 |
| | | 36.0 | 0.0448251 | CONTRIB | 2.39% | 0.00% | 97.06% | 0.55% | 20 |
| 99 | | | | RATIOS | 0.7881 | 0.6403 | 1.0913 | 0.8399 | |
| | 36.6 | | | CONTRIB | 0.12% | 0.02% | 99.44% | 0.42% | 5 |
| | | 36.0 | 0.0148177 | CONTRIB | 0.12% | 0.03% | 99.45% | 0.40% | 6 |
| 100 | | | | RATIOS | 0.7105 | 1.0325 | 0.3795 | 0.7075 | |
| | 35.9 | | | CONTRIB | 0.03% | 99.94% | 0.00% | 0.03% | 5 |
| | | 36.0 | 0.0102605 | CONTRIB | 0.03% | 99.94% | 0.00% | 0.03% | 4 |
| 101 | | | | RATIOS | 0.5975 | 0.7981 | 0.7626 | 0.7194 | |
| | 28.0 | | | CONTRIB | 0.10% | 81.11% | 16.01% | 2.78% | 5 |
| | | 36.0 | 0.0002090 | CONTRIB | 0.00% | 91.50% | 6.55% | 1.96% | 0 |
| 102 | | | | RATIOS | 0.5461 | 1.0629 | 0.4561 | 0.6884 | |
| | 37.0 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0160623 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 7 |
| 103 | | | | RATIOS | 0.4761 | 0.9958 | 0.5493 | 0.6737 | |
| | 34.7 | | | CONTRIB | 0.00% | 99.98% | 0.00% | 0.02% | 5 |
| | | 36.0 | 0.0058610 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 3 |
| 104 | | | | RATIOS | 0.6697 | 0.7479 | 0.3818 | 0.5998 | |
| | 25.9 | | | CONTRIB | 2.20% | 97.35% | 0.00% | 0.45% | 5 |
| | | 36.0 | 0.0000700 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 105 | | | | RATIOS | 0.5430 | 0.7193 | 0.4191 | 0.5605 | |
| | 24.9 | | | CONTRIB | 0.14% | 99.58% | 0.00% | 0.28% | 5 |
| | | 36.0 | 0.0000383 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |

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| 0.011414% Exc. | | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca- tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 106 | | | | RATIOS | 0.5075 | 0.7652 | 0.4695 | 0.5807 | |
| | 26.4 | | | CONTRIB | 0.00% | 99.82% | 0.00% | 0.18% | 5 |
| | | 36.0 | 0.0000996 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 107 | | | | RATIOS | 1.0389 | 0.7354 | 0.7036 | 0.8260 | |
| | 32.0 | | | CONTRIB | 93.27% | 3.17% | 0.27% | 3.29% | 5 |
| | | 36.0 | 0.0016393 | CONTRIB | 93.81% | 3.29% | 0.17% | 2.73% | 1 |
| 108 | | | | RATIOS | 0.5967 | 0.8823 | 1.0274 | 0.8354 | |
| | 34.7 | | | CONTRIB | 0.00% | 14.49% | 84.57% | 0.94% | 5 |
| | | 36.0 | 0.0055015 | CONTRIB | 0.00% | 16.38% | 82.63% | 0.99% | 2 |
| 109 | | | | RATIOS | 0.7593 | 0.8105 | 0.9646 | 0.8448 | |
| | 32.5 | | | CONTRIB | 0.44% | 10.36% | 85.78% | 3.42% | 5 |
| | | 36.0 | 0.0016497 | CONTRIB | 0.57% | 14.70% | 80.71% | 4.01% | 1 |
| 110 | | | | RATIOS | 0.5301 | 0.9270 | 0.4051 | 0.6207 | |
| | 32.2 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0019357 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 1 |
| 111 | | | | RATIOS | 0.4624 | 0.4691 | 0.6895 | 0.5403 | |
| | 23.0 | | | CONTRIB | 0.04% | 0.44% | 98.97% | 0.56% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| 112 | | | | RATIOS | 0.4893 | 0.7938 | 0.4240 | 0.5690 | |
| | 27.6 | | | CONTRIB | 0.00% | 99.93% | 0.00% | 0.07% | 5 |
| | | 36.0 | 0.0001759 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 113 | | | | RATIOS | 0.4685 | 0.8695 | 0.4706 | 0.6029 | |
| | 30.2 | | | CONTRIB | 0.00% | 99.96% | 0.00% | 0.04% | 5 |
| | | 36.0 | 0.0007195 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 114 | | | | RATIOS | 0.6003 | 0.8689 | 0.6048 | 0.6913 | |
| | 30.2 | | | CONTRIB | 0.03% | 99.53% | 0.04% | 0.40% | 5 |
| | | 36.0 | 0.0007120 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 115 | | | | RATIOS | 0.6234 | 0.7530 | 0.5585 | 0.6450 | |
| | 26.1 | | | CONTRIB | 0.62% | 97.82% | 0.15% | 1.41% | 5 |
| | | 36.0 | 0.0000778 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 116 | | | | RATIOS | 0.4522 | 0.8232 | 0.4646 | 0.5800 | |
| | 28.5 | | | CONTRIB | 0.00% | 99.95% | 0.00% | 0.05% | 5 |
| | | 36.0 | 0.0003088 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 117 | | | | RATIOS | 0.6673 | 0.9403 | 0.8517 | 0.8198 | |
| | 32.8 | | | CONTRIB | 0.05% | 91.72% | 6.46% | 1.77% | 5 |
| | | 36.0 | 0.0025712 | CONTRIB | 0.00% | 93.90% | 4.58% | 1.53% | 1 |
| 118 | | | | RATIOS | 0.6603 | 0.8219 | 1.1180 | 0.8667 | |
| | 37.5 | | | CONTRIB | 0.00% | 1.47% | 98.07% | 0.47% | 5 |
| | | 36.0 | 0.0239925 | CONTRIB | 0.00% | 1.25% | 98.32% | 0.43% | 10 |
| 119 | | | | RATIOS | 0.6540 | 0.7554 | 1.0517 | 0.8204 | |
| | 35.4 | | | CONTRIB | 0.00% | 1.04% | 98.43% | 0.53% | 5 |
| | | 36.0 | 0.0072919 | CONTRIB | 0.00% | 1.12% | 98.33% | 0.55% | 3 |
| 120 | | | | RATIOS | 0.5463 | 0.6110 | 0.6591 | 0.6055 | |
| | 22.5 | | | CONTRIB | 0.73% | 34.71% | 58.99% | 5.57% | 5 |
| | | 36.0 | 0.0000000 | CONTRIB | 0.00% | 0.00% | 0.00% | 0.00% | 0 |

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| 0.011414% Exc. | | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca- tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 121 | | | | RATIOS | 0.6197 | 0.7428 | 0.4806 | 0.6144 | |
| | 25.8 | | | CONTRIB | 0.71% | 98.52% | 0.00% | 0.77% | 5 |
| | | 36.0 | 0.0000630 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 122 | | | | RATIOS | 0.9268 | 0.5140 | 0.8126 | 0.7511 | |
| | 29.2 | | | CONTRIB | 69.71% | 0.03% | 27.11% | 3.15% | 5 |
| | | 36.0 | 0.0002964 | CONTRIB | 81.17% | 0.00% | 15.92% | 2.91% | 0 |
| 123 | | | | RATIOS | 0.7948 | 0.4263 | 1.2152 | 0.8121 | |
| | 40.8 | | | CONTRIB | 0.02% | 0.00% | 99.94% | 0.04% | 5 |
| | | 36.0 | 0.0739457 | CONTRIB | 0.03% | 0.00% | 99.93% | 0.05% | 32 |
| 124 | | | | RATIOS | 0.8303 | 0.5522 | 0.9930 | 0.7919 | |
| | 33.3 | | | CONTRIB | 1.30% | 0.00% | 97.94% | 0.76% | 5 |
| | | 36.0 | 0.0024070 | CONTRIB | 1.68% | 0.00% | 97.43% | 0.90% | 1 |
| 125 | | | | RATIOS | 0.8750 | 1.1974 | 0.9236 | 0.9987 | |
| | 41.7 | | | CONTRIB | 0.08% | 98.72% | 0.31% | 0.89% | 5 |
| | | 36.0 | 0.0846418 | CONTRIB | 0.11% | 97.79% | 0.68% | 1.42% | 37 |
| 126 | | | | RATIOS | 1.0497 | 0.6022 | 1.0764 | 0.9094 | |
| | 36.5 | | | CONTRIB | 14.13% | 0.00% | 84.05% | 1.82% | 5 |
| | | 36.0 | 0.0133293 | CONTRIB | 13.64% | 0.00% | 84.57% | 1.78% | 6 |
| 127 | | | | RATIOS | 0.6059 | 0.7260 | 0.4463 | 0.5927 | |
| | 25.1 | | | CONTRIB | 0.72% | 98.66% | 0.00% | 0.62% | 5 |
| | | 36.0 | 0.0000442 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 128 | | | | RATIOS | 0.6214 | 0.8022 | 0.5328 | 0.6522 | |
| | 27.8 | | | CONTRIB | 0.21% | 99.21% | 0.00% | 0.58% | 5 |
| | | 36.0 | 0.0002071 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 0 |
| 129 | | | | RATIOS | 0.6438 | 0.6809 | 0.9656 | 0.7634 | |
| | 32.4 | | | CONTRIB | 0.03% | 0.78% | 98.52% | 0.66% | 5 |
| | | 36.0 | 0.0013838 | CONTRIB | 0.00% | 1.03% | 98.14% | 0.83% | 1 |
| 130 | | | | RATIOS | 0.8907 | 0.6695 | 0.5224 | 0.6942 | |
| | 27.5 | | | CONTRIB | 90.26% | 7.57% | 0.00% | 2.18% | 5 |
| | | 36.0 | 0.0001361 | CONTRIB | 92.74% | 7.26% | 0.00% | 0.00% | 0 |
| 131 | | | | RATIOS | 0.8438 | 0.5644 | 0.6901 | 0.6994 | |
| | 26.0 | | | CONTRIB | 83.48% | 1.17% | 9.37% | 5.98% | 5 |
| | | 36.0 | 0.0000550 | CONTRIB | 95.44% | 0.00% | 0.00% | 4.56% | 0 |
| 132 | | | | RATIOS | 0.7495 | 0.2528 | 1.4139 | 0.8054 | |
| | 47.4 | | | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 5 |
| | | 36.0 | 0.2975500 | CONTRIB | 0.00% | 0.00% | 99.99% | 0.01% | 130 |
| 133 | | | | RATIOS | 0.8044 | 0.2592 | 1.2554 | 0.7730 | |
| | 42.1 | | | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 5 |
| | | 36.0 | 0.0997212 | CONTRIB | 0.02% | 0.00% | 99.96% | 0.01% | 44 |
| 134 | | | | RATIOS | 0.8381 | 0.6473 | 1.1015 | 0.8623 | |
| | 37.0 | | | CONTRIB | 0.29% | 0.02% | 99.13% | 0.56% | 5 |
| | | 36.0 | 0.0178100 | CONTRIB | 0.26% | 0.03% | 99.18% | 0.53% | 8 |
| 135 | | | | RATIOS | 0.6652 | 1.0660 | 0.8501 | 0.8604 | |
| | 37.2 | | | CONTRIB | 0.00% | 98.91% | 0.59% | 0.50% | 5 |
| | | 36.0 | 0.0170160 | CONTRIB | 0.00% | 98.80% | 0.67% | 0.53% | 7 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| 0.011414% Exc. | | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca- tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 136 | | | | RATIOS | 1.1648 | 0.8338 | 0.8856 | 0.9614 | |
| | 36.1 | | | CONTRIB | 88.61% | 3.44% | 2.28% | 5.67% | 5 |
| | | 36.0 | 0.0107895 | CONTRIB | 88.41% | 3.49% | 2.33% | 5.77% | 5 |
| 137 | | | | RATIOS | 0.9436 | 0.6293 | 1.2797 | 0.9509 | |
| | 42.9 | | | CONTRIB | 0.17% | 0.00% | 99.60% | 0.23% | 5 |
| | | 36.0 | 0.1197630 | CONTRIB | 0.27% | 0.00% | 99.30% | 0.43% | 52 |
| 138 | | | | RATIOS | 1.0566 | 0.7977 | 0.7677 | 0.8740 | |
| | 32.7 | | | CONTRIB | 85.60% | 7.68% | 0.93% | 5.79% | 5 |
| | | 36.0 | 0.0023462 | CONTRIB | 86.16% | 8.09% | 0.66% | 5.08% | 1 |
| 139 | | | | RATIOS | 0.4344 | 1.0366 | 0.5726 | 0.6812 | |
| | 36.1 | | | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| | | 36.0 | 0.0109051 | CONTRIB | 0.00% | 100.00% | 0.00% | 0.00% | 5 |
| 140 | | | | RATIOS | 1.0756 | 1.0101 | 0.9666 | 1.0174 | |
| | 36.4 | | | CONTRIB | 20.70% | 56.44% | 10.28% | 12.59% | 5 |
| | | 36.0 | 0.0130559 | CONTRIB | 20.69% | 55.98% | 10.61% | 12.72% | 6 |
| 141 | | | | RATIOS | 0.7467 | 0.9968 | 0.7940 | 0.8458 | |
| | 34.7 | | | CONTRIB | 0.12% | 98.12% | 0.57% | 1.19% | 5 |
| | | 36.0 | 0.0060560 | CONTRIB | 0.12% | 98.27% | 0.50% | 1.12% | 3 |
| 142 | | | | RATIOS | 0.6511 | 1.1421 | 1.1799 | 0.9910 | |
| | 41.2 | | | CONTRIB | 0.00% | 54.86% | 44.22% | 0.92% | 5 |
| | | 36.0 | 0.1062270 | CONTRIB | 0.00% | 45.97% | 53.04% | 0.99% | 47 |
| 143 | | | | RATIOS | 0.6660 | 1.0242 | 0.9819 | 0.8907 | |
| | 36.2 | | | CONTRIB | 0.00% | 81.82% | 16.69% | 1.48% | 5 |
| | | 36.0 | 0.0111061 | CONTRIB | 0.00% | 81.57% | 16.94% | 1.49% | 5 |
| 144 | | | | RATIOS | 1.1611 | 0.6142 | 0.9170 | 0.8974 | |
| | 35.8 | | | CONTRIB | 92.84% | 0.00% | 5.20% | 1.96% | 5 |
| | | 36.0 | 0.0099425 | CONTRIB | 93.11% | 0.00% | 4.99% | 1.90% | 4 |
| 145 | | | | RATIOS | 0.9548 | 1.2609 | 0.8999 | 1.0385 | |
| | 43.9 | | | CONTRIB | 0.15% | 99.07% | 0.07% | 0.72% | 5 |
| | | 36.0 | 0.1359320 | CONTRIB | 0.29% | 97.72% | 0.25% | 1.74% | 60 |
| 146 | | | | RATIOS | 0.8517 | 0.9638 | 0.8505 | 0.8887 | |
| | 33.7 | | | CONTRIB | 1.63% | 90.02% | 3.78% | 4.57% | 5 |
| | | 36.0 | 0.0038732 | CONTRIB | 1.57% | 91.36% | 2.96% | 4.11% | 2 |
| 147 | | | | RATIOS | 0.9676 | 0.8175 | 1.5733 | 1.1195 | |
| | 52.8 | | | CONTRIB | 0.00% | 0.00% | 99.89% | 0.11% | 5 |
| | | 36.0 | 0.6388400 | CONTRIB | 0.08% | 0.04% | 98.52% | 1.36% | 280 |
| 148 | | | | RATIOS | 0.7618 | 1.1213 | 0.6209 | 0.8347 | |
| | 39.0 | | | CONTRIB | 0.03% | 99.85% | 0.00% | 0.13% | 5 |
| | | 36.0 | 0.0368192 | CONTRIB | 0.03% | 99.83% | 0.00% | 0.15% | 16 |
| 149 | | | | RATIOS | 0.8556 | 0.6012 | 1.1036 | 0.8535 | |
| | 37.1 | | | CONTRIB | 0.39% | 0.00% | 99.16% | 0.45% | 5 |
| | | 36.0 | 0.0184955 | CONTRIB | 0.36% | 0.00% | 99.22% | 0.43% | 8 |
| 150 | | | | RATIOS | 1.0987 | 0.3765 | 0.7783 | 0.7512 | |
| | 33.6 | | | CONTRIB | 98.98% | 0.00% | 0.74% | 0.27% | 5 |
| | | 36.0 | 0.0038448 | CONTRIB | 99.25% | 0.00% | 0.53% | 0.22% | 2 |

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The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| 0.011414% Exc. Location | Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 151 | | | | RATIOS | 1.1036 | 0.5275 | 0.9048 | 0.8453 | |
| | 34.2 | | | CONTRIB | 88.42% | 0.00% | 10.02% | 1.56% | 5 |
| | | 36.0 | 0.0045514 | CONTRIB | 90.12% | 0.00% | 8.41% | 1.47% | 2 |
| 152 | | | | RATIOS | 0.5859 | 0.8368 | 0.7238 | 0.7155 | |
| | 29.2 | | | CONTRIB | 0.04% | 95.85% | 2.78% | 1.33% | 5 |
| | | 36.0 | 0.0004060 | CONTRIB | 0.00% | 97.87% | 1.22% | 0.92% | 0 |
| 153 | | | | RATIOS | 0.8262 | 1.2756 | 1.0811 | 1.0610 | |
| | 44.4 | | | CONTRIB | 0.00% | 97.27% | 1.90% | 0.83% | 5 |
| | | 36.0 | 0.1634310 | CONTRIB | 0.02% | 90.37% | 7.51% | 2.10% | 72 |
| 154 | | | | RATIOS | 0.8411 | 0.4920 | 1.3737 | 0.9023 | |
| | 46.1 | | | CONTRIB | 0.00% | 0.00% | 99.97% | 0.03% | 5 |
| | | 36.0 | 0.2284340 | CONTRIB | 0.02% | 0.00% | 99.89% | 0.09% | 100 |
| 155 | | | | RATIOS | 0.9536 | 0.7985 | 0.7577 | 0.8366 | |
| | 30.1 | | | CONTRIB | 59.77% | 26.26% | 3.36% | 10.61% | 5 |
| | | 36.0 | 0.0006433 | CONTRIB | 59.48% | 29.96% | 1.88% | 8.69% | 0 |
| 156 | | | | RATIOS | 0.7920 | 0.9358 | 1.0221 | 0.9166 | |
| | 35.1 | | | CONTRIB | 0.27% | 31.61% | 64.10% | 4.02% | 5 |
| | | 36.0 | 0.0066430 | CONTRIB | 0.28% | 33.74% | 61.88% | 4.10% | 3 |
| 157 | | | | RATIOS | 1.1158 | 0.4571 | 1.0940 | 0.8890 | |
| | 37.2 | | | CONTRIB | 25.86% | 0.00% | 73.33% | 0.81% | 5 |
| | | 36.0 | 0.0205371 | CONTRIB | 23.86% | 0.00% | 75.36% | 0.78% | 9 |
| 158 | | | | RATIOS | 0.7811 | 0.7316 | 0.8371 | 0.7833 | |
| | 28.4 | | | CONTRIB | 5.74% | 15.92% | 69.47% | 8.86% | 5 |
| | | 36.0 | 0.0001668 | CONTRIB | 8.97% | 29.87% | 50.46% | 10.70% | 0 |
| 159 | | | | RATIOS | 1.0544 | 0.7969 | 0.7344 | 0.8619 | |
| | 32.7 | | | CONTRIB | 87.07% | 7.83% | 0.41% | 4.70% | 5 |
| | | 36.0 | 0.0022427 | CONTRIB | 87.19% | 8.34% | 0.29% | 4.18% | 1 |
| 160 | | | | RATIOS | 0.3159 | 0.8032 | 0.9483 | 0.6892 | |
| | 31.9 | | | CONTRIB | 0.00% | 12.00% | 87.87% | 0.14% | 5 |
| | | 36.0 | 0.0011668 | CONTRIB | 0.00% | 18.09% | 81.91% | 0.00% | 1 |
| 161 | | | | RATIOS | 0.8632 | 0.6285 | 0.9107 | 0.8008 | |
| | 30.6 | | | CONTRIB | 8.97% | 0.49% | 86.84% | 3.70% | 5 |
| | | 36.0 | 0.0005387 | CONTRIB | 14.10% | 0.46% | 80.58% | 4.86% | 0 |
| 162 | | | | RATIOS | 0.7799 | 0.9572 | 0.4879 | 0.7416 | |
| | 33.3 | | | CONTRIB | 0.48% | 99.26% | 0.00% | 0.25% | 5 |
| | | 36.0 | 0.0031997 | CONTRIB | 0.46% | 99.33% | 0.00% | 0.22% | 1 |
| 163 | | | | RATIOS | 1.0699 | 1.0564 | 0.4208 | 0.8490 | |
| | 37.2 | | | CONTRIB | 14.13% | 85.47% | 0.00% | 0.40% | 5 |
| | | 36.0 | 0.0171642 | CONTRIB | 14.44% | 85.14% | 0.00% | 0.42% | 8 |
| 164 | | | | RATIOS | 1.0472 | 0.4573 | 0.9248 | 0.8098 | |
| | 32.9 | | | CONTRIB | 68.15% | 0.00% | 30.49% | 1.36% | 5 |
| | | 36.0 | 0.0023657 | CONTRIB | 73.89% | 0.00% | 24.76% | 1.34% | 1 |
| 165 | | | | RATIOS | 0.8487 | 0.8923 | 1.0697 | 0.9369 | |
| | 36.2 | | | CONTRIB | 0.51% | 9.48% | 86.53% | 3.48% | 5 |
| | | 36.0 | 0.0115158 | CONTRIB | 0.50% | 9.31% | 86.73% | 3.45% | 5 |

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| 0.011414% Exc. | | ---Criterion--- | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Loca- tion | Ground Speed | Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
| 166 | | | | RATIOS | 1.1560 | 0.6309 | 0.9572 | 0.9147 | |
| | 35.9 | | | CONTRIB | 85.97% | 0.03% | 11.40% | 2.60% | 5 |
| | | 36.0 | 0.0101160 | CONTRIB | 86.06% | 0.03% | 11.32% | 2.59% | 4 |
| 167 | | | | RATIOS | 0.8926 | 0.5244 | 0.9177 | 0.7783 | |
| | 31.0 | | | CONTRIB | 13.48% | 0.00% | 84.58% | 1.94% | 5 |
| | | 36.0 | 0.0006514 | CONTRIB | 20.09% | 0.00% | 77.46% | 2.45% | 0 |
| 168 | | | | RATIOS | 0.9136 | 0.8281 | 0.6640 | 0.8019 | |
| | 29.7 | | | CONTRIB | 36.85% | 56.43% | 0.33% | 6.39% | 5 |
| | | 36.0 | 0.0005561 | CONTRIB | 34.31% | 60.86% | 0.00% | 4.82% | 0 |
| 169 | | | | RATIOS | 0.7354 | 0.6285 | 0.7173 | 0.6937 | |
| | 24.7 | | | CONTRIB | 21.17% | 13.37% | 53.08% | 12.38% | 5 |
| | | 36.0 | 0.0000123 | CONTRIB | 45.88% | 20.26% | 33.86% | 0.00% | 0 |
| 170 | | | | RATIOS | 0.7336 | 0.6775 | 0.6128 | 0.6746 | |
| | 24.2 | | | CONTRIB | 27.93% | 57.77% | 3.61% | 10.70% | 5 |
| | | 36.0 | 0.0000182 | CONTRIB | 29.67% | 70.33% | 0.00% | 0.00% | 0 |
| 171 | | | | RATIOS | 0.8152 | 0.6983 | 1.3464 | 0.9533 | |
| | 45.1 | | | CONTRIB | 0.00% | 0.00% | 99.90% | 0.10% | 5 |
| | | 36.0 | 0.1903420 | CONTRIB | 0.02% | 0.01% | 99.69% | 0.28% | 83 |
| 172 | | | | RATIOS | 0.8413 | 0.9313 | 0.2806 | 0.6844 | |
| | 32.5 | | | CONTRIB | 2.53% | 97.37% | 0.00% | 0.10% | 5 |
| | | 36.0 | 0.0021298 | CONTRIB | 2.35% | 97.65% | 0.00% | 0.00% | 1 |
| 173 | | | | RATIOS | 0.9976 | 0.5471 | 0.7883 | 0.7777 | |
| | 30.7 | | | CONTRIB | 92.30% | 0.04% | 5.36% | 2.30% | 5 |
| | | 36.0 | 0.0008368 | CONTRIB | 95.00% | 0.00% | 3.12% | 1.88% | 0 |
| 174 | | | | RATIOS | 0.6460 | 0.5293 | 0.7693 | 0.6482 | |
| | 25.7 | | | CONTRIB | 1.36% | 0.51% | 96.21% | 1.93% | 5 |
| | | 36.0 | 0.0000162 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 0 |
| 175 | | | | RATIOS | 1.1756 | 0.6163 | 0.7668 | 0.8529 | |
| | 36.0 | | | CONTRIB | 99.10% | 0.00% | 0.15% | 0.75% | 5 |
| | | 36.0 | 0.0104913 | CONTRIB | 99.11% | 0.00% | 0.14% | 0.74% | 5 |
| 176 | | | | RATIOS | 0.9468 | 0.4708 | 0.8664 | 0.7613 | |
| | 30.3 | | | CONTRIB | 52.98% | 0.00% | 44.96% | 2.05% | 5 |
| | | 36.0 | 0.0005154 | CONTRIB | 66.02% | 0.00% | 31.86% | 2.12% | 0 |
| 177 | | | | RATIOS | 0.8695 | 0.3775 | 0.7701 | 0.6724 | |
| | 27.4 | | | CONTRIB | 67.10% | 0.00% | 31.55% | 1.34% | 5 |
| | | 36.0 | 0.0001020 | CONTRIB | 83.78% | 0.00% | 16.22% | 0.00% | 0 |
| 178 | | | | RATIOS | 0.4165 | 0.3559 | 1.0187 | 0.5971 | |
| | 34.1 | | | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 5 |
| | | 36.0 | 0.0038570 | CONTRIB | 0.00% | 0.00% | 100.00% | 0.00% | 2 |
| 179 | | | | RATIOS | 1.0495 | 0.7717 | 0.9936 | 0.9383 | |
| | 34.5 | | | CONTRIB | 35.67% | 2.16% | 53.76% | 8.42% | 5 |
| | | 36.0 | 0.0047069 | CONTRIB | 38.52% | 2.41% | 50.40% | 8.67% | 2 |
| 180 | | | | RATIOS | 1.0438 | 1.1666 | 0.3661 | 0.8589 | |
| | 40.6 | | | CONTRIB | 2.18% | 97.72% | 0.00% | 0.10% | 5 |
| | | 36.0 | 0.0669737 | CONTRIB | 2.48% | 97.39% | 0.00% | 0.13% | 29 |

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| 0.011414% Exc. Loca-tion | Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 181 | | | | RATIOS | 0.8677 | 0.5379 | 1.0750 | 0.8269 | |
| | 36.1 | | | CONTRIB | 0.75% | 0.00% | 98.84% | 0.41% | 5 |
| | | 36.0 | 0.0111250 | CONTRIB | 0.74% | 0.00% | 98.85% | 0.41% | 5 |
| 182 | | | | RATIOS | 1.1170 | 0.7271 | 1.0825 | 0.9755 | |
| | 37.0 | | | CONTRIB | 28.80% | 0.27% | 66.44% | 4.49% | 5 |
| | | 36.0 | 0.0184119 | CONTRIB | 27.08% | 0.25% | 68.33% | 4.35% | 8 |
| 183 | | | | RATIOS | 0.8456 | 0.9293 | 0.8977 | 0.8909 | |
| | 33.0 | | | CONTRIB | 2.12% | 73.62% | 17.10% | 7.16% | 5 |
| | | 36.0 | 0.0025620 | CONTRIB | 2.12% | 78.58% | 12.82% | 6.48% | 1 |
| 184 | | | | RATIOS | 1.1858 | 0.7277 | 0.6891 | 0.8675 | |
| | 36.3 | | | CONTRIB | 98.75% | 0.38% | 0.00% | 0.86% | 5 |
| | | 36.0 | 0.0114236 | CONTRIB | 98.68% | 0.40% | 0.00% | 0.92% | 5 |
| 185 | | | | RATIOS | 0.8187 | 0.3032 | 0.9152 | 0.6790 | |
| | 30.6 | | | CONTRIB | 3.81% | 0.00% | 95.98% | 0.21% | 5 |
| | | 36.0 | 0.0005101 | CONTRIB | 6.30% | 0.00% | 93.70% | 0.00% | 0 |
| 186 | | | | RATIOS | 0.5834 | 0.5238 | 1.0015 | 0.7029 | |
| | 33.6 | | | CONTRIB | 0.00% | 0.00% | 99.92% | 0.08% | 5 |
| | | 36.0 | 0.0027677 | CONTRIB | 0.00% | 0.00% | 99.90% | 0.10% | 1 |
| 187 | | | | RATIOS | 0.9105 | 0.6538 | 0.9219 | 0.8287 | |
| | 31.2 | | | CONTRIB | 16.13% | 0.70% | 78.21% | 4.96% | 5 |
| | | 36.0 | 0.0007843 | CONTRIB | 23.01% | 0.75% | 70.20% | 6.05% | 0 |
| 188 | | | | RATIOS | 1.0017 | 0.4516 | 1.0633 | 0.8389 | |
| | 35.9 | | | CONTRIB | 8.62% | 0.00% | 90.78% | 0.60% | 4 |
| | | 36.0 | 0.0097826 | CONTRIB | 8.69% | 0.00% | 90.71% | 0.60% | 4 |
| 189 | | | | RATIOS | 0.9291 | 1.1309 | 0.6497 | 0.9032 | |
| | 39.4 | | | CONTRIB | 0.55% | 99.03% | 0.00% | 0.42% | 5 |
| | | 36.0 | 0.0424027 | CONTRIB | 0.59% | 98.91% | 0.00% | 0.50% | 19 |
| 190 | | | | RATIOS | 0.9605 | 0.3585 | 0.9168 | 0.7452 | |
| | 31.4 | | | CONTRIB | 35.47% | 0.00% | 63.81% | 0.72% | 5 |
| | | 36.0 | 0.0009316 | CONTRIB | 46.15% | 0.00% | 53.05% | 0.81% | 0 |
| 191 | | | | RATIOS | 1.0784 | 0.3114 | 0.8999 | 0.7632 | |
| | 33.4 | | | CONTRIB | 85.82% | 0.00% | 13.79% | 0.39% | 5 |
| | | 36.0 | 0.0031705 | CONTRIB | 88.79% | 0.00% | 10.86% | 0.36% | 1 |
| 192 | | | | RATIOS | 1.2068 | 0.8572 | 0.7771 | 0.9470 | |
| | 37.2 | | | CONTRIB | 93.94% | 3.34% | 0.10% | 2.62% | 5 |
| | | 36.0 | 0.0143581 | CONTRIB | 92.51% | 4.02% | 0.14% | 3.34% | 6 |
| 193 | | | | RATIOS | 0.9374 | 0.4481 | 1.0146 | 0.8000 | |
| | 34.1 | | | CONTRIB | 6.36% | 0.00% | 93.04% | 0.60% | 5 |
| | | 36.0 | 0.0038794 | CONTRIB | 7.46% | 0.00% | 91.88% | 0.66% | 2 |
| 194 | | | | RATIOS | 1.2225 | 0.4271 | 1.1280 | 0.9259 | |
| | 39.3 | | | CONTRIB | 50.14% | 0.00% | 49.17% | 0.68% | 5 |
| | | 36.0 | 0.0433696 | CONTRIB | 34.56% | 0.00% | 64.70% | 0.75% | 19 |
| 195 | | | | RATIOS | 1.1895 | 0.4061 | 0.9211 | 0.8389 | |
| | 36.5 | | | CONTRIB | 95.71% | 0.00% | 3.85% | 0.43% | 5 |
| | | 36.0 | 0.0122087 | CONTRIB | 95.08% | 0.00% | 4.44% | 0.48% | 5 |

The ratios of pedestrian-level wind speeds to the reference height wind speeds at the old Alameda NAS meteorological station are shown in the first line of output for each location.

The second line of the output shows the pedestrian level wind speeds, in mph, which would be exceeded one hour per year (0.01141552512% of the time) for each measurement location. This assumes that a wind hazard occurs if a one-minute average speed of 36 mph is reached or exceeded a total of one hour per year.

The third line of output for each location shows the criterion speed and the percentage of the time the criterion would be exceeded. The rows labeled CONTRIB tabulate the percentage contribution to the total or the exceedance from each wind direction. The SUMs are the equivalent number of events.

| 0.011414% Exc. Location | Ground Speed | ---Criterion--- Speed Exc. | % Time Exc. | | NNW | W | SSE | OTHER | SUM |
|---|---|---|---|---|---|---|---|---|---|
| 196 | | | | RATIOS | 0.7103 | 0.5148 | 1.0986 | 0.7745 | |
| | 36.9 | | | CONTRIB | 0.00% | 0.00% | 99.91% | 0.09% | 5 |
| | | 36.0 | 0.0167850 | CONTRIB | 0.02% | 0.00% | 99.89% | 0.09% | 7 |
| 197 | | | | RATIOS | 0.7001 | 0.8217 | 0.9470 | 0.8229 | |
| | 32.0 | | | CONTRIB | 0.15% | 16.25% | 80.77% | 2.83% | 5 |
| | | 36.0 | 0.0012735 | CONTRIB | 0.20% | 23.54% | 72.97% | 3.30% | 1 |
| 198 | | | | RATIOS | 1.0584 | 0.8672 | 1.1029 | 1.0095 | |
| | 37.3 | | | CONTRIB | 10.23% | 3.49% | 79.41% | 6.86% | 5 |
| | | 36.0 | 0.0223139 | CONTRIB | 9.31% | 3.09% | 81.11% | 6.49% | 10 |
| 199 | | | | RATIOS | 1.0042 | 0.4546 | 0.9905 | 0.8164 | |
| | 33.7 | | | CONTRIB | 23.94% | 0.00% | 75.00% | 1.06% | 5 |
| | | 36.0 | 0.0031529 | CONTRIB | 28.09% | 0.00% | 70.75% | 1.16% | 1 |
| 200 | | | | RATIOS | 0.9764 | 0.5869 | 1.4274 | 0.9969 | |
| | 47.8 | | | CONTRIB | 0.05% | 0.00% | 99.87% | 0.08% | 5 |
| | | 36.0 | 0.3264910 | CONTRIB | 0.17% | 0.00% | 99.47% | 0.36% | 143 |
| 201 | | | | RATIOS | 0.7124 | 0.8785 | 0.6395 | 0.7435 | |
| | 30.5 | | | CONTRIB | 0.45% | 98.30% | 0.10% | 1.15% | 5 |
| | | 36.0 | 0.0008546 | CONTRIB | 0.39% | 98.76% | 0.00% | 0.85% | 0 |
| 202 | | | | RATIOS | 0.5852 | 0.6646 | 0.8248 | 0.6915 | |
| | 27.6 | | | CONTRIB | 0.08% | 5.66% | 92.55% | 1.70% | 5 |
| | | 36.0 | 0.0000714 | CONTRIB | 0.00% | 11.78% | 88.22% | 0.00% | 0 |
| 203 | | | | RATIOS | 0.7540 | 0.8250 | 1.5388 | 1.0393 | |
| | 51.5 | | | CONTRIB | 0.00% | 0.00% | 99.96% | 0.04% | 5 |
| | | 36.0 | 0.5676740 | CONTRIB | 0.00% | 0.06% | 99.52% | 0.42% | 249 |
| 204 | | | | RATIOS | 0.7397 | 0.9301 | 1.0172 | 0.8957 | |
| | 34.9 | | | CONTRIB | 0.10% | 31.55% | 65.37% | 2.98% | 5 |
| | | 36.0 | 0.0059710 | CONTRIB | 0.10% | 34.16% | 62.69% | 3.05% | 3 |
| 205 | | | | RATIOS | 0.9854 | 0.9015 | 1.1448 | 1.0106 | |
| | 38.7 | | | CONTRIB | 1.97% | 4.02% | 89.87% | 4.13% | 5 |
| | | 36.0 | 0.0408507 | CONTRIB | 1.59% | 3.08% | 91.71% | 3.62% | 18 |
| 206 | | | | RATIOS | 1.1899 | 0.9338 | 1.0854 | 1.0697 | |
| | 38.3 | | | CONTRIB | 45.32% | 7.41% | 35.23% | 12.03% | 5 |
| | | 36.0 | 0.0310361 | CONTRIB | 37.52% | 6.99% | 42.74% | 12.75% | 14 |

# APPENDIX H: FLORA OF YERBA BUENA ISLAND SAN FRANCISCO COUNTY

Wood Biological Consulting

# Checklist Of The Flora Of Yerba Buena Island, San Francisco County

Jun 21, 2010

Sort By : Family

| Scientific Name | Common Name | Note |
|---|---|---|
| **Aizoaceae - Fig-Marigold Family** | | |
| *Aptenia cordifolia* | ice-plant | • |
| *Carpobrotus edulis* | Hottentot fig | • |
| *Conicosia pugioniformis* | narrowleaf iceplant | • |
| *Tetragonia tetragoniodes* | New Zealand spinach | • |
| **Anacardiaceae - Sumac Family** | | |
| *Schinus terebinthifolius* | Brazilian peppertree | • |
| *Toxicodendron diversilobum* | poison oak | |
| **Apiaceae - Carrot Family** | | |
| *Anthriscus caucalis* | bur-chervil | • |
| *Apium graveolens* | celery | • |
| *Conium maculatum* | poison-hemlock | • |
| *Foeniculum vulgare* | sweet fennel | • |
| *Sanicula crassicaulis* | Pacific sanicle | |
| *Scandix pecten-veneris* | shepherd's needle | • |
| **Apocynaceae - Dogbane Family** | | |
| *Vinca major* | big periwinkle | • |
| **Araceae - Arum Family** | | |
| *Zantedeschia aethiopica* | calla lily | • |
| **Araliaceae - Ginseng Family** | | |
| *Hedera canariensis* | Algerian ivy | • |
| *Hedera helix* | English ivy | • |
| **Arecaceae - Palm Family** | | |
| *Phoenix canariensis* | Canary Island palm | • |

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2 = other special-status species
* = Species not indigenous to CA
AG = agricultural species
HORT = horticultural species

| Scientific Name | Common Name | Note |
|---|---|---|
| *Washingtonia robusta* | Mexican fan palm | • |

## Aristolochiaceae - Pipevine Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Aristolochia californica* | Dutchman's pipevine | |

## Asteraceae - Sunflower Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Achillea millefolium* | yarrow | |
| *Ageratina adenophora* | sticky eupatorium | • |
| *Agoseris grandiflora* | California dandelion | |
| *Ambrosia chamissonis* | beach-bur | |
| *Anaphalis margaritacea* | pearly everlasting | |
| *Anthemis cotula* | dog mayweed | • |
| *Arctotheca calendula* | capeweed | • |
| *Argyranthemum foeniculaceum* | Canary Island marguerite | • |
| *Artemisia californica* | California sagebrush | |
| *Baccharis pilularis* | coyote brush | |
| *Bellis perennis* | English daisy | • |
| *Carduus pycnocephalus* | Italian thistle | • |
| *Centaurea solstitialis* | yellow starthistle | • |
| *Chamomilla suaveolens* | pineapple weed | • |
| *Chrysanthemum coronarium* | crown daisy | • |
| *Cirsium occidentale* var. *occidentale* | cobwebby thistle | |
| *Cirsium vulgare* | bull thistle | • |
| *Conyza canadensis* | horseweed | • |
| *Cotula australis* | Australian brass-buttons | • |

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# Checklist Of The Flora Of Yerba Buena Island, San Francisco County

Wood Biological Consulting

Sort By : Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Cotula coronopifolia* | brassbuttons | • |
| *Crepis bursifolia* | Italian hawksbeard | • |
| *Delairia odorata* | Cape ivy | • |
| *Erechtites glomerata* | Australasian fireweed | • |
| *Erechtites minima* | Australian fireweed | • |
| *Ericameria ericoides* | mock heather | |
| *Erigeron glaucus* | seaside daisy | |
| *Eriophyllum staechadifolium* | seaside woolly sunflower | |
| *Felicia amelloides* | blue marguerite | • |
| *Gnaphalium bicolor* | bicolor cudweed | |
| *Gnaphalium californicum* | California everlasting | |
| *Gnaphalium canescens* ssp. *beneolens* | fragrant everlasting | |
| *Gnaphalium luteo-album* | cudweed | • |
| *Gnaphalium stramineum* | cotton-batting plant | |
| *Grindelia stricta* | coastal gumplant | |
| *Hypochaeris glabra* | smooth cat's-ear | • |
| *Jaumea carnosa* | jaumea | |
| *Lactuca serriola* | prickly lettuce | • |
| *Logfia gallica* | narrow-leaf filago | • |
| *Osteospermum fruticosum* | African daisy | • |
| *Picris echioides* | bristly ox-tongue | • |
| *Senecio hybridus* | cineraria | • Hort |
| *Senecio vulgaris* | common groundsel | • |

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| Scientific Name | Common Name | Note |
|---|---|---|
| *Silybum marianum* | milkthistle | • |
| *Soliva sessilis* | common soliva | • |
| *Sonchus asper* ssp. *asper* | prickly sowthistle | • |
| *Sonchus oleraceus* | common sowthistle | • |
| *Stephanomeria virgata* ssp. *pleurocarpa* | tall stephanomeria | |
| *Taraxacum officinale* | common dandelion | • |

## Betulaceae - Birch Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Alnus cordata* | Italian alder | • |
| *Corylus cornuta* var. *californica* | California hazelnut | |

## Brassicaceae - Mustard Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Brassica nigra* | black mustard | • |
| *Cakile maritima* | sea rocket | • |
| *Capsella bursa-pastoris* | shepard's purse | • |
| *Cardamine oligosperma* | bitter-cress | |
| *Coronopus didymus* | lesser wart-cress | • |
| *Hirschfeldia incana* | shortpod mustard | • |
| *Lepidium latifolium* | perennial pepperweed | • |
| *Lepidium nitidum* var. *nitidum* | shining pepper-grass | |
| *Lobularia maritima* | sweet alyssum | • |
| *Raphanus sativus* | wild radish | • |
| *Sisymbrium orientale* | Indian hedgemustard | • |

## Buddlejaceae - Buddleja Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Buddleja davidii* | butterfly bush | • |

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HORT = horticultural species

# Checklist Of The Flora Of Yerba Buena Island, San Francisco County



Wood Biological Consulting

Sort By : Family

| Scientific Name | Common Name | Note |
| --- | --- | --- |
| **Caprifoliaceae - Honeysuckle Family** | | |
| *Lonicera japonica* | Japanese honeysuckle | • |
| *Sambucus mexicana* | blue elderberry | |
| *Symphoricarpos albus* var. *laevigatus* | common snowberry | |
| **Caryophyllaceae - Pink Family** | | |
| *Cardionema ramosissimum* | sand mat | |
| *Cerastium glomeratum* | mouse-ear chickweed | • |
| *Silene gallica* | common catchfly | • |
| *Spergularia bocconei* | Boccon's sand-spurrey | |
| *Spergularia macrotheca* var. *macrotheca* | large flowered sand-spurrey | |
| *Stellaria media* | common chickweed | • |
| **Chenopodiaceae - Goosefoot Family** | | |
| *Atriplex triangularis* | spearscale | |
| *Chenopodium album* | lamb's quarters | • |
| *Chenopodium californicum* | California goosefoot | |
| *Salicornia virginica* | pickleweed | |
| **Commelinaceae - Spiderwort Family** | | |
| *Tradescantia fluminensis* | spiderwort | • |
| **Convolvulaceae - Morning-glory Family** | | |
| *Calystegia purpurata* ssp. *purpurata* | purple western morning-glory | |
| **Crassulaceae - Stonecrop Family** | | |
| *Aeonium haworthii* | stone crop | • |
| *Crassula argentea* | jade plant | • |
| *Crassula connata* | pygmyweed | |

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HORT = horticultural species

| Scientific Name | Common Name | Note |
|---|---|---|
| *Dudleya farinosa* | powdery dudleya | |
| *Sedum dendroideum* | stonecrop | • |

## Cucurbitaceae - Gourd Family

| | | |
|---|---|---|
| *Marah fabaceus* | California man-root | |

## Cupressaceae - Cypress Family

| | | |
|---|---|---|
| *Chamaecyparis lawsonii* | Lawson cypress | • |
| *Chamaecyparis pisifera* | Sawara false cypress | • |
| *Cupressus arizonica* | Arizona cypress | |
| *Cupressus macrocarpa* | Monterey cypress | 2 |

## Cyperaceae - Sedge Family

| | | |
|---|---|---|
| *Carex barbarae* | Santa Barbara sedge | |
| *Cyperus eragrostis* | umbrella sedge | |

## Dennstaedtiaceae - Bracken Fern Family

| | | |
|---|---|---|
| *Pteridium aquilinum* var. *pubescens* | western brackenfern | |

## Dryopteridaceae - Wood Fern Family

| | | |
|---|---|---|
| *Crytomium falcatum* | holly fern | • Hort |
| *Dryopteris arguta* | wood fern | |
| *Polystichum munitum* | western sword fern | |

## Equisetaceae - Horsetail Family

| | | |
|---|---|---|
| *Equisetum telmateia* ssp. *braunii* | giant horsetail | |

## Euphorbiaceae - Spurge Family

| | | |
|---|---|---|
| *Chamaesyce maculata* | spotted spurge | • |
| *Euphorbia peplus* | petty spurge | • |

| Scientific Name | Common Name | Note |
|---|---|---|

## Fabaceae - Legume Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Acacia baileyana* | Cootamundra wattle | • |
| *Acacia decurrens* | green wattle | • |
| *Acacia melanoxylon* | blackwood acacia | • |
| *Acmispon wrangelianus* | Chile trefoil | |
| *Albizia lophantha* | plume acacia | • |
| *Bauhinia variegata* | purple orchid tree | • |
| *Ceratonia siliqua* | carob | • |
| *Cercis occidentalis* | western redbud | |
| *Cytisus scoparius* | Scotch broom | • |
| *Genista monspessulana* | French broom | • |
| *Lathyrus tingitanus* | Tangier pea | • |
| *Lathyrus vestitus* var. *vestitus* | common Pacific pea | |
| *Lotus corniculatus* | broadleaf bird's-foot trefoil | • |
| *Lotus scoparius* | California broom | |
| *Lotus strigosus* | strigose treefoil | |
| *Lupinus arboreus* | yellow bush lupine | |
| *Lupinus bicolor* | dove lupine | |
| *Lupinus microcarpus* var. *microcarpus* | chick lupine | |
| *Lupinus nanus* | Douglas' lupine | |
| *Medicago polymorpha* | burclover | • |
| *Medicago sativa* | alfalfa | • |
| *Melilotus albus* | white sweetclover | • |

| Scientific Name | Common Name | Note |
|---|---|---|
| *Melilotus officinalis* | yellow sweetclover | • |
| *Trifolium gracilentum* var. *gracilentum* | pinpoint clover | |
| *Trifolium hirtum* | rose clover | • |
| *Trifolium willdenovii* | tomcat clover | |
| *Vicia americana* var. *americana* | American vetch | |
| *Vicia benghalensis* | purple vetch | • |
| *Vicia sativa* ssp. *nigra* | common vetch | • |
| *Vicia sativa* ssp. *sativa* | common vetch | • |
| *Vicia villosa* ssp. *villosa* | hairy vetch | • |

## Fagaceae - Oak Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Quercus agrifolia* | coast live oak | |

## Geraniaceae - Geranium Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Erodium botrys* | long-beaked storksbill | • |
| *Erodium cicutarium* | red-stemmed filaree | • |
| *Erodium moschatum* | white-stemmed filaree | • |
| *Geranium dissectum* | cut-leaved geranium | • |
| *Geranium molle* | dove's-foot geranium | • |
| *Pelargonium peltatum* | ivy geranium | • |

## Grossulariaceae - Gooseberry Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Ribes sanguineum* var. *glutinosum* | red-flowering currant | |

## Hippocastanaceae - Buckeye Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Aesculus californica* | California buckeye | |

## Hydrophyllaceae - Waterleaf Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Nemophila maculata* | five-spot | |

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| Scientific Name | Common Name | Note |
|---|---|---|
| *Phacelia distans* | common phacelia | |
| *Phacelia malvifolia* | stinging phacelia | |
| *Pholistoma auritum* var. *auritum* | fiestaflower | |

## Iridaceae - Iris Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Chasmanthe aethiopica* | chasmanthe | • Hort |
| *Iris x hybrid* | bearded iris | • |
| *Iris xiphium* | Dutch iris | • |
| *Sisyrinchium bellum* | blue-eyed grass | |

## Juncaceae - Rush Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Juncus balticus* | wire rush | |
| *Juncus bufonius* var. *bufonius* | toad rush | |
| *Juncus bufonius* var. *congestus* | congested toad rush | |
| *Juncus effusus* var. *pacificus* | Pacific bog rush | |
| *Juncus patens* | spreading rush | |
| *Luzula comosa* | Pacific wood rush | |

## Lamiaceae - Mint Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Monardella villosa* ssp. *franciscana* | coyote mint | |
| *Salvia leucantha* | Mexican bush sage | • |
| *Stachys ajugoides* var. *rigida* | rigid hedge nettle | |

## Liliaceae - Lily Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Agapanthus africanus* | lily-of-the-Nile | • HORT |
| *Agave americana* | century plant | • |
| *Allium triquetrum* | white-flowered onion | • |

| Scientific Name | Common Name | Note |
|---|---|---|
| *Aloe saponaria* | aloe | • |
| *Amaryllis belladonna* | naked lady | • |
| *Chlorogalum pomeridianum* var. *divaricatum* | spreading soaproot | |
| *Dichelostemma capitatum* ssp. *capitatum* | blue dicks | |
| *Narcissus pseudonarcissus* | common daffodil | • |
| *Triteleia laxa* | Ithuriel's spear | |

## Linaceae - Flax Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Linum bienne* | narrow-leaved flax | • |

## Malvaceae - Mallow Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Abutilon striatum* | Indian mallow | • |
| *Lavatera assurgentiflora* | malva rosa | |
| *Malva nicaeensis* | bull mallow | • |
| *Malva parviflora* | cheeseweed | • |
| *Malva sylvestris* | high mallow | • |

## Moraceae - Mulberry Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Ficus pumila* | creeping fig | • |

## Myoporaceae - Myorporum Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Myoporum laetum* | myoporum | • |

## Myrtaceae - Myrtle Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Eucalyptus camaldulensis* | river red gum | • |
| *Eucalyptus ficifolia* | scarlet flowering gum | • |
| *Eucalyptus globulus* | Tasmanian blue gum | • |
| *Eucalyptus leucoxylon* | white ironbark | • |
| *Eucalyptus sideroxylon* | red ironbark | • |

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| Scientific Name | Common Name | Note |
|---|---|---|
| *Leptospermum laevigatum* | Australian tea tree | • |
| *Melaleuca decussata* | lilac melaleuca | • Hort |
| *Metrosideros excelsus* | New Zealand Christmas tree | • Hort |

## Oleaceae - Olive Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Ligustrum japonicum* | waxleaf privet | • |
| *Ligustrum lucidum* | glossy privet | • |
| *Ligustrum ovalifolium* | California privet | • Hort |

## Onagraceae - Evening Primrose Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Camissonia ovata* | sun cups | |
| *Clarkia amoena* | farewell-to-spring | |
| *Clarkia unguiculata* | elegant clarkia | |
| *Epilobium brachycarpum* | tall willowherb | |
| *Epilobium ciliatum* ssp. *ciliatum* | northern willowherb | |
| *Oenothera elata* ssp. *hookeri* | Hooker's evening-primrose | |

## Oxalidaceae - Oxalis Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Oxalis pes-caprae* | Bermuda buttercup | • |
| *Oxalis rubra* | windobox oxalis | • |

## Papaveraceae - Poppy Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Eschscholzia californica* | California poppy | |
| *Fumaria parviflora* | small-flowered fumitory | • |

## Pinaceae - Pine Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Pinus canariensis* | Canary Island pine | • |
| *Pinus halepensis* | Aleppo pine | • |
| *Pinus pinea* | Italian stone pine | • |

| Scientific Name | Common Name | Note |
|---|---|---|
| *Pinus ponderosa* | ponderosa pine | |
| *Pinus radiata* | Monterey pine | 2 |

## Pittosporaceae - Pittosporum Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Pittosporum crassifolium* | thick-leaved pittosporum | • |
| *Pittosporum eugenioides* | tarata | • |
| *Pittosporum tenuifolium* | pittosporum | • |

## Plantaginaceae - Plantain Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Plantago coronopus* | cut-leaved plantain | • |
| *Plantago erecta* | California plantain | |
| *Plantago lanceolata* | English plantain | • |

## Poaceae - Grass Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Agrostis capillaris* | colonial bent grass | • |
| *Agrostis pallens* | leafy bent grass | |
| *Avena barbata* | slender wild oats | • |
| *Avena fatua* | wild oats | • |
| *Briza maxima* | big quaking grass | • |
| *Briza minor* | little quaking grass | • |
| *Bromus carinatus* var. *carinatus* | California brome | |
| *Bromus diandrus* | ripgut brome | • |
| *Bromus hordeaceus* | soft chess | • |
| *Bromus madritensis* ssp. *rubens* | red brome | • |
| *Cortaderia selloana* | pampas grass | • |
| *Cynodon dactylon* | Bermudagrass | • |

| Scientific Name | Common Name | Note |
|---|---|---|
| *Cynosurus echinatus* | hedgehog dogtail | • |
| *Dactylis glomerata* | orchardgrass | • |
| *Distichlis spicata* | saltgrass | |
| *Ehrharta erecta* | erect veldtgrass | • |
| *Elymus glaucus* ssp. *glaucus* | blue wildrye | |
| *Festuca arundinacea* | tall fescue | • |
| *Festuca rubra* | red fescue | |
| *Gastridium ventricosum* | nit grass | • |
| *Holcus lanatus* | common velvet-grass | • |
| *Hordeum marinum* ssp. *gussoneanum* | Mediterranean barley | • |
| *Hordeum murinum* ssp. *glaucum* | hare barley | • |
| *Hordeum murinum* ssp. *leporinum* | foxtail barley | • |
| *Leptochloa fascicularis* | bearded sprangletop | |
| *Leymus condensatus* | giant wildrye | |
| *Leymus triticoides* | creeping wildrye | |
| *Leymus x vancouverensis* | Vancouver's ryegrass | |
| *Lolium multiflorum* | Italian ryegrass | • |
| *Lolium perenne* | perennial ryegrass | • |
| *Melica imperfecta* | Coast Range melic | |
| *Nassella lepida* | foothill needlegrass | |
| *Nassella pulchra* | purple needlegrass | |
| *Parapholis incurva* | sickle grass | • |
| *Pennisetum clandestinum* | kikuyugrass | • |

| Scientific Name | Common Name | Note |
|---|---|---|
| *Phalaris aquatica* | hardinggrass | • |
| *Phalaris minor* | littleseed canarygrass | • |
| *Poa annua* | annual bluegrass | • |
| *Poa secunda* ssp. *secunda* | one-sided bluegrass | |
| *Polypogon monspeliensis* | annual rabbitsfoot grass | • |
| *Vulpia bromoides* | six-weeks fescue | • |
| *Vulpia myuros* var. *hirsuta* | western six-weeks fescue | • |

## Polemoniaceae - Phlox Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Gilia capitata* ssp. *chamissonis* | dune gilia | 2 |

## Polygonaceae - Buckwheat Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Eriogonum fasciculatum* | flat-top buckwheat | |
| *Eriogonum latifolium* | coast buckwheat | |
| *Muehlenbeckia complexa* | maidenhair vine | • |
| *Polygonum arenastrum* | common knotweed | • |
| *Rumex acetosella* | sheep sorrel | • |
| *Rumex crispus* | curly dock | • |
| *Rumex pulcher* | fiddle dock | • |

## Polypodiaceae - Polypody Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Polypodium californicum* | California polypody | |

## Portulacaceae - Purslane Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Claytonia exigua* ssp. *exigua* | serpentine spring beauty | |
| *Claytonia perfoliata* ssp. *perfoliata* | miner's lettuce | |

## Primulaceae - Primrose Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Anagallis arvensis* | scarlet pimpernel | • |

| Scientific Name | Common Name | Note |
|---|---|---|
| **Proteaceae - Protea Family** | | |
| *Hakea suaveolens* | sweet hakea | • |
| **Pteridaceae - Fern Family** | | |
| *Adiantum jordanii* | maidenhair fern | |
| *Pellaea andromedifolia* | coffee fern | |
| *Pentagramma triangularis* ssp. *triangularis* | goldback fern | |
| **Ranunculaceae - Buttercup Family** | | |
| *Ranunculus californicus* | California buttercup | |
| *Ranunculus muricatus* | spiny buttercup | • |
| **Rhamnaceae - Buckthorn Family** | | |
| *Ceanothus dentatus* | dwarf ceanothus | |
| *Ceanothus foliosus* var. *medius* | La Cuesta ceanothus | |
| *Ceanothus thyrsiflorus* | blue blossom | |
| **Rosaceae - Rose Family** | | |
| *Cotoneaster franchetii* | orange cotoneaster | • |
| *Cotoneaster lacteus* | Parney's cotoneaster | • |
| *Cotoneaster pannosa* | silverleaf cotoneaster | • |
| *Eriobotrya japonica* | loquat | • |
| *Heteromeles arbutifolia* | toyon | |
| *Malus sylvestris* | apple | • |
| *Oemleria cerasiformis* | oso berry | |
| *Prunus ilicifolia* | hollyleaf cherry | |
| *Pyracantha angustifolia* | common firethorn | • |
| *Rhaphiolepis indica* | Indian hawthorn | • Hort |

| Scientific Name | Common Name | Note |
|---|---|---|
| *Rosa gymnocarpa* | wood rose | |
| *Rubus discolor* | Himalayan blackberry | • |
| *Rubus ursinus* | California blackberry | |

## Rubiaceae - Madder Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Coprosma repens* | mirror plant | • |
| *Galium aparine* | goose grass | |
| *Sherardia arvensis* | field madder | • |

## Salicaceae - Willow Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Populus nigra* | Lombardy poplar | • |
| *Populus tremuloides* | quaking aspen | |
| *Salix laevigata* | red willow | |
| *Salix lasiolepis* | arroyo willow | |

## Saxifragaceae - Saxifrage Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Escallonia rubra* | redclaws | • |

## Scrophulariaceae - Figwort Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Hebe speciosa* | showy hebe | • |
| *Mimulus aurantiacus* | sticky monkeyflower | |
| *Mimulus guttatus* | common large monkey-flower | |
| *Scrophularia californica* | California figwort | |
| *Triphysaria pusilla* | dwarf owl's-clover | |
| *Veronica persica* | Persian speedwell | • |

## Solanaceae - Nightshade Family

| Scientific Name | Common Name | Note |
|---|---|---|
| *Solanum furcatum* | forked nightshade | • |
| *Solanum nigrum* | black nightshade | • |

# Checklist Of The Flora Of Yerba Buena Island, San Francisco County



Sort By : Family

| Scientific Name | Common Name | Note |
|---|---|---|
| **Taxaceae - Yew Family** | | |
| *Taxus baccata* | English yew | • |
| **Taxodiaceae - Bald Cypress Family** | | |
| *Sequoia sempervirens* | coast redwood | |
| **Tropaeolaceae - Nasturtium Family** | | |
| *Tropaeolum majus* | garden nasturtium | • |
| **Ulmaceae - Elm Family** | | |
| *Ulmus pumila* | Siberian elm | • |
| **Valerianaceae - Valerian Family** | | |
| *Centranthus ruber* | red valerian | • |

Footnotes:

1 = federal or State listed Species
2 = other special-status species
AG = agricultural species
3 = CALIPC Listed Invasive Species
* = Species not indigenous to CA
HORT = horticultural species

# APPENDIX I: FINAL WATER SUPPLY ASSESSMENT FOR THE PROPOSED TREASURE ISLAND – YERBA BUENA ISLAND PROJECT

# Final

# Water Supply Assessment

**for the**

## Proposed Treasure Island – Yerba Buena Island Project

## November 2009

Prepared by:

PBS&J

In coordination with the San Francisco Public Utilities Commission, Water Enterprise

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# 1.0 INTRODUCTION

The City of San Francisco and the Treasure Island Development Authority ("TIDA") are conducting an environmental review under the requirements of the California Environmental Quality Act (CEQA) for the proposed Treasure Island – Yerba Buena Island Project (proposed project or TI-YBI). This water supply assessment (WSA) will provide information for use in the CEQA analysis for this proposed project. The environmental review for the proposed project includes an assessment of the available water supply to serve the proposed project. The requirements for a WSA are set forth in the California Water Code (Water Code) Sections 10910 et seq.

A WSA connects water supply and land use planning with the environmental review process. The law also reflects the growing awareness of the need to incorporate water supply and demand analysis at the earliest possible stage in the land use planning process. The core of this law is an assessment of whether available water supplies are sufficient to serve the demand generated by a project, as well as the reasonably foreseeable cumulative demand in the region over the next 20 years under a range of hydrologic conditions.

This WSA provides information on the available water supply to serve the proposed project based on Water Code Sections 10631, and 10910 et seq.

This document is divided into six sections: Introduction, Water Supply Sources, Demand Analysis, Supply and Demand Comparison, Conclusion of Analysis and Findings. The Introduction describes the proposed project and water supply planning under Water Code 10910 et seq.

## 1.1. Project Location, Land Use, Zoning and Characteristics

### 1.1.1. Project Location

The proposed project includes portions of Treasure Island and Yerba Buena Island in San Francisco Bay (see Figure 1-1: Regional and Project Location) which comprise the former Naval Station Treasure Island (NSTI) owned and operated by the United States Navy until its closure in 1997. The proposed project area encompasses approximately 370 acres of land on Treasure Island, approximately 90 acres of land on Yerba Buena Island and about 550 acres of tidal and submerged lands adjacent to the Islands. The US Navy is in the process of conveying most of these areas to TIDA, which currently manages a variety of interim residential, industrial, institutional and recreational land uses.

The project area is designated as a recycled water use area as defined in the City of San Francisco's Recycled Water Ordinances (effective November 7, 1991, and amended in 1994). The ordinances require property owners to install dual-plumbing systems for recycled water use within the designated water use areas.[1]

[1] On November 18, 2009, the Building Standards Commission unanimously voted to approve the California Dual Plumbing Code that establishes statewide standards for installing both potable and recycled water plumbing systems in commercial, retail, and office buildings, theaters, auditoriums, condominiums, schools, hotels, apartments, barracks, dormitories, jails, prisons, and reformatories. The new code is effective Jan. 11, 2011. Website address: http://www.water.ca.gov/recycling/DualPlumbingCode/


FIGURE 1-1

## Regional and Project Location

100010780

Treasure Island WSA

#### *1.1.1.1. Proposed Project Overview*

The proposed Treasure Island and Yerba Buena Island Redevelopment Plan (Redevelopment Plan) would provide the basis for redevelopment of NSTI lands from a primarily low-density residential area with vacant and underutilized nonresidential structures to a new mixed-use community with a retail center, a variety of open space and recreation opportunities, on-site infrastructure, and public and community services. The proposed project would consist of up to 8,000 residential units, approximately 550,000 square feet of commercial, flex and retail space including renovated historic buildings, up to 500 hotel rooms, 300 acres of parks and open space, transportation, bicycle and pedestrian facilities, a ferry terminal/transit hub, miscellaneous public and community facilities, and utilities. The proposed project would be implemented in four major phases from approximately 2011 through 2030 A major component of the proposed Redevelopment Plan is the Sustainability Plan, which includes goals, strategies, and targets for the sustainable redevelopment of NSTI. Figure 1-2 is the Treasure Island – Yerba Buena Island Land Use Plan.

***Sustainability Plan.*** The Sustainability Plan documents the guiding principles for the proposed project's Development Program and identifies implementation measures to be undertaken by the developers and other stakeholders. Many of these measures are integral to the proposed Development Program, and are intended to facilitate progressively higher levels of sustainability over time. These include the proposed residential densities, proximity to transit facilities, orientation of streets and buildings, and green building specifications, which would be incorporated into the Design for Development guidelines and conditions of approval. In addition, the proposed Development Program would include strategies intended to achieve Gold certification under the U.S. Green Building Council's Leadership in Energy and Environmental Design for Neighborhood Development program. These include a comprehensive transportation demand management program, provision of infrastructure to maximize the on-site production of renewable energy as technologies and delivery mechanisms become available; and a parks and open space program to create, restore and maintain habitat and landscape areas, and other features that would reduce potable water usage.

#### *1.1.1.2. Proposed Project Land Use Information*

The proposed project consists of mixed-use development areas on Treasure Island and Yerba Buena Island, the majority of which occur on Treasure Island. Table 1-1 presents the overall land use distribution and proposed facilities.

#### *1.1.1.3. Project Characteristics and Development Components*

***Residential.*** The proposed Development Program would include up to approximately 8,000 residential dwelling units (DU), including approximately 7,700 – 7800 units on Treasure Island and up to 300 units on Yerba Buena Island. The southwest corner of Treasure Island will be developed as an "Urban Core" neighborhood, located near the proposed Ferry Quay and Transit Hub. The proposed residences would include housing sized for families.

***Proposed Neighborhood-Serving Retail, Commercial, and Institutional Uses.*** The proposed Development Program commercial component would include: approximately 500 hotel rooms; approximately 311,000 square feet (sf) of commercial uses in the renovated historic buildings, retail uses concentrated and organized as a main street between the Ferry Quay and Transit Hub, the Clipper Cove plaza, and two of the historic buildings, ancillary retail uses along the Clipper Cove marina and in the residential area. The total amount of new retail space provided in the Development Program's commercial component will be up to 140,000 sf.


**Source:** Lennar Urban; Wilson, Meany Sullivan, 2009.

FIGURE **1-2**

**Land Use Plan for the Proposed Treasure Island Project**

**Table 1-1: Project Proposed Land Uses**

| Land Use Description | Land Use Designation | Unit/Area |
|---|---|---|
| Residential (DU) | Treasure Island | 7,700 – 7,850 |
| | Yerba Buena Island | 150 - 300 |
| **Total (DU)** | | **8,000** |
| Hotel (rooms) | Full Service Hotel at the Ferry Terminal | 300 - 350 rooms |
| | Boutique at Clipper Cove | 70 - 100 rooms |
| | Wellness Center on YBI | 50 rooms |
| **Total (rooms)** | | **Up to 500 rooms** |
| Office (sf) | New Office Space on TI | 100,000 |
| New Construction Retail (sf) | Neighborhood Service | 45,000 |
| | Other Retail Uses | 95,000 |
| **Total (sf)** | | **Up to 140,000** |
| Adaptive Reuse (sf) | Building 1 | 76,000 |
| | Building 2 | 85,000 |
| | Building 3 | 150,000 |
| **Total (sf)** | | **311,000** |
| Parking (sf) | Structures | 2,479,750 |
| Open Space (acres) | | 300 |
| YBI Historic/Open Space Structures (sf) | Structures | 75,000 |
| Marina (slips) | | 400 |
| Community / Civic Facilities (sf) | Treasure Island School | 105,000 |
| | Police/Fire | 30,000 |
| | Misc. small community facilities | 13,500 |
| | Pier 1 community center | 35,000 |
| | TI Sailing Center | 15,000 |
| | Museum | 75,000 |
| **Total (sf)** | | **273,500** |
| Job Corps (sf) | Existing Square Feet to Remain | 490,000 |
| Coast Guard Facility | Existing Square Feet to Remain | 110,000 |
| Utility Facilities (sf) | Wastewater Treatment Plant | 10,000. |
| | Corporation Yard Buildings at Treatment Plant and Water Tanks | 4,000 |
| **Total (sf)** | | **14,000** |

Notes:
DU = Dwelling Units; sf = square feet
Source: [NEED REPORT and SOURCE INFO] Infrastructure Plan Chapter One – Larger Project Details

The proposed Development Program would provide space for a variety of community programs in an existing historic building, in some of the proposed residential buildings, and possibly in a stand-alone community center with space for child-care facilities. The existing, closed public grammar school on Treasure Island would be improved and reopened for use by the San Francisco Unified School District. The existing wastewater treatment plant would be replaced. A solid waste recycling program would be established and a recycling center/corporation yard would be provided. A joint police/fire station would be provided on Treasure Island. The existing Job Corps facility would remain in use in its current location on Treasure Island, under the jurisdiction of the Department of Labor. Similarly, the U.S. Coast Guard facility on Yerba Buena Island would remain in its current location.

***Proposed Open Space and Recreation.*** The proposed Development Program would include approximately 300 acres of publicly accessible pathways, parks, open space, plazas, and shoreline improvements. The recreational and open space uses would include perimeter shoreline and water access, a stormwater treatment wetland, a Great Park covering much of the northeast portion of Treasure Island, a regional recreational facility, and a variety of active and passive recreational areas.

***Transit Facilities and Services.*** The proposed Development Program would include the construction of a new ferry quay and terminal and a bus transit facility on the western shore of Treasure Island. These two uses would anchor the proposed Intermodal Transit Hub, which would provide transportation facilities, services, and information. Proposed funding for ferry vessels would provide the opportunity for an operator to initiate ferry service to the Islands between San Francisco and Treasure Island, and the proposed bus transit facility would provide stops for Muni service to San Francisco and East Bay transit service. In addition, the proposed Development Program would include a free shuttle service around the Islands.

***Recycled Water and Potable Water Efficiency Considerations.*** The proposed Development Program includes a proposal to use recycled water treated to tertiary levels to irrigate open space areas, the urban farm, roadside plantings, public open spaces, and landscape water features, and for appropriate plumbing fixtures within commercial buildings. As such, the proposed recycled water program would provide for an on-island recycled water plant (part of the proposed wastewater treatment facility), sized to meet the long-term demand. New distribution piping for proposed recycled water would be provided for uses on Treasure Island only. At this time, on-site recycled water facilities are still being evaluated; therefore, this WSA provides a water supply analysis with and without the use of recycled water at the project site.

The proposed Development Program, as stated above would include strategies intended to achieve Gold certification under the U.S. Green Building Council's Leadership in Energy and Environmental Design for Neighborhood Development program. These include a transportation demand management program, infrastructure provisions to maximize the on-site production of renewable energy; a parks and open space program to create, restore and maintain habitat and landscape areas; and features that would reduce potable water usage. In order to reduce the use of potable water on a per-unit basis, water reduction measures could include a combination of high-efficiency fixtures and appliances, and retrofitting existing building infrastructure.

## 1.2. Water Supply Planning

Senate Bill 610 was passed into law on January 1, 2002. This law reflects the need to incorporate water supply and demand analysis at the earliest possible stage in the planning process. SB 610 amended portions of the Water Code, including Section 10631, which contains the Urban Water Management Planning Act, as well as adding Sections 10910, 10911, 10912, 10913, and 10915, which describe the required elements of a WSA. Upon signing this bill and a related bill not applicable to the proposed project, Governor Gray Davis stated, "Most notably, these bills will coordinate local water supply and land use decisions to help provide California's cities, farms, and rural communities with adequate water supplies. Additionally, these bills increase requirements and incentives for urban water suppliers to prepare and adopt comprehensive management plans on a timely basis."[2]

Senate Bill 610 is designed to build on the information that is typically contained in an Urban Water Management Plan (UWMP). The amendments to Water Code Section 10631 were designed to make WSAs and UWMPs consistent. A key difference between the WSAs and UWMPs is that UWMPs are required to be revised every five years, in years ending with either zero or five, while WSAs are required as part of the environmental review process for each individually qualifying project. As a result, the 20-year planning horizons for each type of document may cover slightly different planning periods than other WSAs or the current UWMP. Additionally, not all water providers who must prepare a WSA are required to prepare an UWMP.

2 Department of Water Resources. 2003. Guidebook for Implementation of SB 610 and SB 221 of 2001.

### 1.2.1. SB 610 Water Supply Assessment

The SB 610 water supply assessment process involves answering the following questions:

- Is the project subject to CEQA?
- Is it a project under SB 610?
- Is there a public water system?
- Is there a current UWMP that accounts for the project demand?
- Is groundwater a component of the supplies for the project?
- Are there sufficient supplies available to serve the project over the next 20 years?

#### *1.2.1.1. "Is the Project Subject to CEQA?"*

The first step in the SB 610 process is determining whether the project is subject to CEQA. SB 610 amended Public Resources Code Section 21151.9 to read: "Whenever a City or county determines that a project, as defined in Section 10912 of the Water Code, is subject to this division [i.e., CEQA], it shall comply with part 2.10 (commencing with Section 10910) of Division 6 of the Water Code." The City of San Francisco and the TIDA have determined that the proposed project is a project subject to CEQA. The information contained in this assessment will be used to inform and support the project specific Environmental Impact Report (EIR) for the proposed project, and will be appended thereto.

#### *1.2.1.2. "Is It a Project Under SB 610?"*

The second step in the SB 610 process is to determine if a project meets the definition of a "Project" under Water Code Section 10912 (a). Under this section, a "Project" is defined as meeting any of the following criteria:

1. A proposed residential development of more than 500 dwelling units;
2. A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet ($ft^2$) of floor space;
3. A commercial building employing more than 1,000 persons or having more than 250,000 $ft^2$ of floor space;
4. A hotel or motel with more than 500 rooms;
5. A proposed industrial, manufacturing, or processing plant, or industrial park, planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 $ft^2$ of floor area;
6. A mixed-use project that includes one or more of these elements; or
7. A project creating the equivalent demand of 500 residential units.

Alternately, if a public water system has less than 5,000 service connections, the definition of a "Project" also includes any proposed residential, business, commercial, hotel or motel, or industrial development that would account for an increase of 10 percent or more in the number of service connections for the public water system. The proposed project is a mixed-use project that would include one or more of these elements listed above, specifically, "the proposed project exceeds residential development of more than 500 dwelling units" and for that reason, it meets the requirements as a "Project" under the Water Code.

#### *1.2.1.3. "Is There a Public Water System?"*

The third step in the SB 610 process is determining if there is a "public water system" to serve the project. Section 10912 (c) of the California Water Code states: "[A] public water system means a system for the provision of piped water to the public for human consumption that has 3,000 or more service connections." The San Francisco Public Utilities Commission (SFPUC) is a public water system that serves the City and County of San Francisco, including the proposed project area. The SFPUC's Retail service area is shown in Figure 1-3. The SFPUC provides water to both retail and wholesale water customers. A population of over 2.5 million people within the counties of San Francisco, San Mateo, Santa Clara, Alameda, and Tuolumne rely entirely or in part on the water supplied by the SFPUC.

***Retail Customers:*** The SFPUC's retail water customers include the residents, business, and industries located within the corporate boundaries of the City and County of San Francisco (City). In addition to these customers, retail water service is also provided to other customers located outside of the City, such as Treasure Island, the Town of Sunol, San Francisco International Airport, Lawrence Livermore Laboratory, Castlewood, and Groveland Community Services District.

***Wholesale Customers:*** The SFPUC sells water to wholesale customers under terms of the recently renegotiated Water Supply Agreement together with individual water sales contracts. Since 1970, the SFPUC has supplied approximately 65 percent of the total wholesale customer water demand. Some of the wholesale water customers are entirely reliant on the SFPUC for their water supply.

#### *1.2.1.4. "Is There a Current UWMP that Accounts for the Project Demand?"*

Step four in the SB 610 process involves determining if there is a current UWMP that considers the projected water demand for the project area. The Water Code requires that all public water systems providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet annually must prepare an UWMP, and the plan must be updated at least every five years on or before December 31 in years ending in five and zero.

Water Code Section 10910 (c)(2) states: "If the projected water demand associated with the proposed project was accounted for in the most recently adopted urban water management plan, the public water system may incorporate the requested information from the urban water management plan in preparing the elements of the assessment required to comply with subdivisions (d), (e), (f), and (g) [i.e., the WSA]." The SFPUC 2005 UWMP is currently available online.[3]

As of late 2008, the SFPUC concluded that its 2005 UWMP no longer accounted for every qualifying project within San Francisco including the land use changes at the proposed project area. Therefore, any qualifying projects not accounted in the 2005 UWMP will require preparation of a WSA that documents the SFPUC's current and projected supplies when compared to projected demands associated with new growth not covered in the 2005 UWMP including agriculture and industrial uses. When the 2005 UWMP was prepared, the redevelopment plan at TI-YBI did not include the development of the proposed project; therefore, this WSA analyzes the change in demand at the project site under the proposed project.

3 SFPUC 2005 Urban Water Management Plan, http://sfwater.org/detail.cfm/MC_ID/13/MSC_ID/165/C_ID/2776.

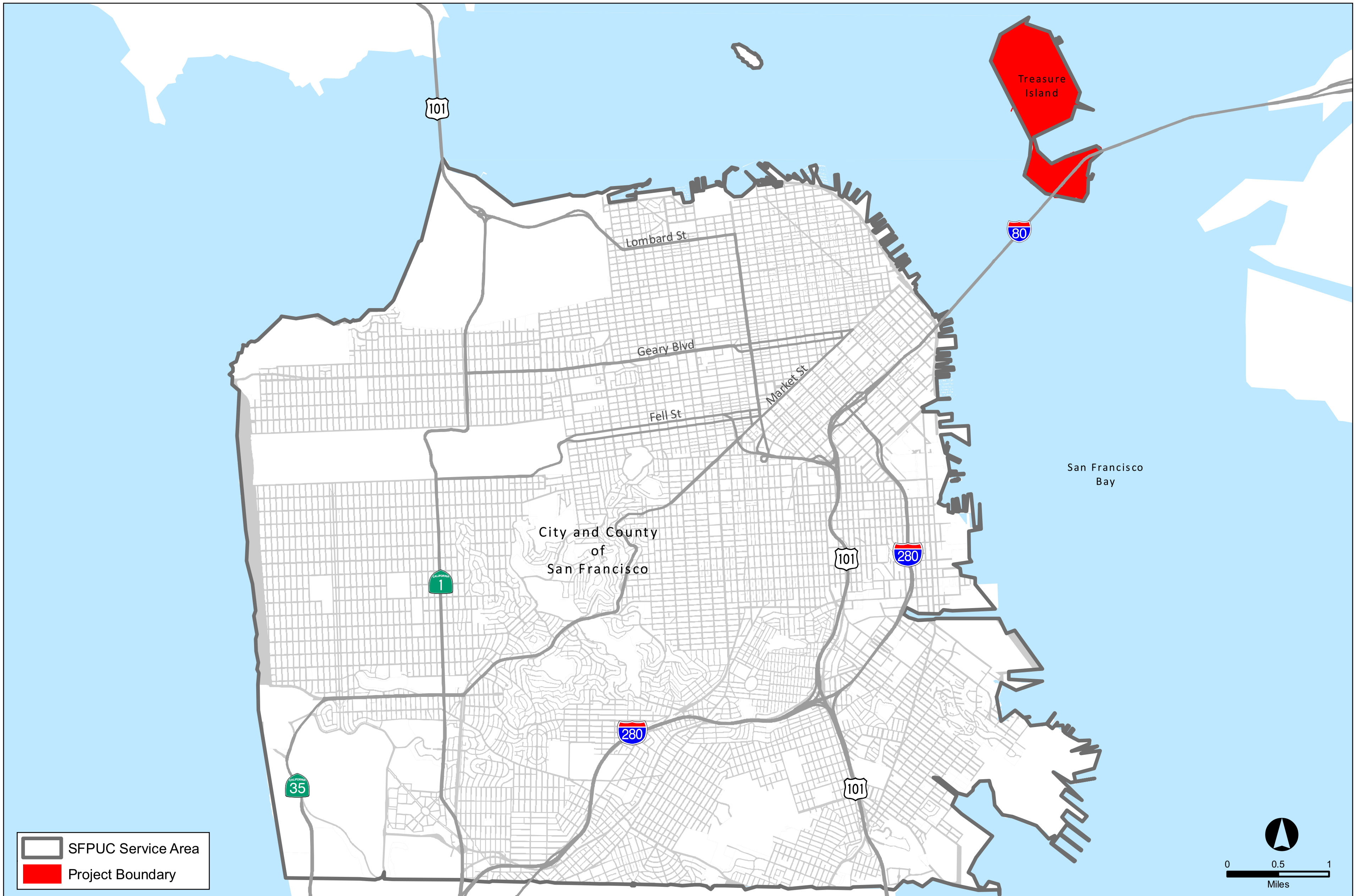


FIGURE 1-3

## SFPUC Service Area within City and County of San Francisco

100010780

Treasure Island WSA

#### *1.2.1.1. "Is Groundwater a Component of the Supplies for the Project?"*

This section addresses the requirements of Water Code Section 10910 (f), paragraphs 1 through 5, which apply if groundwater is a source of supply for a proposed project. As required by Water Code Section 10910 (f) a description and status of the local groundwater basin is discussed below. Groundwater is a minor component of water supply for the SFPUC and for the proposed project. A discussion of the SFPUC's groundwater supply programs is included in Sections 2.6.2.1 and 3.4 of this WSA.

In April 2005, the SFPUC completed the Final Draft North Westside Basin Groundwater Management Plan (GWMP), which identified opportunities for increasing groundwater production in San Francisco. The GWMP included a Plan Element to regularly report on groundwater conditions in the North Westside Groundwater Basin. Since completion of the GWMP, the SFPUC prepared two annual reports on the condition, status and water supply programs involving the North Westside Groundwater Basin.

### *Groundwater Basin Descriptions*

The City and County of San Francisco are located over seven groundwater basins: Westside, Lobos, Marina, Downtown, Islais Valley, South San Francisco, and Visitation Valley. The Lobos, Marina, Downtown, and South San Francisco Basins are located completely within City limits; the remaining basins extend into San Mateo County. The basins are part of the larger San Francisco Bay Hydrologic Region, as defined by the Department of Water Resources (DWR) in its Bulletin 118. DWR Bulletin 118 describes the groundwater resources of the state and provides individual basin descriptions. DWR has not identified any of the basins listed above as being in overdraft or as being adjudicated.[4]

The following information is from the SFPUC's *2008 Annual Groundwater Monitoring Report Westside Basin.* See Appendix A for the entire report.

> The Westside Basin is about 40 square miles in area and includes four major geologic units. These units are the Jurassic - Cretaceous Franciscan Complex, Pliocene Merced Formation, Pleistocene Colma Formation, and Pleistocene to recent Dune Sands. There are also minor, yet widespread, units of recent alluvium along stream channels. Groundwater development has primarily occurred in the Colma and Merced Formations. The Merced Formation is the primary water-producing aquifer in the basin; however, the Colma Formation is also of interest since Lake Merced is incised within this formation. As a result of the difficulty of differentiating the contacts between the Dune Sands, the Colma Formation, and the Merced Formation, the precise thickness of the Colma Formation and Dune Sands overlying the Merced Formation has not been determined. Groundwater in the vicinity of Lake Merced, and north to Stern Grove and Golden Gate Park, is encountered at relatively shallow depths (ranging from approximately 5 to 60 feet). South of Lake Merced, the depth to groundwater can exceed 300 feet below ground surface (bgs).
>
> Phillips, et al. (1993) defined each of the groundwater basins in San Francisco as a continuous body of unconsolidated sediments and the surrounding surface drainage area. All seven major groundwater basins identified in San Francisco are open to the Pacific Ocean or San Francisco Bay. The landward parts of the groundwater basins generally are bounded horizontally and vertically by bedrock, which is assumed to be relatively impermeable compared with unconsolidated marine and alluvial deposits. Groundwater flow may occur between basins where the bedrock ridge that constitutes the boundary is subterranean. The north-south topography and bedrock height defined by

4 Department of Water Resources. Groundwater Management Technical Assistance – Adjudicated Basins. http://www.groundwater.water.ca.gov/technical_assistance/gw_management/#adbasins

the Coast Ranges generally forms an east-west hydrologic boundary through San Francisco.

The western part of San Francisco is divided into the Westside and Lobos Basins on the basis of a northwest-trending bedrock ridge through the northeastern part of Golden Gate Park. The bedrock ridge has several small surface expressions, and bedrock altitude data indicate that the ridge is continuous, though subterranean. Some degree of hydraulic connection is possible between the two basins where the ridge is not exposed at the land surface, but the degree of connection probably is minimal. The Westside Basin extends south to Burlingame and Hillsborough. Well drillers' logs for the San Bruno area indicate a deep sandy unit overlain by about 200 feet of predominantly fine-grained clays. Correlation of the deeper sand deposits is unclear; however, surficial mapping may indicate a relationship to exposures of sand/gravel deposits in the Burlingame area, which are mapped as non-marine Santa Clara Formation (Brabb and Pampeyan, 1983). A southward-extending ridge of Franciscan bedrock appears to separate San Bruno from the San Francisco Bay to the east. The upper fine grained beds appear to be Holocene to Late Pleistocene estuarine deposits of the San Francisco Bay (LSCE, 2004).

The subsurface configuration of the various geologic units in the Westside Basin has been delineated in a series of geologic cross-sections based on a combination of lithologic logs; water well drillers' reports, and geophysical logs (LSCE, 2004 and 2006). Lithologic units and other significant features in the basin are illustrated in geological cross-section form. In the northern Westside Basin, in San Francisco, there are up to three aquifer units separated by two distinctive fine-grained units, the –100-foot clay and the W-Clay (LSCE, 2004). The aquifer units are generally designated as: 1) The "Shallow aquifer", which is present to an elevation of approximately –100 feet mean sea level (msl) (located above the –100-foot clay), in the vicinity of Lake Merced and the southern portion of the Sunset District of San Francisco; 2) The "Primary Production aquifer", which overlies the W-Clay; and 3) The "Deep aquifer" which underlies the W-Clay. In the Daly City area, the –100-foot clay is absent, and the aquifer system is primarily composed of the Primary Production aquifer and the Deep aquifer. Further to the south, in the South San Francisco area, the W-Clay is absent and the Primary Production aquifer is split into shallow and deep units, separated by a fine-grained unit at an elevation of approximately 300 feet below msl. The primary production aquifer in the San Bruno area is located at an elevation less than 200 feet below msl, and it underlies a thick, surficial fine-grained unit comprised of clay, sandy clay, and sand beds.

#### *1.2.1.2. "Are There Sufficient Supplies to Serve the Project Over the Next 20 Years?"*

Water Code Section 10910 (c)(4) states: "If the City or county is required to comply with this part pursuant to subdivision (b), the water assessment for the project shall include a discussion with regard to whether the total projected water supplies, determined to be available by the City or county for the project during normal, single dry and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses."

The SFPUC, based on the analysis in this WSA, concludes that are adequate supplies to serve the proposed project, including existing demand and planned future uses in the SFPUC's Retail service area through 2030. However, after 2030 in multiple dry-year events, the SFPUC would have to implement its demand management programs to reduce demand to meet projected supply curtailments.

As required, the next step in the SB 610 process is to prepare the assessment of the available water supplies, including the availability of these supplies in all water-year conditions over a 20-year planning horizon, and an assessment of how these supplies relate to project-specific and cumulative demands over that same 20-year period. In this case, the period is 20 years and covers the years 2010 to 2030.

There are three primary areas addressed in a water supply assessment:

- relevant water supply entitlements, water rights, and water contracts;
- a description of the available water supplies; and,
- an analysis of the demand placed on those supplies, both by the project and on a cumulative basis.

Water entitlements and contracts are addressed in Section 2 and demand analysis is discussed in Section 4. Section 6 contains conclusions and findings.

# 2.0 WATER SUPPLY

This section presents the local climate conditions and reviews the SFPUC's water supply sources, entitlements, water rights and contracts.

## 2.1. Climate

San Francisco has a Mediterranean climate. Summers are cool and winters are mild with infrequent rainfall. Temperatures in the San Francisco area average 58 degrees Fahrenheit annually ranging from the mid-40s in winter to the mid-70s in late summer. Strong onshore winds in summer keep the air cool, generating fog through September. The warmest temperatures generally occur in September and October. Rainfall in the San Francisco area averages about 20 inches[5] per year and is generally confined to the "wet" season, from late October to early May. Except for occasional light drizzles from thick marine stratus clouds, summers are nearly completely dry. Coastal fog helps reduce summer irrigation requirements. A summary of temperature and rainfall data for the City of San Francisco is included in Table 2-1.

**Table 2-1: City of San Francisco Climate Summary**

| | Maximum Average Temperature (°F)[a] | Minimum Average Temperature (°F)[a] | Average Monthly Rainfall (inches)[1] |
|---|---|---|---|
| January | 55.8 | 42.5 | 4.38 |
| February | 59.1 | 44.9 | 3.63 |
| March | 61.2 | 46.1 | 2.81 |
| April | 63.9 | 47.6 | 1.37 |
| May | 66.8 | 50.2 | 0.39 |
| June | 70.0 | 52.7 | 0.11 |
| July | 71.5 | 54.1 | 0.02 |
| August | 72.1 | 55.0 | 0.05 |
| September | 73.4 | 54.8 | 0.18 |
| October | 70.2 | 51.9 | 0.96 |
| November | 62.9 | 47.4 | 2.36 |
| December | 56.4 | 43.2 | 3.76 |
| **Annual Average** | **65.3** | **49.2** | **20.00** |

Note:
1. Source: Western Regional Climate Center – San Francisco. Data from 1/1/1937 to 12/31/2008.

According to the Department of Water Resources, eleven droughts have occurred in California since 1850.[6] The year 1977 is recognized as the driest single year of California's measured hydrologic record. The most recent multi-year statewide drought took place between 1987 and 1992. Droughts exceeding three years are relatively rare in Northern California; however, even localized droughts in Northern California have extensive repercussions for water agencies dependent upon Sierra Nevada snowpack and spring runoff.

5 Hydrologic data from 1971 -2000: Western Regional Climate Center; Mission Delores/SF 047772 and Richmond/SF 047767.

6 Department of Water Resources. Background: Droughts in California. http://watersupplyconditions.water.ca.gov/background.cfm, accessed September 2007.

## 2.2. Water Supply Entitlements, Water Rights and Contracts

Water Code Section 10910 (d)(1) states: "The assessment required by this section shall include an identification of any existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project, and a description of the quantities of water received in prior years by the public water system, or the City or county if either is required to comply with this part pursuant to subdivision (b), under the existing water supply entitlements, water rights or water service contracts."

## 2.3. Introduction to the SFPUC Water Supply Sources

The Regional Water System (RWS) currently delivers an annual average of approximately 265 million gallons of water per day (mgd), with approximately 85 percent of that water supply provided by the Hetch Hetchy system, which diverts water from the Tuolumne River. The balance (of approximately 15 percent) comes from runoff in the Alameda Creek watershed, which is stored in the Calaveras and San Antonio reservoirs, and runoff from the San Francisco Peninsula, which is stored in the Crystal Springs, San Andreas, and Pilarcitos reservoirs (which also provide storage for water delivered from the Hetch Hetchy Project). A small portion of retail demand is met through locally produced groundwater, used primarily for irrigation at local parks and on highway medians, and recycled water, which is used for wastewater treatment process water, sewer box flushing, and similar wash down operations. The SFPUC also retails groundwater (pumped from the Pleasanton well field) to the Castlewood development in Alameda County.

### 2.3.1. Surface Water Rights

The City and County hold pre-1914 appropriative water rights to store and deliver water from the Tuolumne River in the Sierra Nevada and locally from the Alameda and Peninsula watersheds. The City and County also divert and store water in the San Antonio Reservoir under an appropriative water right license granted by the State Water Resources Control Board (SWRCB) in 1959.

Appropriative water rights allow the holder to divert water from a source to a place of use not connected to the water source. These rights are based on seniority and use of water must be reasonable, beneficial, and not wasteful. In 1914, California established a formal water rights permit system, which is administered by the SWRCB. The SWRCB has sole authority to issue new appropriative water rights but cannot define property rights created under a pre-1914 appropriative water right.

The 1912 Freeman Report identified the ultimate diversion rate from the Tuolumne River to the Bay Area as 400 mgd and the City used this as the basis for designing the export capacity of the Hetch Hetchy project. The City has sufficient water rights for current diversions and the ultimate planned diversion rate of the Hetch Hetchy Project.

The federal Raker Act, enacted on December 19, 1913, grants to the City rights-of-way and public land use on federal property in the Sierra Nevada Mountains to construct, operate, and maintain reservoirs, dams, conduits, and other structures necessary or incidental to developing and using water and power. It also imposes restrictions on the City's use of the Hetch Hetchy Reservoir, including (among others) the requirement that the City recognize the senior water rights of the Turlock and Modesto Irrigation Districts (TID and MID) to divert water from the Tuolumne River. Specifically, the Raker Act requires the City to bypass certain flows through its Tuolumne River reservoirs to TID and MID for beneficial use. By agreement, the City, TID, and MID have supplemented these Raker Act obligations to increase the TID and MID entitlements to account for other senior Tuolumne River water rights and to allow the City to "pre-pay" TID and

MID their entitlement by storing water in the Don Pedro water bank. The City is required to bypass inflow to TID and MID sufficient to allow these districts to divert 2,416 cfs or natural daily flow, whichever is less, at all times (as measured at La Grange), except for April 15 to June 13, when the requirement is 4,066 cfs or natural daily flow as measured at La Grange, whichever is less.

## 2.4. Water Supply Considerations

The SFPUC prepared a Program Environmental Impact Report (PEIR) under CEQA for the Water System Improvement Program (WSIP). (A discussion of the WSIP follows in Section 2.7.1). At the request of the SFPUC, the San Francisco Planning Department studied the Phased WSIP Variant as part of the environmental analysis. The SFPUC identified this variant in order to consider a program scenario that involved full implementation of all proposed WSIP facility improvement projects to insure that the public health, seismic safety, and delivery reliability goals were achieved as soon possible, but phased implementation of a water supply program to meet projected water purchases through 2030. Deferring the 2030 water supply element of the WSIP until 2018 would allow the SFPUC and its wholesale customers to focus first on implementing additional local recycled water, groundwater, and demand management actions while minimizing additional diversions from the Tuolumne River.

The Phased WSIP Variant establishes a mid-term planning milestone in 2018 when the SFPUC would reevaluate water demands through 2030 in the context of then-current information, analysis, and available water resources. The SFPUC currently delivers an annual average of approximately 265 million gallons per day (mgd) from local watersheds (Peninsula and Alameda Creek) and the Tuolumne River Watershed. By 2030, demand on the SFPUC system is expected to increase to an annual average of 300 mgd. The Phased WSIP Variant would meet the projected 2018 purchase requests of 285 mgd from the RWS by capping purchases at 265 mgd; the remaining 20 mgd would be met through water conservation, recycling, and groundwater use—10 mgd by Wholesale Customers and 10 mgd in the City. Before 2018, the SFPUC and the Wholesale Customers will engage in a new planning process to re-evaluate water system demands and supply options, including conducting additional studies and environmental reviews necessary to address water supply needs after 2018. Therefore, this WSA assumes the SFPUC will limit purchases to an annual average of 265 mgd from the RWS watersheds.

## 2.5. SFPUC Regional Water System

In 1934, San Francisco combined the Hetch Hetchy system and Spring Valley system to create the SFPUC RWS. The rights to local diversions were originally held by the Spring Valley Water Company, which was formed in 1862. The RWS is owned and operated by the City and County.

On average, the Hetch Hetchy Project provides over 85 percent of the water delivered and the balance approximately 15 percent is met through the Bay Area reservoirs. The RWS delivers an annual average of approximately 265 mgd – 81 mgd serves the Retail customers within the City and County of San Francisco and the other 184 mgd is delivered to the Wholesale customers. The RWS currently delivers water to 2.5 million users in Tuolumne, Alameda, Santa Clara, San Mateo, and San Francisco counties.

The RWS is a complex system, shown in Figure 2-1, and supplies water from two primary sources:

- Tuolumne River through the Hetch Hetchy Reservoir, and

- Local runoff into reservoirs in Bay Area reservoirs in the Alameda and Peninsula watersheds.

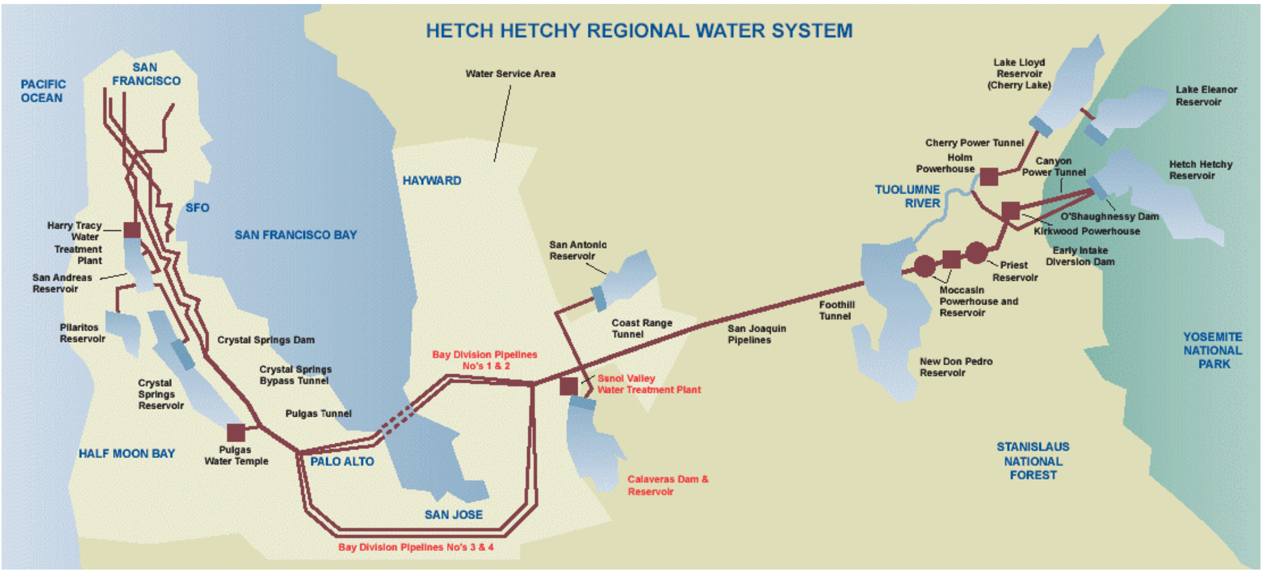


**Figure 2-1: Regional Water Supply System**

Water from Hetch Hetchy Reservoir, through the Hetch Hetchy facilities represents the majority of the water supply available to the SFPUC. On average, the Hetch Hetchy Project provides over 85 percent of the water delivered to the Bay Area. During droughts the water received from the Hetch Hetchy system can amount to over 93 percent of the total water delivered.

Bay Area reservoirs provide on average approximately 15 percent of the water delivered by the SFPUC RWS. The local watershed facilities are operated to conserve local runoff for delivery. On the San Francisco Peninsula, the SFPUC utilizes Crystal Springs Reservoir, San Andreas Reservoir, and Pilarcitos Reservoir to capture local watershed runoff. In the Alameda Creek watershed, the SFPUC constructed the Calaveras Reservoir and San Antonio Reservoir. In addition to capturing runoff, San Antonio, Crystal Springs, and San Andreas reservoirs also provide storage for Hetch Hetchy diversions. The local watershed facilities also serve as an emergency water supply in the event of an interruption to Hetch Hetchy diversions.

### 2.5.1. Local Groundwater

San Francisco overlies all or part of seven groundwater basins. These groundwater basins include the Westside, Lobos, Marina, Downtown, Islais Valley, South, and Visitation Valley basins. The Lobos, Marina, Downtown, and South basins are located wholly within the City limits, while the remaining three extend south into San Mateo County. The portion of the Westside Basin aquifer located within San Francisco is commonly referred to as the North Westside Basin. With the exception of the Westside and Lobos basins, all of the basins are generally inadequate to supply a significant amount of groundwater for municipal supply because of low yield.

Early in its history, San Francisco made significant use of local groundwater, springs, and spring-fed surface water. However, after the development of surface water supplies in the Peninsula and Alameda watersheds by Spring Valley Water Company and the subsequent completion of the Hetch Hetchy Reservoir and aqueduct in the 1930's, the municipal water supply system has relied almost exclusively on surface water from local runoff, the Alameda and

Peninsula watersheds, and the Tuolumne River watershed. Local groundwater use, however, has continued in the City primarily for irrigation purposes. The San Francisco Zoo and Golden Gate Park use groundwater for non-potable purposes. Current use accounts for annual average of approximately 2.5 mgd.

About one (1) mgd of groundwater is delivered to Castlewood Country Club from well fields operated by the SFPUC in Pleasanton and drawn from the Central Groundwater Sub Basin in the Livermore/Amador Valley. These wells are metered and have been in operation for several decades. For purposes of water accounting and billing, these deliveries to Castlewood are accounted for as part of San Francisco's Retail Customer base. Castlewood groundwater supplies are used entirely within Castlewood and not available for use in the City and County of San Francisco.

### 2.5.2. Local Recycled Water

From 1932 to 1981, the City's McQueen Treatment Plant provided recycled water to Golden Gate Park for irrigation purposes. Because of changes in regulations the City closed the McQueen plant and discontinued use of recycled water in Golden Gate Park. Currently, recycled water from the SFPUC's Southeast Water Pollution Control Plant is used on a limited basis for wash-down operations and is provided to construction contractors for dust control and other nonessential construction purposes. Current use of recycled water for these purposes in the City is less than one mgd.

### 2.5.3. Local Water Conservation

The SFPUC is committed to demand-side management programs and the City's per capita water use has dropped by about one-third since 1977 due, in part, to these programs. The first substantial decrease came following the 1976-77 drought in which gross per capita water use dropped from 160 to 130 gallons per capita per day (gpcd). Despite continuous growth in the City since then, water demands have remained lower than pre-drought levels.

A second substantial decrease in water use within the City occurred as a result of the 1987-92 drought when a new level of conservation activities resulted in further water use savings. It is anticipated that through the continuation and expansion of these programs, per capita water use will continue to decrease into the future. Current gross per capita water use within the City is 91.5 gpcd with residential water use calculated to be approximately 57 gpcd, the lowest use of any major urban area in the State.

The SFPUC's demand management programs range from financial incentives for plumbing devices to improvements in the distribution efficiency of the system. The conservation programs implemented by the SFPUC are based on the California Urban Water Conservation Council's list of fourteen Best Management Practices identified by signatories of the Memorandum of Understanding Regarding Urban Water Conservation in California executed in 1991.

## 2.6. Water Supply Reliability and Improvements

To improve dry-year supplies and ensure that the future water needs of its retail and wholesale customers will be met in a more reliable and sustainable manner, the SFPUC has undertaken water supply projects in the WSIP. In addition, the SFPUC is looking to diversify and enhance the City's water supply portfolio through the development of local water supplies, such as recycled water, groundwater, and water conservation.

### 2.6.1. Water System Improvement Program and the Phased WSIP Variant

The WSIP is a multi-billion dollar, multi-year, capital program to upgrade the RWS. The program will deliver improvements that enhance the SFPUC's ability to provide reliable, affordable, high quality drinking water to its 27 wholesale customers and regional Retail customers in Alameda, Santa Clara, and San Mateo counties, and to 800,000 Retail customers in San Francisco, in an environmentally sustainable manner.

As required under CEQA, the San Francisco Planning Department prepared a PEIR for the WSIP. The PEIR evaluated the potential environmental impacts of the proposed WSIP and identified potential mitigations to those impacts. The PEIR also evaluated several alternatives to meet the SFPUC service area's projected increase in water demand between now and 2030. The water supply improvement options investigated included 10 alternatives using various water supply combinations from the local watersheds; the Tuolumne and Lower Tuolumne; ocean desalination; and additional recycled water, groundwater, and conservation.

The PEIR was certified by the San Francisco Planning Commission on October 30, 2008. On the same day the SFPUC adopted the Phased WSIP Variant option. (Appendix B contains the SFPUC Commission Agenda Item for approval of the PEIR)

#### *2.6.1.1. Phased WSIP Variant*

At the request of the SFPUC, the San Francisco Planning Department studied the Phased WSIP Variant as part of the environmental analysis. The SFPUC identified this variant in order to consider a program scenario that involved full implementation of all proposed WSIP facility improvement projects to insure that the public health, seismic safety, and delivery reliability goals were achieved as soon possible, but phased implementation of a water supply program to meet projected water purchases through 2030. Deferring the 2030 water supply element of the WSIP until 2018 would allow the SFPUC and its wholesale customers to focus first on implementing additional local recycled water, groundwater, and demand management actions while minimizing additional diversions from the Tuolumne River.

The Phased WSIP Variant establishes a mid-term planning milestone in 2018 when the SFPUC would reevaluate water demands through 2030 in the context of then-current information, analysis and available water resources. The SFPUC currently delivers an annual average of approximately 265 million gallons of water per day from local watersheds (Peninsula and Alameda Creek) and the Tuolumne River Watershed. By 2030, demand on the SFPUC system is expected to increase to an annual average of 300 million gallons of water per day. The Phased WSIP Variant would meet the projected 2018 purchase requests of 285 mgd from the RWS by capping purchases from the watersheds at 265 mgd; the remaining 20 mgd would be met through water efficiencies and conservation, water recycling and local groundwater use—10 mgd by Wholesale Customers and 10 mgd in the City and County. Before 2018, the SFPUC and the Wholesale Customers will engage in a new planning process to reevaluate water system demands and supply options, including conducting additional studies and environmental reviews necessary to address water supply needs after 2018.

The Phased WSIP Variant includes the following key program elements:

- Full implementation of all WSIP facility improvement projects.
- Water supply delivery to RWS customers through 2018 only of 265 mgd average annual target delivery originating from the watersheds. This includes 184 mgd for the Wholesale Customers and 81 mgd for the Retail Customers.

- Water supply sources include: 265 mgd average annual from the Tuolumne River and local watersheds and 20 mgd of water conservation, recycled water and local groundwater developed within the SFPUC's service area (10 mgd Retail; 10 mgd wholesale).
- Dry-year water transfers of 2 mgd coupled with the Westside Groundwater Basin Conjunctive Use Project.
- Re-evaluation of 2030 demand projections, potential RWS purchase requests and water supply options by December 31, 2018 and a separate SFPUC decision in 2018 regarding RWS water deliveries after 2018.
- The ability to impose financial penalties is included in the new Water Supply Agreement to limit water sales to an average annual of 265 mgd from the watersheds.

The additional 10 mgd of supplies produced in San Francisco by implementation of the local WSIP programs have been included in this WSA. This WSA assumes WSIP local water supplies will be in place in the timeframes stated in the SFPUC WSIP. With this assumption, total Retail supplies increase to 94.50 mgd in 2015 and remain constant over the 20-year planning horizon. Projects related to these efforts are detailed below. WSIP programs, financials and progress-to-date is presented in Appendix C.

### 2.6.2. Local Groundwater Projects

#### *2.6.2.1. San Francisco Groundwater Supply Project*

The San Francisco Groundwater Supply Project would provide up to 4 mgd of local groundwater water to improve reliability during drought or maintenance conditions, as well as ensure that a reliable, high-quality source of water is available in the case of an earthquake or other emergency. The project proposes the construction of up to six wells and associated facilities in the western part of San Francisco to extract up to 4 mgd of groundwater water from the Westside Groundwater Basin for distribution in the City. The extracted groundwater, which would be used both for regular and emergency water supply purposes, would be disinfected and blended in small quantities with imported surface water before entering the municipal drinking water system. The environmental review for this project begins in November 2009.

#### *2.6.2.2. Lake Merced Water Level Restoration Project*

The goal of the Lake Merced Water Level Restoration Project is to protect and balance the beneficial uses of Lake Merced by providing a more stable water level regime using groundwater and stormwater, rather than supplies provided through the RWS.

#### *2.6.2.3. Local Recycled Water Projects*

In March 2006, the SFPUC updated the Recycled Water Master Plan (RWMP) for the City. The 2006 RWMP identified where and how San Francisco could most feasibly develop recycled water in the City and provided strategies for implementing the recycled water projects that were identified.

The proposed Westside, Harding Park and Eastside Recycled Water Projects would provide up to 4 mgd of recycled water to a variety of users in San Francisco. Recycled water will primarily be used for landscape irrigation, toilet flushing and industrial purposes. The Harding Park Project has completed environmental review, and the Westside Project will begin environmental review in late 2009 or early 2010.

The proposed Westside Project would bring recycled water from the proposed recycled water treatment facility in Golden Gate Park to the San Francisco Zoo, Golden Gate Park, and Lincoln Park Golf Course. Recycled water would be used for irrigation at all three sites; additionally, it would be used for non-potable uses in Golden Gate Park at the California Academy of Sciences. The proposed Harding Park Recycled Water Project would use available recycled water from the North San Mateo County Sanitation District (NSMCSD) located in Daly City, to irrigate Harding Park and Fleming Park golf courses in San Francisco. The SFPUC has partnered with the NSMCSD for this proposed project.

Currently, the SFPUC is conducting a recycled water demand assessment on the Eastside of San Francisco. The assessment examines the potential uses of recycled water for irrigation, toilet flushing, and commercial applications. The WSIP contains funding for planning, design, and environmental review for the San Francisco Eastside Recycled Water Project.

### 2.6.3. Local Water Conservation

The SFPUC has also increased its water conservation programs in an effort to achieve new water savings by 2018. The SFPUC's conservation program is based on the Demand Study that identified water savings and implementation costs associated with a number of water conservation and efficiency measures. The Demand Study evaluated the costs and benefits of implementing 48 different conservation measures using an end-use model. The results indicated that local conservation programs implemented through 2030 could cumulatively reduce Retail purchases from the SFPUC RWS by 4.5 mgd in year 2030. These new conservation programs include high-efficiency toilet replacement in low-income communities, plumbing retrofits in compliance with the 1992 California plumbing code and water efficient irrigation systems in municipal parks. Through its expanded conservation program, the SFPUC anticipates reducing gross per capita consumption from 91.5 gpcd to 87.4 gpcd by 2018 for an average daily savings of approximately 4.0 mgd.

### 2.6.4. Summary of New Local Water Supply Programs

As previously stated, the SFPUC anticipates that the expanded groundwater and recycled water production, and increased conservation programs will provide the City with an additional 10 mgd of local water supplies. As quantified in Table 2-2 with implementation of the WSIP, the SFPUC expects to have in these local supplies in place by 2015. These programs and projects are reliable in all hydrologic conditions and are not subject to WSAP reductions or curtailments. (Appendix C contains the Summary of the WSIP Projects, a Quarterly Progress Report [April – June 2009] and other progress-to-date information)

**Table 2-2: WSIP Water Supply Sources (mgd)**

| WSIP Water Supplies | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| Groundwater (SF GWSP) | 0.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Recycled Water | 0.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Conservation Supply | 0.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| **Total New Supplies** | **0.0** | **10.0** | **10.0** | **10.0** | **10.0** |

Source: SFPUC Water System Improvement Program, October 2008.

## 2.7. Total SFPUC Retail Water Supplies

Table 2-3 summarizes the SFPUC's total water supplies now and over the 20-year planning period. In 2010, prior to the development of the 10 mgd of local supplies, the SFPUC can access an annual average 84.50 mgd from all sources discussed above. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.5 mgd. These supplies are assumed to be available in the quantities listed in Table 2-3. The SFPUC intends to use these supplies to meet its Retail customer demands.

**Table 2-3: SFPUC Water Supplies 2010 - 2030**

| Water Supply Sources | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| **Current Water Supply Sources** | | | | | |
| SFPUC RWS (Surface water: Tuolumne River, Alameda & Peninsula)(1) | 81.0 | 81.0 | 81.0 | 81.0 | 81.0 |
| **Groundwater Sources** | | | | | |
| Groundwater (In-City Irrigation Purposes) | 2.5(2) | 0.5(3) | 0.5(3) | 0.5(3) | 0.5(3) |
| Groundwater at Castlewood(4) | 1.0(4) | 1.0(4) | 1.0(4) | 1.0(4) | 1.0(4) |
| Groundwater: Treated for Potable – Previously used for In-City Irrigation purposes(5) | 0.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| **Groundwater Subtotal** | **3.5** | **3.5** | **3.5** | **3.5** | **3.5** |
| **Current Water Supply Subtotal** | **84.5** | **84.5** | **84.5** | **84.5** | **84.5** |
| WSIP Water Supply Sources | | | | | |
| Groundwater Development: Potable from SF GWSP (Westside Groundwater Basin)(6) | 0.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Recycled Water Expansion for Irrigation(7) | 0.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Conservation Supply Program | 0.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| **WSIP Supply Subtotal** | **0.0** | **10.0** | **10.0** | **10.0** | **10.0** |
| **Total Retail Supply (Current and WSIP Supplies)** | **84.5** | **94.5** | **94.5** | **94.5** | **94.5** |

Notes:
1. RWS surface water supplies are subject to reductions due to below-normal precipitation. This may affect dry year supplies - model shows supply reduction occurs in year 2 of multiple dry year event. (Source: SFPUC 2008 WSIP Phase Variant Supply limitation)
2. Groundwater serves irrigation to Golden Gate Park, SF Zoo, and Great Highway Median. (Source: 2005 SFPUC UWMP Table 8B page 43)
3. A Groundwater reserve of 0.5 mgd for irrigation purposes will remain as part of SFPUC's non-potable groundwater supply. (Source: SFPUC 2008 WSIP Phase Variant)
4. Castlewood current and projected use remains unchanged over 20 year planning horizon. (Source: 2005 SFPUC UWMP Table 8B page 43)
5. 2.0 mgd of groundwater treated and blended for Potable water supply purposes. (Source: 2005 SFPUC UWMP Table 8B page 43)
6. 2.0 mgd of new groundwater developed as part of the new local supply target. (Source: SFPUC 2008 WSIP Phase Variant Supply Target)
7. 2.0 mgd of Recycled used for irrigation at Golden Gate Park, SF Zoo, Great Highway Median, and 2.0 mgd for other non-potable purposes. (Source: SFPUC 2008 WSIP Phase Variant Supply Target)

Figure 2-1 is a graphical representation of the SFPUC's current supply sources and the WSIP local supply sources. As shown in Figure 2-2, the supplies grow from 84.5 mgd in 2010 to 94.5 mgd as the WSIP local supplies are brought into the SFPUC Retail supply system. The figure shows the total supplies increasing in 2015 and holding constant over the 20-year planning horizon.

### 2.7.1. New Drought Year Supplies

As outlined above, the WSIP includes development of dry-year supplies for the RWS – these supplies would be readily available during dry years when the watershed supplies are cutback due to below-normal precipitation. The PEIR also included an analysis of dry-year water supply transfers from the senior water rights holders (MID and TID) on the Tuolumne River in 2018; a groundwater conjunctive use project; and, a regional desalination project. The latter two projects are described in greater detail in Section 3.4. The SFPUC is currently investigating the possibility of a dry-year water transfer with MID and TID in 2018. (See Appendix D for an expanded discussion of dry year water supply programs and projects)

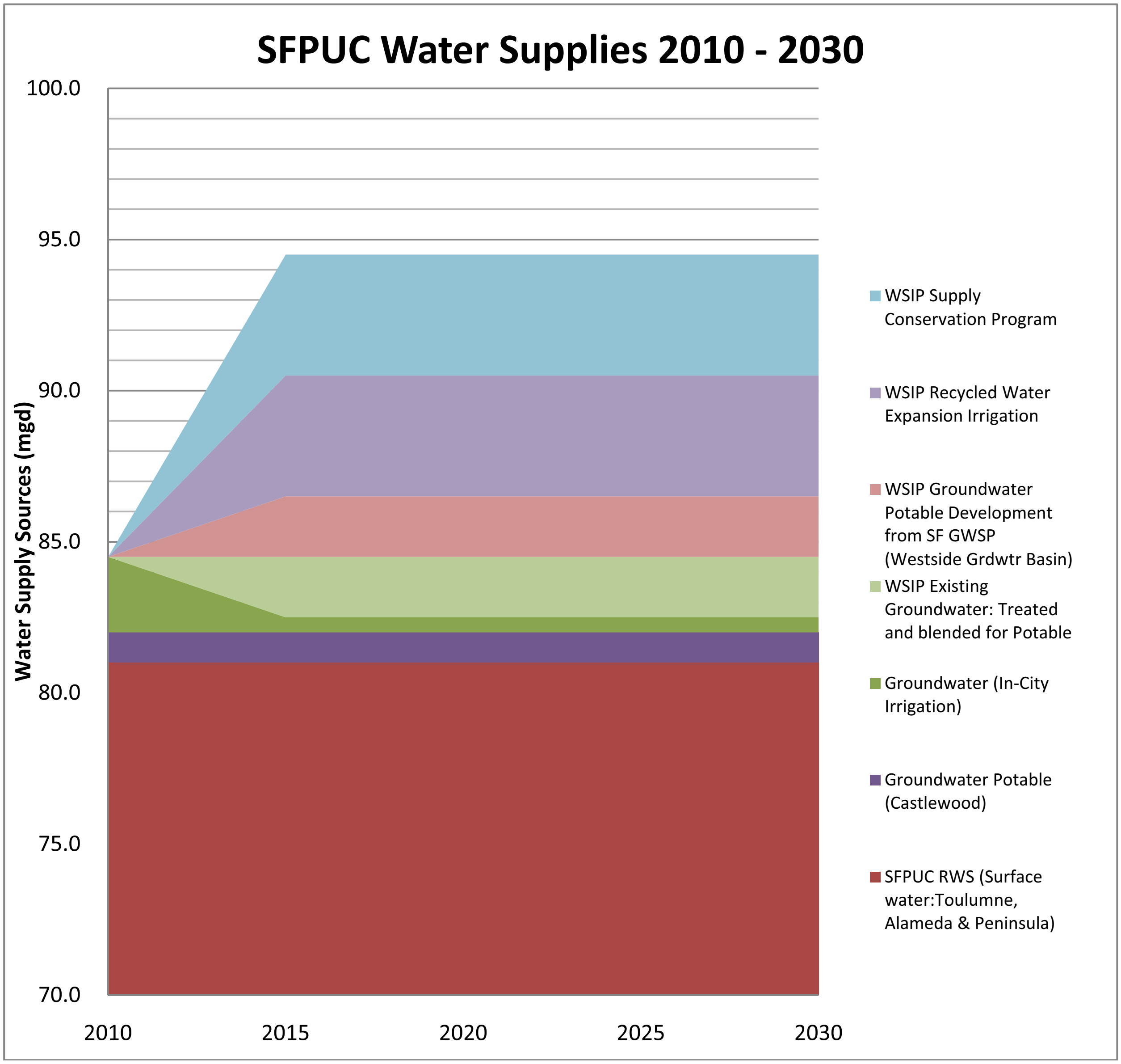


**Figure 2-2: SFPUC Water Supplies**

# 3.0 DROUGHT SUPPLY PLANNING AND WATER SUPPLY RELIABILITY

## 3.1. Overview

The SFPUC water supply system reliability is expressed in terms of its ability to deliver water during droughts. Reliability is defined by the amount and frequency of water delivery reductions required to balance customer demands with available supplies in droughts. The SFPUC has a reliability goal of meeting dry-year delivery needs while limiting rationing to a maximum 20 percent system-wide reduction in water service during extended droughts.

The total amount of water the SFPUC has available to deliver to its retail and wholesale customers during a defined period of time is dependent on several factors. These include the amount of water that is available to the SFPUC from natural runoff, the amount of water in reservoir storage, and the amount of water that must be released from the SFPUC's system for commitments to purposes other than customer deliveries, such as releases below Hetch Hetchy reservoir to meet the Raker Act and fishery purposes.

The SFPUC operates its system to optimize the reliability and quality of its water deliveries. Hetch Hetchy Reservoir operations are guided by two principal objectives: collection of Tuolumne River water runoff for diversion to the Bay Area; and fulfillment of the SFPUC's downstream release obligations. To conserve runoff, Hetch Hetchy Project reservoirs are drawn down beginning in early winter, relying on the recurrence and forecast of snow melt to guide drawdown releases. Similarly, the RWS Bay Area reservoirs are operated to conserve watershed runoff. As such, reservoirs are drawn down during the winter period to capture storms and reduce the potential for spilling water out of the reservoirs. In the spring, excess Hetch Hetchy water supply (snowmelt) is transferred to three of the Bay Area reservoirs, capable of receiving the water, to fill any unused reservoir storage.

Prior to the late 1970's, droughts did not seriously affect the ability of the SFPUC to sustain full deliveries to its customers. However, as the 1987-1992 drought progressed and reservoir storage continued to decline, it became apparent that continued full deliveries could not be sustained without the risk of running out of water before the drought ended.

To provide some level of assurance that water could be delivered continuously throughout a drought (although at reduced levels), the SFPUC adopted a drought planning sequence and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in SFPUC's reservoirs. Each year, during the snowmelt period, the SFPUC evaluates the amount of total water storage expected to occur throughout the RWS. If this evaluation finds the projected total water storage to be less than an identified level sufficient to provide sustained deliveries during drought, the SFPUC may impose delivery reductions or rationing.

SFPUC's UWMP assumes "firm" delivery "as the amount the system can be expected to deliver during historically experienced drought periods."[7] The 1987 to 1992 drought is the basis for this plan, plus an additional period of limited water availability.[8] The SFPUC plans its water deliveries assuming that the worst drought experience is likely to recur and then adds an additional period of limited water availability. An 8.5-year drought scenario is referred to as the "design drought" and is ultimately the basis for SFPUC's water resource planning and modeling.

7 San Francisco Public Utilities Commission. December 2005. *Urban Water Management Plan*. p. 21.
8 San Francisco Public Utilities Commission. December 2005. *Urban Water Management Plan*. p. 21.

The "design drought" is based on the 1986-1992 drought plus 2.5 years of "prospective drought", which includes 6 months of recovery period.[9]

### 3.1.1. Water Shortage Allocation Plan

During a drought, it is expected that the retail and wholesale customers would experience a reduction in the amount of water received from the RWS. The amount of this reduction has been dictated by existing contractual agreements between the SFPUC and the Wholesale Customers, as detailed in the existing Water Shortage Allocation Plan (WSAP). The WSAP provides specific allocations of available water between the retail and wholesale customers collectively associated with different levels of system-wide shortages, as shown in Table 3-1.

**Table 3-1: WSAP Allocation**

| Level of System-Wide Reduction in Water Use Required | Share of Available Water | |
|---|---|---|
| | SFPUC Share | Wholesale Customers Share (collectively) |
| 5% or less | 35.5% | 64.5% |
| 6% through 10% | 36.0% | 64.0% |
| 11% through 15% | 37.0% | 63.0% |
| 16% through 20% | 37.5% | 62.5% |

In addition to providing an allocation method, the plan also includes provisions for transfers, banking and excess use charges.

Under the WSAP, SFPUC retail customers would experience no reduction in deliveries at a 10 percent shortage. However, during a 20 percent system-wide shortage, the retail customers would experience a 1.9 percent reduction in retail deliveries. This assumes the development of the additional 10 mgd of local supplies in the retail service area. These additional supplies are not subject to a reduction under the WSAP as the WSAP only allocates water from the RWS. Table 3-2 compares SFPUC RWS retail supplies during normal, single dry year, and multiple dry year periods.

**Table 3-2: 2005 – 2030 SFPUC Retail Allocations in Normal, Dry and Multiple Dry Years**

| | Normal Year | | Single Dry Year | | Multiple Dry Year Event | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Year 1 | | Year 2 | | Year 3 | |
| | mgd | % | mgd | % | mgd | % | mgd | % | mgd | % |
| 2010 | 81.0 | 100% | 81.0 | 100.0% | 81.0 | 100.0% | 79.5 | 98.1% | 79.5 | 98.1% |
| 2015 | 81.0 | 100% | 81.0 | 100.0% | 81.0 | 100.0% | 79.5 | 98.1% | 79.5 | 98.1% |
| 2020 | 81.0 | 100% | 81.0 | 100.0% | 81.0 | 100.0% | 79.5 | 98.1% | 79.5 | 98.1% |
| 2025 | 81.0 | 100% | 81.0 | 100.0% | 81.0 | 100.0% | 79.5 | 98.1% | 79.5 | 98.1% |
| 2030 | 81.0 | 100% | 81.0 | 100.0% | 81.0 | 100.0% | 79.5 | 98.1% | 79.5 | 98.1% |

Notes:
1. In 2010 the retail allocation of RWS supply is reduced to 81 mgd to reflect the retail allocation under the 2018 Phased WSIP Variant. 10 mgd of recycled water, groundwater, and conservation will be implemented by 2015 to make up for the loss in RWS supply. The 10 mgd of local supply is not subject to reduction under the WSAP.
2. Under the WSAP, the SFUPC retail allocations at a 10 percent shortage are 85.86 mgd. However, due to the Phased WSIP Variant, only 81 mgd of RWS supply is shown. The remaining supply can be transferred to the Wholesale Customers under the terms of the Water Supply Agreement.

Source: San Francisco Public Utilities Commission. 2005. Urban Water Management Plan for the City and County of San Francisco. p. 54-57 and discussions with SFPUC staff.

9 San Francisco Public Utilities Commission. April 2000. *Water Supply Master Plan*. p. 22.

The WSAP has been carried forward in the new Water Supply Agreement for system-wide shortages of up to 20 percent. For shortages in excess of this amount, the Water Supply Agreement provides that the SFPUC may allocate water in its discretion.

## 3.2. Retail Water Shortage Allocation Plan

San Francisco has established criteria that relate water deliveries to water supply and the SFPUC's objectives to manage water deliveries during extended drought. These criteria provide guidance to the SFPUC for the determination of the annual availability of water. The structure of the criteria was developed during the course of the 1987-92 drought period and incorporates procedures which were implemented during actual operations.

The established water delivery criteria incorporate a three-level staging of delivery reductions: the first stage is associated with voluntary actions by customers and the second and third stages are associated with mandatory rationing programs enforced by the SFPUC. Depending on the level of water demand and the desired maximum delivery reduction, one, two or all three of the stages are required. These criteria have been found to be viable through computer simulation of historical drought events and resultant SFPUC operations.

Based on past drought experience and the established criteria, San Francisco's Retail Water Shortage Allocation Plan (RWSAP) was adopted to formalize the three-stage program of action to be taken in San Francisco to reduce water use during a drought.

In accordance with the RWSAP, prior to the initiation of any water delivery reductions in San Francisco, whether it be initial implementation of reduction delivery or increasing the severity of water shortage, the SFPUC would outline a drought response plan that would address the following: the water supply situation; proposed water use reduction objectives; alternatives to water use reductions; methods to calculate water use allocations and adjustments; compliance methodology and enforcement measures; and, budget considerations. This drought response will be presented at a regularly scheduled SFPUC Commission meeting for public input. The meeting will be advertised in accordance with the requirements of Water Code Section 6066 of the Government Code, and the public will be invited to comment on the SFPUC's intent to reduce deliveries.

Depending on the level of water demand and the desired objective for water use reduction, one, two, or all three stages of the RWSAP may be required.

<u>Stage 1 (Voluntary)</u>

- System-wide demand reductions of 5-10 percent experienced
- Voluntary rationing request of customers
- Customers are alerted to water supply conditions
- Remind customers of existing water use prohibitions
- Education on, and possible acceleration of, incentive programs

<u>Stage 2 (Mandatory)</u>

- System-wide demand reductions of 11-20 percent experienced
- All Stage 1 actions implemented
- All customers receive an "allotment" of water based on the Inside/Outside allocation method (based on base year water usages for each account)

- Water use above the "allocation" level will be subject to excess use flow restrictor devices and shut-off of water

Stage 3 (Mandatory)

- System-wide demand reductions of 20 percent or greater experienced
- Same actions as in Stage 2 with further reduced allocations

## 3.3. Urban Water Management Planning Act (Water Code Section 10632)

Pursuant to the Urban Water Management Planning Act (Water Code Section 10632), water suppliers with an existing dry year shortage contingency plan can implement subsequent stages of demand reduction measures listed in its UWMP as a strategy to balance supply and demand. The WSAP and the RWSAP, contained in Section 9 of the SFPUC's 2005 UWMP is the SFPUC's dry year shortage contingency plan that allows the SFPUC to reduce water deliveries to customers and implement demand reductions during periods of water shortage. Therefore, when a supply deficit occurs, the SFPUC would follow its adopted water shortage contingency plans (WSAP and RWSAP) to implement drought-planning sequences and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in the SFPUC reservoirs. These delivery reductions allow the SFPUC to maintain water in storage over an extended period. In addition, under the RWSAP, the SFPUC would balance Retail supply curtailments by reducing demand.

## 3.4. Dry Year Water Supply Projects

As discussed in Section 2.7, the SFPUC, as part of the WSIP, has currently engaged the following projects or programs as methods to improve RWS dry-year supplies. Within the WSIP, the SFPUC addressed the development of supplies to be utilized during dry year events. These plans include the use of recycled water as component of a conjunctive use program and participation in the development of Bay Area desalination plant. Each of these plans is discussed below. (See Appendix D for an expanded discussion of dry year water supply programs and projects)

## 3.5. Development of Dry Year Supplies

### 3.5.1. Groundwater Storage and Recovery Project

The proposed Regional Groundwater Storage and Recovery Project would balance the use of both groundwater and surface water to increase water supply reliability during dry years or in emergencies. The proposed project is located in San Mateo County and is sponsored by the SFPUC in coordination with its partner agencies, the California Water Service Company, City of Daly City and City of San Bruno. The partner agencies currently purchase wholesale surface water from the SFPUC and also independently operate groundwater production wells for drinking water and irrigation.

The proposed Regional Groundwater Storage and Recovery Project would extract groundwater from the South Westside Basin groundwater aquifer in San Mateo County. The project would consist of installing up to 16 new recovery well facilities in northern San Mateo County to pump stored groundwater during a drought. During years of normal or heavy precipitation, the proposed project would provide surface water to the partner agencies in order to reduce the amount of groundwater pumped. Over time, the reduced pumping would result in the storage of approximately 61,000 acre-feet of water (more than the supply contained in the Crystal Springs Reservoir on the SFPUC Peninsula Watershed). This would allow recovery of this stored water at a rate of up to 7.2 mgd for a 7.5-year dry period. The water would be in compliance with the California Department of Public Health requirements for drinking water supplies. This project would include construction of well pump stations, disinfection units, and piping. This project is currently undergoing environmental review.

### 3.5.2. Desalination

The SFPUC's investigations of desalination as a water supply source have focused primarily on the potential for regional facilities. The proposed Bay Area Regional Desalination Project is a joint venture between the SFPUC, Contra Costa Water District, East Bay Municipal Utility District, and the Santa Clara Valley Water District. The regional desalination project would: provide an additional source of water during emergencies; provide a supplemental water supply source during extended droughts; allow other major water facilities to be taken out of service for maintenance or repairs; and increase supply reliability by providing water supply from a regional facility. The Bay Area Regional Desalination Project would have an ultimate total capacity of up to 65 mgd.[10]

10 EBMUD, "Desalination Project", www.ebmud.com/water_&_environment/water_supply/current_projects/desalination_project/default.htm, accessed July 30, 2009.

# 4.0 WATER DEMAND OVERVIEW

The SFPUC provides wholesale water service to 27 Bay Area water agencies located in Alameda, San Mateo and Santa Clara Counties (Wholesale Customers), and also serves as the retail water supplier for the City. This section shows the calculated water demand for the proposed project as well the calculated water demand projections for San Francisco based on recent housing and population forecasts within the entire system.

## 4.1. Overview

Over 2.5 million people in Bay Area counties currently rely on water supplied by the SFPUC RWS. The water supplied by the RWS comes from sources in the Bay Area (reservoirs with local runoff) and water from the Tuolumne River watershed. The water is of excellent quality and reasonable cost, and is a positive factor in attracting businesses, new residents, and industry to the Bay Area.

In addition to providing wholesale water supply, the SFPUC provides retail water service to residents, businesses, and institutions within the City limits, as well as to a number of residential and commercial accounts in the Bay Area and the Sierra Nevada foothills.

**Wholesale Customers**: The SFPUC provides wholesale water service to 27 Bay Area water agencies in Alameda, San Mateo, and Santa Clara Counties under the terms of a recently renegotiated Water Supply Agreement. The SFPUC supplies approximately 65 percent of the total wholesale customer water demand. Some of the wholesale water customers rely entirely on the SFPUC for their water supplies.

**Retail Customers**: The SFPUC's retail water customers include the residents, businesses, and industries within the municipal boundaries of the City and County. In addition to these customers, retail water service is also provided to other customers in the Bay Area and Sierra Nevada foothills. These accounts include the San Francisco International Airport and the San Francisco County Jail in San Mateo County, the unincorporated Town of Sunol and Lawrence Livermore Laboratory in Alameda County, and the Groveland Community Services District in Tuolumne County. In addition, the SFPUC retails groundwater (pumped from the Pleasanton well field) to the Castlewood development in Alameda County.

Historically, approximately 96 percent of the SFPUC's retail water demands have been met through deliveries from the SFPUC RWS. A small portion of San Francisco's demand is met through locally produced groundwater and secondary treated recycled water. The groundwater is used primarily for irrigation at local parks and on highway medians. The recycled water is used mostly at municipal facilities for wastewater treatment process water, sewer box flushing, and similar wash down operations.

## 4.2. Historical System Demand

Table 4-1 presents the historical water demands in the SFPUC Retail service area in fiscal years 2000-2008 and shows the changes in demands over this same year period. As shown in Table 4-1, over the last eight years, total demand in the Retail service area has decreased by 7.9 mgd.

**Table 4-1: SFPUC Water Demands (mgd)**

| Fiscal Years[1] | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|
| In City Retail Total | 83.3 | 84.2 | 84.2 | 81.3 | 78.4 | 78.4 | 78.1 | 75.5 | 75.3 |
| Outside Retail Customers[2] | 8.4 | 8.4 | 8.6 | 8.2 | 9.1 | 9.1 | 7.7 | 8.4 | 8.5 |
| **Total Demand[3]** | **91.7** | **92.6** | **92.8** | **89.5** | **87.5** | **87.1** | **85.8** | **83.9** | **83.8** |

Notes:
1. Fiscal Years June to July
2. Other Retail Customers include: Groveland CSD, Lawrence Livermore Laboratory, City Irrigation, Castlewood.
3. Includes Unaccounted for water
Source: SFPUC 2005 UWMP and data from SFPUC staff August 2009.

## 4.3. Proposed Project Water Demand

The project sponsor's water resource consultants provided the expected water use of the proposed project. Initial water demand estimates of 1.7 mgd were provided to the SFPUC as part of the Water Supply Availability Study (WSAS) [WSAS Appendix B] in August 2009. For this WSA, the project sponsor provided refined water demand estimates of 1.63 mgd[11] (Appendix E). The refinement of projected water demand at the project site does not change the results of the WSAS. An independent analysis was performed as a part of the WSAS and this WSA by analyzing similar land uses and assigning a demand factor for each use. The results of the independent analysis conclude that the demand estimates provided by the project sponsors are reliable.

Proposed project implementation is expected by 2011 and buildout is expected by 2030. Table 4-2 on the following page presents the proposed project estimated water demand at buildout, including continuing demand associated with the Department of Labor and US Coast Guard. Total demand at the project site is estimated at 1.63 mgd. The potable average daily demand shown in Table 4-2 is estimated at 1.20 mgd (1,826.4 acre-feet per year). Table 4-2 estimates the projected water demand at the project site with compliance to the California plumbing code and San Francisco's Green Building Ordinance.

[11] Appendix E - Table 7.2 Treasure Island Project Water Demand with Recycled Water for Residential Toilets, November 2009.

**Table 4-2: Treasure Island Redevelopment Project Estimated Water Demand (mgd)(14)**

| Land Use and Facilities | Units/Area | Potable Water Demand (gpd) | Total Water Demand |
|---|---|---|---|
| Residential(1) | 8,000 Dwelling Units | 812,704 | 962,000 |
| Small Community Facilities(3) | 13,500 sf | 945 | 1,418 |
| Pier 1 Community Center(3) | 35,000 sf | 2,450 | 3,675 |
| Open Space(10) | 300 acres | 30,000 | 210,000 |
| **Subtotal Residential(1)** | | **846,099** | **1,177,093** |
| Hotel(2) | 500 rooms | 132,500 | 136,000 |
| Office(3) | 100,000 sf | 7,000 | 10,500 |
| Retail(3) | 140,000 sf | 9,800 | 14,700 |
| Adaptive Reuse, General(3) | 244,000 sf | 17,080 | 25,620 |
| Adaptive Reuse, Retail(3) | 67,000 sf | 4,690 | 7,035 |
| Miscellaneous Structures(4) | 75,000 sf | 5,625 | 7,500 |
| Marina(13) | 400 slips | 20,000 | 20,000 |
| Treasure Island School(7) | 105,000 sf | 21,000 | 21,000 |
| Police/Fire(6) | 30,000 sf | 4,000 | 6,000 |
| TI Sailing Center(3) | 15,000 sf | 1,050 | 1,575 |
| Museum(3) | 75,000 sf | 5,250 | 7,875 |
| Department of Labor(8) | 900 rooms | 111,542 | 111,542 |
| Coast Guard Facility(9) | | 17,000 | 17,000 |
| Utility Facilities(3) | 14,000 sf | 980 | 1,470 |
| Urban Farm(11) | 20 acres | 2,000 | 62,000 |
| **Subtotal Non-Residential** | | 359,517 | **449,817** |
| **Total)** | | **1,205,616** | **1,626,910(14)** |

Notes:
1. 50 gallons per capita per day (gpcd), based on water conserving projections for 2030, based on 8000 units at 2.33 residents per dwelling unit. Population per dwelling unit based on City average from Demands Report Includes 30,000 gpd irrigation (CMG 8/7/09 spreadsheet) 1.17 mgd with outdoor irrigation that cannot accounted for as non-residential.
2. Potable use based on 265 gpd/room; this includes all uses within the hotel. Recycled use based on 7 gallons recycled water per room per day (toilet flushing). Assumes no grounds for irrigation. Water demand based on AWWA standards.
3. Potable water demand based on 0.07 gpd/sf. Recycled water demand based on 0.375 gpd/sf. Reference : CCSF Retail Demands Report Nov 2004
4. Allowance for misc. open space buildings not included elsewhere, including the YBI Historic Buildings, kiosks, warming hut, etc. Estimated potable use is based on 1 person per 200 SF, 20 gpcd total water use, minus 5 gpcd recycled water for toilets.
6. Potable use based on 400 persons per day at 15 gpcd total water use, minus recycled water use (toilets) at 5 gpcd
7. 1 Student per 100 SF, 20 gpd per students
8. Value based on 2007 monthly demand provided by S. Larano, SFPUC.
9. Value provided by S. Larano, SFPUC.
10. Potable demand at 100 gpd/acre. Irrigation demand at 180,000 gpd for TI (CMG 8/7/09 spreadsheet).
11. Potable demand at 100 gpd/acre. Irrigation demand at 60,000 gpd (CMG 8/7/09 spreadsheet).
13. Based on 400 slips, day use only (no live aboard). 50 gpd per slip
14. Appendix E - Table 7.2 Treasure Island Project Water Demand with Recycled Water for Residential Toilets, November 2009.

## 4.4. Potential Recycled Water of Proposed Project

The project area is designated as a recycled water use area as defined in the City of San Francisco's Recycled Water Ordinances (effective November 7, 1991, and amended in 1994). The ordinances require property owners to install dual-plumbing systems for recycled water use within the designated water use areas. [12]

In compliance with the City's Recycled Water Ordinances, and to support the goals of the proposed Sustainability Plan for development at TI-YBI, the Sustainability Plan includes a program to utilize recycled water at the project site. As proposed, the use of recycled water is for irrigation of the open space areas, the urban farm, roadside planter areas, landscape water

12 On November 18, 2009, the Building Standards Commission unanimously voted to approve the California Dual Plumbing Code that establishes statewide standards for installing both potable and recycled water plumbing systems in commercial, retail, and office buildings, theaters, auditoriums, condominiums, schools, hotels, apartments, barracks, dormitories, jails, prisons, and reformatories. The new code is effective Jan. 11, 2011. Website address: http://www.water.ca.gov/recycling/DualPlumbingCode.

features, plumbing fixtures in commercial buildings and for indoor residential use (toilet flushing) and irrigation in the residential areas. In 2006, Brown and Caldwell prepared an *Evaluation of Wastewater and Recycled Water Treatment Alternatives for the Proposed Treasure Island Development* report that evaluated, at a planning level, the recycled water options for Treasure Island. The report reviewed general options for an on-island and off-island supply of recycled water, and recommended a new on-island Recycled Water Treatment Plant. The results of the Brown and Caldwell (2006) report still hold (in 2009), but the proposed development at TI-YBI has been modified to include greater residential densities.

As shown in Table 4-3 recycled water demand is estimated at 421,294 gpd or 0.42 mgd.

**Table 4-3: Estimated Recycled Water Demand Treasure Island Redevelopment Project (mgd)[14]**

| Land Use and Facilities | Unit/Area | Recycled Water Demand |
|---|---|---|
| Residential[1] | 8,000 Units | 149,296 |
| Small Community Facilities[3] | 13,500 sf | 473 |
| Pier 1 Community Center[3] | 35,000 sf | 1,225 |
| Open Space[10] | 300 acres | 180,000 |
| **Subtotal Residential[1]** | | **330,994** |
| Hotel[2] | 500 Rooms | 3,500 |
| Office[3] | 100,000 sf | 3,500 |
| Retail[3] | 140,000 sf | 4,900 |
| Adaptive Reuse, General[3] | 244,000 sf | 8,540 |
| Adaptive Reuse, Retail[3] | 67,000 sf | 2,345 |
| Miscellaneous Structures[4] | 75,000 sf | 1,875 |
| Marina[13] | 400 Slips | 0 |
| Treasure Island School[7] | 105,000 sf | 0 |
| Police/Fire[6] | 30,000 sf | 2,000 |
| TI Sailing Center[3] | 15,000 sf | 525 |
| Museum[3] | 75,000 sf | 2,625 |
| Department of Labor[8] | 900 Rooms | 0 |
| Coast Guard Facility[9] | ~ | 0 |
| Utility Facilities[3] | 14,000 sf | 490 |
| Urban Farm[11] | 20 acres | 60,000 |
| **Subtotal Non-Residential** | **~** | **90,300** |
| **Totals[14] (gpd)** | **~** | **421,294[14]** |
| **Totals (mgd)** | **~** | **0.42** |

Notes:
1. Potable water demand based on 50 gallons per capita per day (gpcd) minus 6.4 gpcd recycled water for toilets, based on water conserving projections for 2030, 8,000 homes at 2.33 residents per dwelling unit. Population per dwelling unit based on City average from 2004 Demands Report.Includes 30,000 gpd irrigation (CMG 8/7/09 spreadsheet)
2. Potable use based on 265 gpd/room; this includes all uses within the hotel. Recycled use based on 7 gallons recycled water per room per day (toilet flushing). Assumes no grounds for irrigation. Water demand based on AWWA standards.
3. Potable water demand based on 0.07 gpd/sf. Recycled water demand based on 0.375 gpd/sf. Reference : CCSF Retail Demands Report t Nov 2004
4. Allowance for misc. open space buildings not included elsewhere, including the YBI Historic Buildings, kiosks, warming hut, etc. Estimated potable use is based on 1 person per 200 SF, 20 gpcd total water use, minus 5 gpcd recycled water for toilets.
6. Potable use based on 400 persons per day at 15 gpcd total water use, minus recycled water use (toilets) at 5 gpcd
7 1 Student per 100 SF, 20 gpd per students
8 Value based on 2007 monthly demand provided by S. Larano, SFPUC.
9 Value provided by S. Larano, SFPUC.
10. Potable demand at 100 gpd/acre. Irrigation demand at 180,000 gpd for TI (CMG 8/7/09 spreadsheet).
11. Potable demand at 100 gpd/acre. Irrigation demand at 60,000 gpd (CMG 8/7/09 spreadsheet).
12. Maximum daily demand 120% of average daily demand
13. Based on 400 slips, day use only (no live aboard). 50 gpd per slip
14. Appendix E - Table 7.2 Treasure Island Project Water Demand with Recycled Water for Residential Toilets, November 2009.

Table 4-4 shows a comparison of demand met by potable uses versus demand met with recycled water. Therefore, if recycled water is developed on Treasure Island, and permitted for uses approved by the State of California at the TI-YBI project site, potable water demand at the project site would be reduced accordingly. Based on the estimates in Table 4-4, potable water demand at the project site would be reduced to approximately 1.2 mgd. (Note: potable demand is reduced by 0.42 mgd but total water demand at the project site remains unchanged at 1.63 mgd). It should be noted that recycled water generated on-site is considered additional water supply sources beyond the SFPUC's WSIP recycled water supplies. The analysis undertaken in this WSA is based on the total water demand of 1.63 mgd, excluding the recycled water supply offset.

**Table 4-4: Estimated Water Demand with Recycled Water at the Treasure Island Redevelopment Project**

| Land Use and Facilities | Potable Water Demand (gpd)(1) | Recycled Water Demand (gpd)(2) | Total Water Demand(1) |
|---|---|---|---|
| Subtotal Residential | 846,099 | 330,994 | 1,177,093 |
| Subtotal Non-Residential | 359,517 | 90,300 | 449,817 |
| **Total (gpd)** | **1,205,616** | **421,294** | **1,626,910** |
| **Total (mgd)** | **1.2** | **0.42** | **1.63** |

Notes:
1. Table 4-2 Treasure Island Redevelopment Project Estimated Water Demand.
2. Table 4-3 Estimated Recycled Water Demand Treasure Island Redevelopment Project (mgd)
Source: Appendix E - Table 7.2 Treasure Island Project Water Demand with Recycled Water for Residential Toilets, November 2009.

## 4.5. City of San Francisco Retail Water Demand Analysis

To update the water supply and demand estimates provided in the 2005 UWMP, the SFPUC developed a WSAS. The WSAS incorporates new water supply information (per the Phased Variant WSIP) and generates new estimates of future water demand that were based on new population and employment estimates, including several major development proposals not anticipated in the 2005 UWMP, including the proposed project, Candlestick Point – Hunters Point Shipyard Phase II and Parkmerced.

To update future water demand, the WSAS compared the estimates of residential households and employees used in the 2005 UWMP with new population and employment forecasts provided by the San Francisco Planning Department,[13] which were designed to closely match the recently adopted Association of Bay Area Governments (ABAG) Projections 2009 target, but taken into account local knowledge of projects currently in various stages of the entitlement process. Updated water demand estimates were then generated, which included the incremental future growth that was not previously included in the 2005 UWMP estimates.

The new demand estimates also incorporate the results of the 2004 Demand Report, which analyzed water demands associated with each retail customer sector and included development of a water use model. The water use model accounts for demand at the end use level (such as individual toilets and showers), and established water use rates for specific units, including multiple family residential households and employees, the latter of which is used to estimate non-residential water demands. The WSAS used an average of these water use rates over the next 20 years (2010-2030) to establish a water use rate for multi-family residential households of 98.7 gpd, and a water use rate for employees of 42.42 gpd. With these unit rates, future water demand can be estimated from changes in the number of residential households and/or employees in San Francisco.

13 San Francisco Planning Department, Projections of Growth by 2030, July 9, 2009 (included as Appendix A to the Water Supply Availability Study).

### 4.5.1. Water Demand of Major Development Projects and Incremental Growth

Upon buildout in 2030, the development at the TY-YBI project site and two other large development projects represent the majority of new growth in San Francisco above the 2030 growth projected in the 2005 UWMP. Table 4-5 shows the total water demand of the proposed project and the other two proposed developments currently in the SF Planning development pipeline. The Candlestick Point – Hunters Point Shipyard Phase II project includes a number of different development scenarios; the development scenario at Candlestick Point – Hunters Point Shipyard Phase II with the highest estimated water demand is listed in Table 4-5.

**Table 4-5: 2030 Water Demand Increase within San Francisco (Proposed Project, Other Development Projects and Incremental Growth) (mgd)**

| Development | Water Demand (mgd)(1) | |
|---|---|---|
| | Projected Demand | Demand with Non-Residential Adjustment (1.40)(7) |
| Treasure Island – Yerba Buena Island(2) | 1.63 | 1.17 |
| Candlestick Point – Hunters Point Shipyard Phase II(3) | 1.99 | 1.05 |
| Parkmerced Project(4) | 0.98 | 0.94 |
| **Development Subtotal** | **4.67** | **3.16** |
| Existing Demand at Development Sites(5) | -1.51 | -1.51 |
| **Net Development Subtotal** | **3.16** | 1.65 |
| Incremental Growth in SF (City and County)(6) | 0.24 | 0.24 |
| **Net Change in Water Demand with Non-Residential Adjustment**(7) | **~** | **1.89**(7) |

Notes:
1. Average annual demands. Residential water demands for the proposed projects were provided to the City by project developer. They were also developed using an end use model on a per unit or per employee basis. The developer demands were independently reviewed by PBS&J and the SFPUC as part of this Study, and appear consistent with the SFPUC demand estimates. (Appendix D [WSAS Appendix B])
2. Table 4-2 Treasure Island Redevelopment Project Estimated Water Demand. (Appendix E)
3. CP-HPS Phase II Arup – Winzler & Kelly Water Demand Memo September 25, 2009 (Appendix D [WSAS Appendix B])
4. Parkmerced Water Demand Spreadsheet from August 2009 (Appendix D [WSAS Appendix B])
5. Existing demand provided by SFPUC from current billing records (CP-HPS = 0.3 mgd) (TI-YBI = 0.5 mgd) (Parkmerced = 0.71 mgd) (Appendix D [WSAS Appendix B])
6. Derived by SFPUC staff based on approximately 2,387 dwelling units at 98.7 gpd. (Appendix D [WSAS Appendix B])
7. To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections.

As stated previously, the Demand Report analyzed water demand associated with each Retail customer sector and established per unit-use rates. As such, between 2010 and 2030, the SFPUC used a per-unit use rate average of 98.7 gpd per household for multi-family residential demands. As shown in Table 4-5, the 98.7 gpd per household rate was applied to the incremental growth of 2,387 new dwelling units throughout the City resulting in a demand of 0.24 mgd in 2030.

At the TI-YBI project site in 2030, total water demand is calculated at 1.63 mgd.[14] In that same year residential demand at the project site is estimated to be 1.17 mgd. As shown in Table 4-5, in 2030 the total net change in demand of 1.89 mgd accounts for demand related to new

14 Appendix E - Table 7.2 Treasure Island Project Water Demand with Recycled Water for Residential Toilets, November 2009.

development less existing demand, and includes a non-residential demand adjustment to avoid double-counting the 2030 SF Planning Employment projections.[15]

### 4.5.2. Water Demand of Residential Projections

In an effort to represent development implementation over the 20-year planning horizon (2010–2030), this WSA assumes that residential growth and demand would occur at a linear rate over the same 20-year period without accounting for market force influences or changes in local economics.

Table 4-6 presents the residential growth projections included the 2005 UWMP and the 2009 growth projections developed by the SF Planning department. As shown in Column A, residential growth in 2010 is estimated at 344,306 units, builds to 351,608 units in 2015 and then grows continually to 373,513 units by 2030. As shown in Column C, under the linear growth assumption, by 2015 new residential units are estimated to increase by 7,447 units, and continue to increase proportionally over the next 15 years to 29,787 units in 2030. Of these 29,787 units, 27,400 are proposed in the large development projects and account for the majority of new residential growth in 2030. The balance of 2,387 is projected as Incremental Growth throughout the San Francisco. As presented in Column A+C, San Francisco can expect 359,055 units in 2015, and based on the 2009 SF Planning Projections estimate, total residential units would be 403,300 by 2030.

**Table 4-6: Projections for Residential Growth and Residential Demand**

| Year | 2005 UWMP Projections (DU)[(1)] | 2005 UWMP Demand (mgd)[(2)] | 2009 SF Planning Projections (DU)[(3)] | 2009 SF Planning Demand (mgd)[(4)] | Total Residential (DU)[(5)] | Total Demand (mgd)[(6)] |
|---|---|---|---|---|---|---|
| | A | B | C | D | A+C | B+D |
| 2010 | 344,306 | 44.7 | 0 | 0 | 344,306 | 44.70 |
| 2015 | 351,608 | 43.8 | 7,447 | 0.47 | 359,055 | 44.27 |
| 2020 | 358,910 | 43.2 | 14,894 | 0.95 | 373,804 | 44.15 |
| 2025 | 366,211 | 42.9 | 22,340 | 1.42 | 388,551 | 44.32 |
| 2030 | 373,513 | 42.9 | 29,787 | 1.89 | 403,300 | 44.79 |

Notes:
DU = Dwelling Units
1. Single and Multiple Family Residential Unit Projections from SFPUC 2005 UWMP(Table 2, page 7)
2. Estimated Demand generated by Residential Unit Projections from SFPUC 2005 UWMP (Table 8B, page 43)
3. Residential Units Projections from 2009 SF Planning (In 2030 - Projects (CP-HPS II (10,500 DU); TI-YBI (8,000 DU) and Parkmerced (total 8,900 DU) including Incremental Growth (2,387 DU) linear distribution over 20-year (2010-2030) planning period (Appendix D [WSAS Table 5-2])
4. Estimated Demand generated by Projects (from developer estimates) and Incremental Growth (98.7 gpd per household) linear distribution over 20-year (2010-2030) planning period (Appendix D [WSAS Tables 5-4 and 5-6])
5. Total Residential Unit Projections (2005 UWMP + 2006 SF Planning) residential units over the 20-year planning horizon. (Appendix D [WSAS Table 5-2])
6. Total Projected Water Demand generated by all new residential units over the 20-year planning horizon. (Appendix D [WSAS Table 5-6])
Source: Developed by PBS&J and SFPUC, October 2009.

Column B shows the residential water demand projected in the 2005 UWMP; demand deceases from 44.7 mgd in 2010 to 42.9 in 2030 because of plumbing fixture retrofits in existing residences and higher water efficiency fixtures at new developments, including the development at the project site. As shown in Column D, water demand Table 4-6, new residential water demand commences in 2015 at 0.47 mgd and progresses to 1.89 mgd in 2030. Column B+D

15 To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the proposed development sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This WSA assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections.

shows the total residential demand, accounting for demand from the 2005 UWMP and 2009 SF Planning Projections over the 20 year planning period.

In 2030, total residential demand is estimated to be 44.79 mgd. In that same year, the proposed project's estimated residential demand of 1.17 mgd would be 2.6 percent (1.17/44.79) of the City's average daily residential demand.

### 4.5.3. Water Demand of Non-Residential Employment Projections

Between 2010 and 2030, SFPUC used an average of 42.42 gallons per day (gpd) per employee for non-residential water demands (Appendix D). As shown in Table 4-7, the 42.42 gpd per employee water demand rate was applied to the growth in jobs over the 20-year planning horizon. In 2015, demand is expected to be 30.52 mgd and by 2030, water demand generated through employment is expected to reach 31.73 mgd. To avoid double-counting the non-residential demand calculated in the developer estimates at each of the development sites, this WSA assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections.

**Table 4-7: Water Demand for Non-Residential Employment Projections**

| Employment Projections and Non-Residential Demand | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| SF Planning Employment Total[1] (jobs) | 712,145 | 719,447 | 726,749 | 734,050 | 748,100 |
| Non-Residential - Business/Industrial Demand[2] (mgd) | 30.21 | 30.52 | 30.83 | 31.14 | 31.73 |

Notes:
1. Table 5-1 2009 SF Planning Projections (Appendix D)
2. Average of 42.42 gallons per day (gpd) per employee for non-residential water demands. (Appendix D])

In 2030, total non-residential demand is estimated to be 31.73 mgd. In that same year, at buildout, the proposed project's estimated non-residential demand of 0.36 mgd would be 1.13 percent (0.36/31.73) of the City's non-residential average daily demand.

### 4.5.4. SFPUC Total Retail System Demand

The SFPUC incorporated the 2009 SF Planning projections for residential and non-residential growth in San Francisco into the WSAS to assess the results of the SF Planning projections and its effects on the City's water demand. The totals of the previous tables (Table 4-6 and Table 4-7) along with demand data from the 2005 UWMP is incorporated in the City's total Retail demand shown in Table 4-8. The table represents the anticipated growth in demand commencing in 2010 and extending over the 20-year planning horizon to 2030.

As shown in Table 4-8, incremental residential growth demand and demand at each of large development sites commences in 2015 at 0.47 mgd and progresses to 1.89 mgd in 2030. In 2015, demand drops slightly due to a reduction in total residential demand. The non-residential demand commences in 2010 at 30.21 mgd, increases to 30.83 mgd and culminates at 31.73 in 2030.

Table 4-8 shows total Retail demands for the SFPUC beginning in 2010 at 91.81, and then drops slightly in 2015 because of a drop in residential demand and then increases to 91.69 mgd in 2020. In 2030, total Retail demand is expected to be 93.42 mgd. In that same year, the proposed project's total demand of 1.63 mgd would be 1.74 percent (1.63 mgd/ 93.42 mgd) of average daily Retail demand.

| Table 4-8: SFPUC Retail Demand (mgd) | | | | | |
|---|---|---|---|---|---|
| **Users, Facilities and Entities** | **Projected Water Demand (mgd)** | | | | |
| | **2010** | **2015** | **2020** | **2025** | **2030** |
| Residential Demand (Single & Multiple Family)(1) | 44.70 | 43.80 | 43.20 | 42.90 | 42.90 |
| New Residential Demand generated by Projects and Incremental Growth(2)(4) | - | 0.47 | 0.95 | 1.42 | 1.89 |
| **Subtotal** | 44.70 | 44.27 | 44.15 | 44.32 | 44.79 |
| Non-Residential - Business/Industrial Demands(3,4) | 30.21 | 30.52 | 30.83 | 31.14 | 31.73 |
| **Subtotal** | **74.91** | **74.79** | **74.97** | **75.46** | **76.52** |
| Unaccounted-for System Losses | 7.30 | 7.30 | 7.30 | 7.30 | 7.30 |
| **Subtotal** | **82.21** | **82.09** | **82.27** | **82.76** | **83.82** |
| Other Retail Demands(5) | 4.90 | 4.90 | 4.90 | 4.90 | 4.90 |
| Lawrence Livermore Laboratory; Groveland CSD(6) | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 |
| City Irrigation Demand(7) | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Castlewood Community Demand(8) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **Total Retail Demand** | **91.81** | **91.69** | **91.87** | **92.36** | **93.42** |

Notes:

1. Residential Demands (Source: 2005 SFPUC UWMP Table 8B, page 43.)
2. See **Table 4-4** Multiple Family – [In 2030 Incremental Growth of 0.24 mgd + (CP-HPS II 10,500 DU) 1.04 mgd + (TI-YBI 8,000 DU) 1.17 mgd + (Parkmerced 8,900 total DU) 0.94 mgd = 3.40 mgd] Existing Demand is 1.51 mgd at all sites. [3.40 mgd – 1.51 = 1.89 mgd] as shown in Tble 4-2 (Sources: ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Appendix E - Table 7.2 Treasure Island Project Water Demand with Recycled Water for Residential Toilets,
3. See Table 4-7. Agriculture, Mining, Construction, Manufacturing, Transportation, Wholesale & Retail Trade, F.I.R.E., Services, Gov't including Builders – Contractors and Docks – Shipping. (Source: Adapted from 2009 ABAG Employment Projections in conjunction with SF Planning, July 2009) As developed in the Demand Study, SFPUC derived the employment water demands by taking the ABAG employment projections and multiplying by 42.42 gallons per employee per day and is consistent with SFPUC's demand projection methodology.
4. See Table 4-7. Non-residential (jobs/employment) demands at major project sites were assumed to be contained in the 2009 ABAG Employment projections. Growth in demand is incrementally increased to reflect the growth in jobs over the 20-year planning horizon. To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections. **Table 4-4** shows the net change in water demand at the Project sites and the adjusted change in water demand without non-residential demand. Adapted by PBS&J and SFPUC September 2009 from ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Updated August 2009.
5. US Navy, SF International Airport, and other suburban/municipal accounts. (Source: 2005 SFPUC UWMP Table 8B, page 43.)
6. Lawrence Livermore Laboratories (0.8 mgd); Groveland CSD (0.4 mgd). (Source: 2005 SFPUC UWMP Table 8B, page 43.)
7. City Irrigation at Golden Gate Park, Great Highway Median and SF Zoo. (Source: 2005 SFPUC UWMP Table 8B, page 43.)
8. Castlewood Community demand served by wells in the Pleasanton well field.

Source: 2005 SFPUC UWMP Table 8B, page 43.

# 5.0 COMPARISON OF AVAILABLE WATER SUPPLIES VERSUS DEMAND

Section 10910 (c)(3) of the Water Code states, "the water supply assessment for the project shall include a discussion with regard to whether the public water system's total projected water supplies available for normal, dry and multiple dry water years during a 20-year projection will meet the projected water demand associated with the proposed project, in addition to the public water system's existing and planned future uses, including agricultural and manufacturing uses."

## 5.1. Supply and Demand Comparison

Table 5-1 compares the SFPUC Retail supplies and demand during normal, single dry year, and multiple dry year periods, as required by Water Code Section 10910 (c)(3). Section 2.7 discusses the SFPUC's total water supplies now and over the 20-year planning period. In 2010, prior to the development of the 10 mgd of local WSIP supplies, the SFPUC has access to annual average of 84.50 mgd from all water supply sources. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.50 mgd. These supplies are assumed to be available in the quantities listed in Table 5-1. The SFPUC intends to use these supplies to meet its Retail customer demands.

The demand estimates in this WSA show that the 2009 SF Planning projections result in an increase in City Retail demand. As stated previously, by 2030 Retail demand is estimated at 93.42 mgd. This increase, however, does not change the findings in the 2005 UWMP, which estimated demand at 93.40 mgd in 2030.[16] As shown in Table 5-1 on the following page, the SFPUC can meet the current and future demands of its Retail customers in normal years, single dry-years and nearly all multiple dry-year events with the exception of years 2 and 3 after 2030.

As modeled in Table 5-1, the deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd as per the Phased WSIP Variant, without full development of the additional 10 mgd of new supplies. It is expected that 10 mgd of local WSIP supply sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (Fiscal Year 2007-2008 use was 83.9 mgd). If Retail demand exceeds the available RWS supply of 81.0 mgd between 2010 and 2015, and total RWS deliveries exceed 265 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water with the payment of an Environmental Surcharge. Notably, total RWS deliveries in Fiscal Year 2007-2008 were 256.7 mgd, which is 8.3 mgd below the 265 mgd watershed delivery goal.

As discussed in Section 3, in time of system-wide shortages due to drought conditions, the WSAP provides a fair and reasonable method for allocating water between the SFPUC's Retail service area and its wholesale customers (collectively). As shown in Table 5-1, after 2030, pursuant to the SFPUC's WSAP, Retail customers would experience no reduction in deliveries at a 10 percent RWS Retail supply curtailment. However, during a 20 percent RWS shortage when Retail RWS supplies are reduced by 1.9 percent to 79.5 mgd, the Retail customers would experience a 1.5 mgd reduction in RWS Retail deliveries. The SFPUC, as part of the WSIP, adopted a water reliability objective of no greater than 20-percent rationing in any one year of a drought. The RWS rationing reduction of 1.9 percent is well within the SFPUC's 20-percent reliability objective.

16 SFPUC 2005 Urban Water Management Plan Table 8B, p. 43.

**Table 5-1: Projected Supply and Demand Comparison - Normal, Dry, and Multiple Dry Years (mgd)**

| | Retail Supply and Demand | Normal Year | Single Dry Year | Multiple Dry Year Event | | |
|---|---|---|---|---|---|---|
| | | | | Year 1 | Year 2 | Year 3 |
| 2010 | RWS Supply[(1)] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater Supply[(2)] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | Total Retail Supply[(3)] | 84.50 | 84.50 | 84.50 | 83.00 | 83.00 |
| | Total Retail Demand[(4)] | 91.81 | 91.81 | 91.81 | 91.81 | 91.81 |
| | **Surplus/(Deficit)[(5)]** | **-7.31** | **-7.31** | **-7.31** | **-8.81** | **-8.81** |
| 2015 | RWS Supply[(1)] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater[(6)] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | WSIP Supply Sources[(7)] | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | Total City Supply[(3)] | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| | Total Retail Demand[(4)] | 91.69 | 91.69 | 91.69 | 91.69 | 91.69 |
| | **Surplus/(Deficit)** | **2.81** | **2.81** | **2.81** | **1.31** | **1.31** |
| 2020 | RWS Supply[(1)] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater[(6)] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | WSIP Supply Sources[(7)] | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | Total City Supply[(3)] | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| | Total Retail Demand[(4)] | 91.87 | 91.87 | 91.87 | 91.87 | 91.87 |
| | **Surplus/(Deficit)** | **2.63** | **2.63** | **2.63** | **1.13** | **1.13** |
| 2025 | RWS Supply[(1)] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater[(6)] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | WSIP Supply Sources[(7)] | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | Total City Supply[(3)] | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| | Total Retail Demand[(4)] | 92.36 | 92.36 | 92.36 | 92.36 | 92.36 |
| | **Surplus/(Deficit)** | **2.14** | **2.14** | **2.14** | **0.64** | **0.64** |
| 2030 | RWS Supply[(1)] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater[(6)] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | WSIP Supply Sources[(7)] | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | Total City Supply[(3)] | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| | Total Retail Demand[(4)] | 93.42 | 93.42 | 93.42 | 93.42 | 93.42 |
| | **Surplus/(Deficit)** | **1.08** | **1.08** | **1.08** | **-0.42[(8)]** | **-0.42[(8)]** |

Notes:
1. RWS Supply SFPUC (Table 2-2)
2. Groundwater Uses for In-City Irrigation and Castlewood (Table 2-2).
3. Total Retail Supply from SFPUC Water Supplies Table 2-2.
4. SFPUC Retail Demand from Table 4-8.
5. The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).
6. Groundwater Supplies at Castlewood and In-City Irrigation (Table 2-2).
7. WSIP Supply Sources (Recycled Water (4.0 mgd; Groundwater (2.0 mgd Existing and 2.0 from NWGWP, and WSIP Water Efficiency and Conservation (4.0 mgd) (Table 2-2).
8. Deficit occurs in year 2 and 3 of multiple dry year event, SFPUC implements its Drought Year Water Shortage Contingency Plans - RWSAP and WSAP to balance supply and demand under this projected shortfall as described in Section 3.0.

As shown in Table 5-1, under this multiple dry-year event scenario,[17] it is possible that the SFPUC will not be able to meet 100 percent of its Retail demand. After 2030, as modeled in this WSA, a supply shortfall of 0.42 mgd is anticipated to occur in the second and third year of a multiple dry-year event due to RWS supply curtailments.

17 Multiple dry-year events are defined as a three-year event per UWMP requirements. SFPUC determined that a multiple dry-year event is years 2-4 of SFPUC's 8.5 year design drought. SFPUC can meet 100 percent of deliveries in the first year of such an event.

Pursuant to the Urban Water Management Planning Act (Water Code Section 10632), water suppliers with an existing dry year shortage contingency plan can implement subsequent stages of demand reduction measures listed in its UWMP as a strategy to balance supply and demand. The WSAP and the RWSAP, contained in Section 9 of the SFPUC's 2005 UWMP is SFPUC's dry year shortage contingency plan that allows the SFPUC to reduce water deliveries to customers and implement demand reductions during periods of water shortage. Therefore, to overcome the potential 0.42 mgd supply deficit expected after 2030, the SFPUC would follow its adopted water shortage contingency plans (WSAP and RWSAP) to implement drought-planning sequences and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in the SFPUC reservoirs. These delivery reductions allow the SFPUC to maintain water in storage over an extended period. In addition, under the RWSAP, the SFPUC would balance Retail supply curtailments by reducing demand.

Table 5-2 was extracted from Table 5-1 to demonstrate the additional conservation necessary to balance supply and demand under the RWSAP in 2030. When the SFPUC implements its RWSAP, as shown in Table 5-2, Retail customers would be required to reduce daily demand by approximately 0.37 percent to balance demand against the supply shortfall. Stage 1 of the RWSAP in Section 3.2 requests voluntary conservation of at least 5 percent up to 10 percent. The 0.44 percent needed falls within Stage 1 and as modeled no further conservation would be required.

**Table 5-2: 2030 Supply and Demand with Implementation of WSAP and RWSAP (mgd)**

| Retail Supply and Demand[1] | Normal Year | Single Dry Year | Multiple Dry Year Event | | |
|---|---|---|---|---|---|
| | | | Year 1 | Year 2 | Year 3 |
| RWS Supply | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| Groundwater | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| WSIP Supply Sources | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| Total City Supply | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| Total Retail Demand | 93.42 | 93.42 | 93.42 | 93.42 | 93.42 |
| **Surplus/(Deficit)** | **1.08** | **1.08** | **1.08** | **-0.42** | **-0.42** |
| **RWSAP Demand Reduction (Conservation Needed)** | | | | | |
| Total City Supply | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| Total Retail Demand | 93.42 | 93.42 | 93.42 | 93.42 | 93.42 |
| Surplus/(Deficit) | None | None | None | -0.42 | -0.42 |
| **Stage 1 Conservation Savings (0.44%)** | **None** | **None** | **None** | **0.42** | **0.42** |
| **Retail Demand Reduction with RWSAP** | **Surplus** | **Surplus** | **Surplus** | **93.00** | **93.00** |
| **Surplus/(Deficit)** | **None** | **None** | **None** | **0.00** | **0.00** |

Note:
1. Table 5-1 Projected Supply and Demand Comparison - Normal, Dry, and Multiple Dry Years.
Adapted by PBS&J October 2009.

As presented in Section 4.4, if recycled water is developed on Treasure Island and permitted for uses approved by the State of California at the TI-YBI project site, potable water demand generated at the project site would be reduced to 1.2 mgd, thereby reducing the City's total Retail demand by 0.42 mgd. The use of recycled water at the TI-YBI project site would contribute to eliminating the Retail water shortage forecasted to occur after 2030 in multiple dry years.

# 6.0 CONCLUSION OF ANALYSIS AND FINDINGS

There is an anticipated increase in the SFPUC supply reliability over the next 20 years as a result of the SFPUC implementing the water supply improvements in the WSIP and local water supply projects. Over this same period, demand in SFPUC's Retail service area will continue to increase as well. This is the result of growth in housing developments, population increases and employment opportunities throughout San Francisco.

In 2030, the proposed project's demand of 1.63 mgd, without accounting for any recycled water, would be 1.74 percent of the average daily demand in the SFPUC's Retail service area. This does not affect the ability of the SFPUC to meet the demand of its Retail customers. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.5 mgd. The SFPUC intends to use these supplies to meet its Retail customer demands. As shown in Table 5-1, the SFPUC has sufficient supplies to meet current and planned future uses in normal year, single dry and all multiple dry-year events with the exception of years 2 and 3 after 2030.

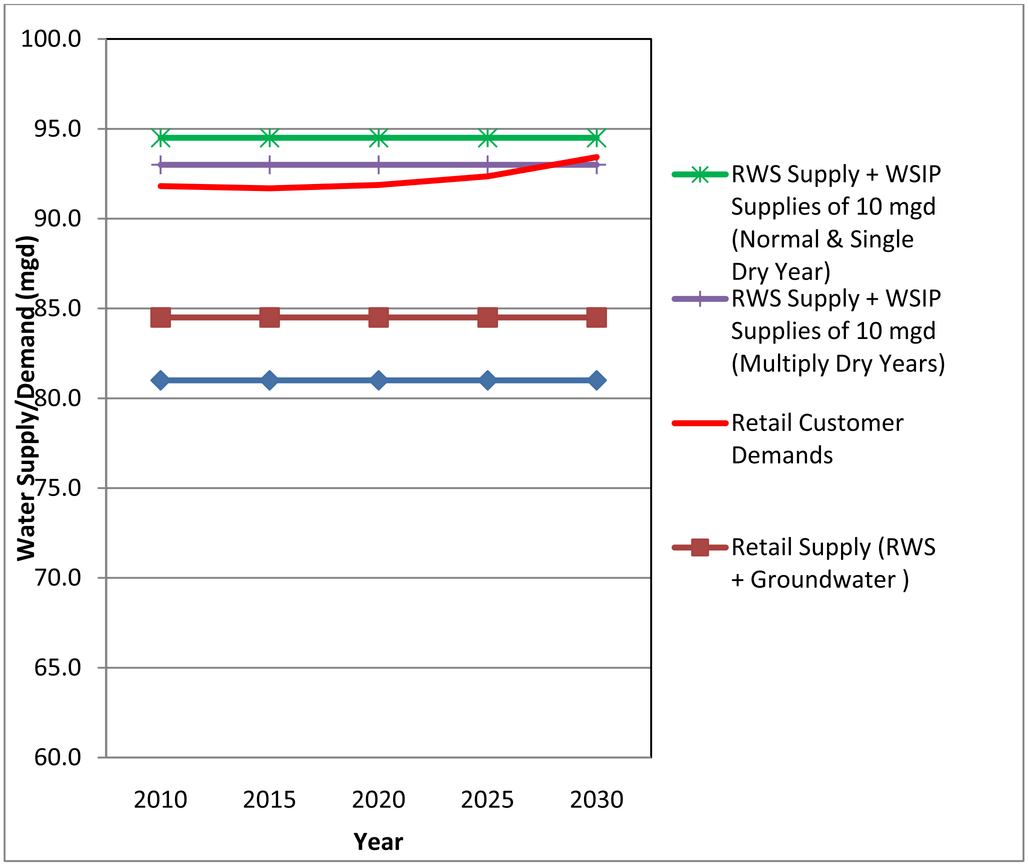


**Figure 6-1: Comparison of Supply and Demand over 20 years**

After 2030, as shown in Figure 6-1, under a multiple dry-year event the SFPUC will experience a 0.42 mgd supply deficit (demand exceeds supply) and would not be able to meet 100 percent of its Retail demand including the proposed project. The water supply deficit is related to increasing demand throughout the SFPUC's Retail service area and the policy decision to limit RWS deliveries from the watersheds until 2018. This WSA used a conservative assumption and extended the decision to limit deliveries to 2030 (Annual average RWS limit is 265 mgd [81 mgd in SFPUC's Retail service area and 184 mgd in the Wholesale service area]).

Pursuant to the Urban Water Management Planning Act (Water Code Section 10632), water suppliers with an existing dry year shortage contingency plan can implement subsequent stages of demand reduction measures listed in its UWMP as a strategy to balance supply and demand. The WSAP and the RWSAP, contained in Section 9 of the SFPUC's 2005 UWMP is the SFPUC's dry year shortage contingency plan that allows the SFPUC to reduce water deliveries to customers and implement demand reductions during periods of water shortage. Therefore, to overcome the potential 0.42 mgd supply deficit expected after 2030, the SFPUC would follow its adopted water shortage contingency plans (WSAP and RWSAP) to implement drought-planning sequences and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in the SFPUC reservoirs. These delivery reductions allow the SFPUC to maintain water in storage over an extended period. In addition, under the RWSAP, the SFPUC would balance Retail supply curtailments by reducing demand.

As discussed previously, the SFPUC has water rights and entitlements that are more than adequate to meet existing and projected future demand throughout the SFPUC's Retail service area. With completion of the WSIP projects, the SFPUC will have the capacity to reliably deliver potable water to meet customer purchases up to an annual average of 300 mgd. However, due to conditions of approval in the WSIP PEIR, the SFPUC is limiting deliveries from the watersheds until at least 2018. Prior to 2018, the SFPUC will engage in a new planning process to re-evaluate water system demand and water supply options. As a part of this process, San Francisco will conduct additional environmental studies and CEQA review as appropriate to address the SFPUC's recommendation regarding water supply and proposed water system deliveries after 2018.

This WSA concludes that the SFPUC has adequate supplies based on water rights and entitlements and adopted plans for local water supply projects to meet Retail demand in all years with the exception of a potential shortfall occurring after 2030 under a multiple dry-year event. In the event of a supply shortfall, the SFPUC, through its WSAP and RWSAP can impose supply curtailments and subsequent stages of demand reductions to balance demand against curtailed supplies.

As discussed previously, if recycled water is developed on Treasure Island and permitted for uses approved by the State of California at the TI-YBI project site, potable water demand generated at the project site would be reduced to 1.2 mgd, thereby reducing the City's total Retail demand by 0.42 mgd. The use of recycled water at the TI-YBI project site would contribute to eliminating the Retail water shortage forecasted to occur after 2030 in multiple dry years.

## 6.1. WSA Findings

Regarding the availability of water supplies to serve the proposed project, beginning in 2015 the SFPUC finds as follows:

- In years of average and above-average precipitation, and including development of the SFPUC's local WSIP water supply sources, the SFPUC has adequate supplies to serve 100 percent of normal, single dry and multiple dry year demand up to 2030.[18]
- In multiple-dry-year events after 2030, when the SFPUC imposes reductions in its supply, the SFPUC has in place the WSAP and RWSAP to balance supply and demand.
- With the WSAP and RWSAP in place, and the addition of local WSIP supplies, the SFPUC finds it has sufficient water supplies available to serve its Retail customers including the demand of the proposed project, and existing and planned future uses.

18 The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).

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# APPENDICES

# APPENDIX A SFPUC 2008 ANNUAL GROUNDWATER MONITORING REPORT WESTSIDE BASIN

# 2008 ANNUAL GROUNDWATER MONITORING REPORT WESTSIDE BASIN SAN FRANCISCO AND SAN MATEO COUNTIES, CALIFORNIA

Prepared By:
San Francisco Public Utilities Commission

In Coordination with the City of Daly City, the City of San Bruno and the California Water Service Company (South San Francisco District)

April 2009

April 28, 2009

## ACKNOWLEDGEMENTS

The Westside Basin Annual Groundwater Report for 2008 was prepared by the San Francisco Public Utilities Commission (SFPUC) in cooperation with the City of Daly City, California Water Services Company (South San Francisco District) and the City of San Bruno. This report summarizes the results of water level elevation monitoring, water quality sampling and analysis, and additional field activities conducted within the basin for 2008.

Obiajulu Nzewi prepared this report under the direction of Jeff Gilman and Greg Bartow.

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# 1.0 INTRODUCTION

This report presents the results of the 2008 Annual Groundwater Monitoring for the Westside Basin. The Westside Groundwater Basin extends from Golden Gate Park in San Francisco to the City of Burlingame in San Mateo County, and is an important municipal and irrigation water supply for the respective communities and businesses that overlie the Basin (Figure 1).

As part of continuing agency coordination and public education, it is intended that the preparation of this annual report, along with future annual reporting and supplemental technical reports, will provide regular summaries of overall basin conditions. The annual report is intended to provide information summarizing basin-wide groundwater pumping in the basin, describe groundwater levels and quality in the different aquifer systems that are present in the basin, and describe surface water conditions, most notably in Lake Merced. In addition to reporting of hydrogeologic conditions, the data-gathering network will be modified as necessary to provide a comprehensive review of basin conditions. Additionally, monitoring activities will be coordinated with ongoing and future project-specific monitoring activities to ensure an efficient, comprehensive monitoring program.

## 1.1 Background

Over the last several years, there has been a significant increase in data collection efforts and cooperative management of groundwater and interrelated surface water resources in the Westside Basin among the San Francisco Public Utilities Commission (SFPUC), the City of Daly City (Daly City), California Water Service Company (Cal Water, municipal water purveyor to South San Francisco, the Town of Colma and a portion of unincorporated San Mateo County), and the City of San Bruno (San Bruno). The initial data collection efforts included increased monitoring of groundwater and lake level elevations in the northern Westside Basin and the initiation of a basin-wide, semi-annual monitoring program that has involved the cooperative efforts of the SFPUC, Daly City, Cal Water, and San Bruno beginning in spring 2000. Part of the increased management effort was the preparation of the 2005 Final Draft North Westside Groundwater Basin Management Plan, which included a Plan Element to regularly report on groundwater conditions in the Westside Basin (SFPUC, 2005).

In 2006, the SFPUC, in cooperation with Daly City, Cal Water, and San Bruno, prepared a report entitled “Hydrogeologic Conditions in the Westside Basin, 2005” (LSCE, 2006). That report provided an overview of historical, current and planned activities related to groundwater use within the Basin, and described the hydrogeologic conditions of the Westside Basin as of 2005. Since 2007, the SFPUC Water Resources Division has prepared the annual groundwater monitoring reports in cooperation with Daly City, San Bruno, and Cal Water.

The monitoring program has expanded to monitor changes in groundwater levels and quality resulting from the recycled water program and the pilot conjunctive use program and to assist the SFPUC in quantifying the change in groundwater storage resulting from the above projects.

The physical barriers to seawater intrusion that are evident west of Daly City (as a result of faulting and steeply dipping beds of the Merced Formation) are not as evident in the North Westside portion of the basin, where the beds do not exhibit pronounced dips, and faults are further offshore. In that light, the expansion of the monitoring program included the construction of monitoring wells along the coast from Daly City to Golden Gate Park to monitor for the potential occurrence of seawater intrusion resulting from ongoing groundwater use and planned groundwater development within the North Westside Basin. Monitoring for the potential occurrence of seawater intrusion on the San Francisco Bay-side (Bay Side) of the basin was implemented by the City of San Bruno in 2006. In the fall of 2006, two new well clusters were installed by San Bruno at locations in the San Francisco Airport and within Burlingame. These wells are monitored semi-annually by San Bruno.

For convenience, the portion of the Westside Groundwater Basin north of the San Francisco/ San Mateo County line is referred to as the North Westside Groundwater Basin. The portion of the Westside Basin located south of the County line is referred to as the South Westside Groundwater Basin.

### 1.1.1 Planned and Ongoing Projects

The purpose and scope of the monitoring program has evolved to monitor changes in the groundwater system resulting from the following planned and ongoing projects:

**Proposed Westside Basin Recycled Water Project**

The proposed Westside Recycled Water Project is part of the SFPUC's Water System Improvement Program. It would deliver highly treated recycled water to a variety of customers through a system of pipelines, pump stations, storage tanks, and reservoirs. The system would bring recycled water from the proposed water treatment facility in Golden Gate Park to the San Francisco Zoo, Golden Gate Park, and Lincoln Park and Golf Course. The recycled water would be used for irrigation at all three sites, as well as non-portable uses at the Zoo and at the California Academy of Sciences.

In 2004, the North San Mateo County Sanitation District (NSMCSD), a subsidiary of Daly City, constructed facilities at its wastewater treatment plant to produce recycled water. The plant currently provides recycled water that is used for irrigation purposes at the Lake Merced Golf Club, the Olympic Club Golf Course, and the San Francisco Golf Club, as well as other landscaped areas in Daly City. These recycled water customers use less than 1 million gallons of recycled water per day on average. The plant has the capacity to produce up to 2.8 million gallons of recycled water per day. As a result, the NSMCSD has recycled water available to irrigate the Harding Park and Fleming Golf Courses, while still meeting the needs for its current recycled water customers.

Daly City and the SFPUC are proposing to expand the NSMCSD's recycled water distribution system in order to provide recycled water for irrigation purposes to the Harding Park and Fleming Golf Courses. Recycled water would replace potable water from the SFPUC's Regional Water System currently being used for irrigation at these locations. The proposed project facilities would include:

- Distribution Facilities: The project would require a new pump station at the Harding Park Maintenance Yard, and approximately 4,800 feet of 18-inch distribution pipeline along Lake Merced Boulevard.
- Storage Reservoir: The project would require construction of a new 700,000 gallon underground recycled water storage tank at Harding Park Maintenance Yard.
- Back-up Connection: The project would require construction of a back-up connection to SFPUC potable water distribution system.

**San Francisco Groundwater Supply Project**

As part of the San Francisco Groundwater Supply Project, the SFPUC proposes the construction of up to six wells and associated facilities in the western part of San Francisco. The wells would extract up to 4 million gallons per day (mgd) of water from the Westside Basin. The extracted groundwater, which would be used both for regular and emergency water supply purposes, would be blended with imported surface water before entering the municipal drinking water system. The project would provide a new source of water and improve reliability during system maintenance and drought conditions.

**South Westside Basin Conjunctive Use Project**

The purpose of the project is to develop a groundwater supply in the South Westside Basin for use during drought conditions. In normal and wet years, the SFPUC will supply supplemental surface water to Daly City, Colma, San Bruno, and the California Water Service Company (South San Francisco District) to be used in place of groundwater pumping. The reduced pumping during the normal and wet years would thereby increase the volume of groundwater in storage that can be pumped in dry years.

The proposed project includes construction of 16 groundwater wells with a total capacity of 7.2 mgd. Five of the wells would be connected to the Daly City water system, six (or three each) will be connected to the water systems of Cal Water and San Bruno, and five would be connected to the SFPUC transmission system. Treatment may be required at some of the wells for the removal of manganese. Additionally, the project would include nearly 9,800 feet of water distribution piping to make the necessary connections.

In October 2008, five new monitoring well clusters were installed at the following locations as part of this project:

- CUP-10A located within SFPUC Right of Way in Daly City
- CUP-18 located within SFPUC Right of Way at Colma Blvd. in Colma;
- CUP-19 located within SFPUC Right of Way at Serramonte Blvd. in Colma;
- CUP-22A located within SFPUC Right of Way at Hickey Blvd. at Camaritas Road, in South San Francisco; and.
- CUP-36-1 located within SFPUC Right of Way at Southwood Drive in South San Francisco.

The well construction permits, as-built construction details, lithologic and geophysical logs, and summaries of groundwater quality are presented in Appendix D. Subsequent monitoring events will incorporate these wells into the monitoring network to enhance characterization of groundwater conditions in the southern portion of the basin.

### 1.2 Municipal Water Agencies

The SFPUC is responsible for providing a reliable, high quality water supply for the City and County of San Francisco (San Francisco). The SFPUC also provides water to a large network of wholesale customers that extend from Daly City, adjacent to San Francisco, south through the Peninsula to Santa Clara County, and up the southeast side of San Francisco Bay through Alameda County to Hayward. The SFPUC water supply system supplies all of the San Francisco municipal demand and about two-thirds of the total water demands of its wholesale customers (SFPUC, 2005). Total water demand of retail customers in San Francisco is nearly 94 million gallons per day (mgd), or about 105,000 acre-feet per year (afy), which represents a significant decrease in water demand from recent drought periods (SFPUC, 2005). The total water requirements of the Bay Area wholesale customers in 2005 were estimated to be about 282 mgd, or about 316,000 afy (SFPUC, 2005).

Since the 1990’s the SFPUC, Daly City, Cal Water and San Bruno have worked cooperatively on Westside Basin investigations, monitoring and coordinated projects. Daly City, Cal Water, and San Bruno have typically included groundwater from the Westside Basin for municipal water supply in combination with SFPUC-imported surface water. The City of Daly City’s Department of Water and Wastewater Resources is responsible for the management and operation of Daly City’s drinking water supply system. The City of San Bruno’s Water Division of the Public Works Department is responsible for the management and operation of San Bruno’s drinking water supply system. Cal Water is an investor-owned utility that serves South San Francisco, Colma and a very small part of Daly City.

## 2.0 SITE DESCRIPTION AND HYDROGEOLOGICAL SETTING

### 2.1 Hydrogeologic Setting

The Westside Basin is about 40 square miles in area (Figure 1) and includes four major geologic units. These units are the Jurassic - Cretaceous Franciscan Complex, Pliocene Merced Formation, Pleistocene Colma Formation, and Pleistocene to recent Dune Sands. There are also minor, yet widespread, units of recent alluvium along stream channels. Groundwater development has primarily occurred in the Colma and Merced Formations. The Merced Formation is the primary water-producing aquifer in the basin; however, the Colma Formation is also of interest since Lake Merced is incised within this formation.

As a result of the difficulty of differentiating the contacts between the Dune Sands, the Colma Formation, and the Merced Formation, the precise thickness of the Colma Formation and Dune Sands overlying the Merced Formation has not been determined. Groundwater in the vicinity of Lake Merced, and north to Stern Grove and Golden Gate Park, is encountered at relatively shallow depths (ranging from approximately 5 to 60 feet). South of Lake Merced, the depth to groundwater can exceed 300 feet below ground surface (bgs).

Phillips, et al. (1993) defined each of the groundwater basins in San Francisco as a continuous body of unconsolidated sediments and the surrounding surface drainage area. All seven major groundwater basins identified in San Francisco are open to the Pacific Ocean or San Francisco Bay. The landward parts of the groundwater basins generally are bounded horizontally and vertically by bedrock, which is assumed to be relatively impermeable compared with unconsolidated marine and alluvial deposits. Groundwater flow may occur between basins where the bedrock ridge that constitutes the boundary is subterranean. The north-south topography and bedrock height defined by the Coast Ranges generally forms an east-west hydrologic boundary through San Francisco.

The western part of San Francisco is divided into the Westside and Lobos Basins on the basis of a northwest-trending bedrock ridge through the northeastern part of Golden Gate Park. The bedrock ridge has several small surface expressions, and bedrock altitude data indicate that the ridge is continuous, though subterranean. Some degree of hydraulic connection is possible between the two basins where the ridge is not exposed at the land surface, but the degree of connection probably is minimal. The Westside Basin extends south to Burlingame and Hillsborough. Well drillers' logs for the San Bruno area indicate a deep sandy unit overlain by about 200 feet of predominantly fine-grained clays. Correlation of the deeper sand deposits is unclear; however, surficial mapping may indicate a relationship to exposures of sand/gravel deposits in the Burlingame area, which are mapped as non-marine Santa Clara Formation (Brabb and Pampeyan, 1983). A southward-extending ridge of Franciscan bedrock appears to separate San Bruno from the San Francisco Bay to the east. The upper fine grained beds appear to be Holocene to Late Pleistocene estuarine deposits of the San Francisco Bay (LSCE, 2004).

The subsurface configuration of the various geologic units in the Westside Basin has been delineated in a series of geologic cross-sections based on a combination of lithologic logs, water well drillers' reports, and geophysical logs (LSCE, 2004 and 2006). Lithologic units and other significant features in the basin are illustrated in geological cross-section form in Figure 2.

In the northern Westside Basin, in San Francisco, there are up to three aquifer units separated by two distinctive fine-grained units, the –100-foot clay and the W-Clay (LSCE, 2004). The aquifer units are generally designated as:

1) The "Shallow aquifer", which is present to an elevation of approximately –100 feet mean sea level (msl) (located above the –100-foot clay), in the vicinity of Lake Merced and the southern portion of the Sunset District of San Francisco;

2) The "Primary Production aquifer", which overlies the W-Clay; and

3) The "Deep aquifer" which underlies the W-Clay.

In the Daly City area, the –100-foot clay is absent, and the aquifer system is primarily composed of the Primary Production aquifer and the Deep aquifer.

Further to the south, in the South San Francisco area, the W-Clay is absent and the Primary Production aquifer is split into shallow and deep units, separated by a fine-grained unit at an elevation of approximately 300 feet below msl. The primary production aquifer in the San Bruno area is located at an elevation less than 200 feet below msl, and it underlies a thick, surficial fine-grained unit comprised of clay, sandy clay, and sand beds.

### 2.2 Lake Merced

Lake Merced is incised in the Shallow aquifer and is composed of four lakes: North Lake, East Lake, South Lake, and Impound Lake. A narrow channel connects the North and East Lakes, thereby creating equal water elevations in both lakes. A conduit between North Lake and South Lake allows water to flow between the lakes when the elevation in either lake is approximately 3.35 feet, San Francisco City datum[1]. When lake levels are below that elevation, these two lakes are separated and typically exhibit different elevations. South Lake and Impound Lake are separated below an elevation of approximately 4.26 feet, San Francisco City datum, by a levee that contains the Ingleside combined sewer pipeline and the foundation of a pedestrian walkway. Soil has accumulated on the foundation to an elevation of approximately 5 feet, San

[1] City Datum = NAVD88-11.37ft.

Francisco City datum. When either lake level is above that 5-foot elevation, water flows freely underneath the pedestrian walkway to connect both lakes.

Until the early 1900's, Lake Merced was one continuous body of water fed by local runoff and springs, with an outflow to the ocean in the form of a stream located at the northwestern end of North Lake. The stream flowed westward toward the ocean through the present-day location of the San Francisco Zoo and Sloat Boulevard. The springs that fed the lake were primarily located on the eastern side and in the southern portion of Lake Merced, causing a primary flow direction through the lake from the south to the north. In contrast, the current flow direction through the lakes is reversed, largely as a result of urban growth in the vicinity of Lake Merced, which has resulted in reduced recharge from springs and increased pumpage in the Primary Production aquifer south of Lake Merced. The urbanization of the watershed has also resulted in the emplacement of large amounts of fill that now impede spring discharge in the lake, and the diversion of an increasing amount of storm water away from Lake Merced and into the ocean or wastewater treatment plant. These diversions began with the construction of the Vista Grande Canal and Tunnel by the Spring Valley Water Works in 1897, and have continued with successive urban development in San Francisco and northern San Mateo County. The development of the watershed has also affected groundwater recharge from precipitation, which previously infiltrated and recharged the Shallow aquifer to a greater extent. As a result of all the preceding, the amount of subsurface inflow into Lake Merced, which in the early 1900's was manifested as spring inflow, has been reduced. The reduction in subsurface recharge to Lake Merced results in short-term lake levels being more sensitive to fluctuations in precipitation, since direct precipitation, along with shallow groundwater inflow, are the primary lake recharge mechanisms.

## 2.3 Pine Lake

Pine Lake is located north/northeast of Lake Merced in the westernmost portion of the Stern Grove and Pine Lake Park. Pine Lake (also known as Laguna Puerca) is one of San Francisco's few natural lakes. It is a small, shallow lake approximately three (3) acres in size. The lake has historically been overgrown with aquatic plants, which have periodically been removed. The San Francisco Recreation and Park Department has recently implemented a park improvement program for the Stern Grove and Pine Lake Park area. In November 2004, the Recreation and Park Department augmented lake levels over a 15-day period using groundwater pumped from a nearby well located east of Pine Lake. The lake addition was part of a study to evaluate the rate of lake level decline following a water addition. Approximately 25 acre-feet were discharged to the lake, which would theoretically raise the lake by about 8 feet. Nearby groundwater monitoring showed a corresponding increase in groundwater levels of about 5 feet in the Shallow aquifer.

We understand that the San Francisco Recreation and Park Department intends to resume groundwater pumping at the newly rehabilitated Pine Lake well in the near future, to once again augment the water level in Pine Lake.

SFPUC will cooperate with the Recreation and Park Department to measure future groundwater pumping from the Pine Lake well.

## 3.0 HISTORICAL GROUNDWATER DEVELOPMENT

By the early 1900's, wells had been constructed north, east, and south of Lake Merced for farming and drinking water supply. During that time, Spring Valley Water Company had two wells located near the Lake Merced outlet. Spring Valley pumpage was only about 100 afy (Bartell, 1913). The total of Lake Merced, Sunset District, and Golden Gate Park pumpage averaged 400 to 500 afy. In the early 1930s, the San Francisco Board of Public Works installed production wells in the Sunset District with a pumping capacity of about 6 mgd (6,700 afy). Groundwater withdrawals for emergency (drought) purposes averaged about 5 mgd (5,600 afy) from October 1930 through October 1935, but were discontinued after the availability of Hetch Hetchy water in the mid-1930s.

Beginning in the early 1950's, post-World War II development of Daly City and farther south onto the Peninsula was met with an increase in groundwater pumping and imported water deliveries from the SFPUC. Groundwater pumping increased from about 1,000 afy to nearly 5,000 afy between 1950 and 1970 (Kirker, Chapman & Associates, 1972). Since then, Daly City's groundwater pumping has ranged between approximately 3,000 and 5,000 afy, where it remained until October 2002, when an increase in SFPUC system water replaced the majority of Daly City's groundwater supply in normal and wet years as part of a demonstration conjunctive use pilot program among San Francisco, Daly City, Cal Water in South San Francisco, and the City of San Bruno. The conjunctive use pilot program ended in 2004. However, a subsequent agreement extended the project with Daly City, which received supplemental surface water until May 2007 when deliveries were suspended due to dry year water conditions. SFPUC plans to continue this demonstration program in Daly City. Daly City groundwater pumping totaled about 3,600 acre-feet (af) for 2008.

Groundwater pumping by Cal Water in South San Francisco has progressively declined from about 2,200 afy in 1947, to about 1,600 afy in 1969, to about 1,200 afy in 2002, to zero in 2003 (Figure 3). The decreases in groundwater pumping have been offset by increases in SFPUC system water deliveries. In early 2003, groundwater pumping in South San Francisco was discontinued as part of the same conjunctive use pilot program described above, with local surface water supplies replacing pumped groundwater. Groundwater pumping for municipal supply in South San Francisco resumed once again in March 2008 and totaled 206 af during 2008.

Pumping in San Bruno ranged from approximately 1,700 to 3,100 afy from 1997 through 2001 (Figure 3). In 2002, San Bruno decreased groundwater pumping to approximately 1,240 acre feet (af) and further decreased groundwater production to about 550 af in 2003 and 2004 as part of the pilot conjunctive use program. San Bruno resumed pumping after cessation of the demonstration conjunctive use program in that part of the basin in early 2005. In 2008 San Bruno pumped approximately 2,100 af of groundwater.

Total municipal pumping in the Westside Basin, as shown in Figure 3, was about 7,500 afy from the mid-1970s to the mid-1980s, and then ranged generally between about 6,000 and 8,000 afy until 2001. From 2002 to 2007, municipal pumping was reduced as part of the conjunctive use pilot program. In spring 2007, due to the dry 2006/2007 winter conditions, the SFPUC discontinued supplemental water delivery to Daly City, and Daly City resumed pumping from its municipal wells. Major groundwater production areas and historical groundwater pumping in the Westside Basin are presented on Figure 1 and Figure 3, respectively. Recent municipal groundwater usage is shown on Figure 4.

In addition to municipal water supply pumping in the Westside Basin, groundwater has historically been developed for irrigation supply and other non-potable uses, most notably on golf courses around Lake Merced, on the cemeteries in Colma, in Golden Gate Park and at the San Francisco Zoo. All unmetered, groundwater pumping for irrigation supply has been estimated infrequently. Kirker Chapman (1972) estimated golf course and cemetery pumping to be about 5,000 afy in 1969, and Yates, et al. (1990) estimated Golden Gate Park pumping to be about 1,000 afy during the late 1970's and 1980's. Adding those estimates to metered municipal pumping, as illustrated in Figure 3, suggests that total pumping was almost 15,000 afy in the late 1960's [assuming that Golden Gate Park pumping was similar in the late 1960's to the late 1970's and 1980's, as reported by Yates, et al. (1990)]. Assuming irrigation pumping to not substantially have changed until 2005 as discussed below, total pumping could be considered to have been about 6,000 afy more than municipal pumping, or in the range of about 12,000 to 14,000 afy from the mid -1980's through 2001.

Between 2002 and 2004, municipal pumping significantly decreased as part of the conjunctive use pilot program, to around 2,000 afy. From 2005 to May 2007 supplemental SFPUC water continued to be delivered to Daly City. In 2005, initial deliveries of recycled water for golf course irrigation largely eliminated groundwater use at the courses around Lake Merced, leaving the cemeteries, the San Francisco Zoo, and Golden Gate Park as the notable pumpers for irrigation and other non-potable uses, using an estimated 3,000 afy. The combination of the conjunctive use demonstration project and recycled water deliveries for golf course irrigation resulted in the combination of metered and estimated pumping in the basin declining to about 6,000 af in 2005, and approximately 5,400 af in 2006. Following discontinuation of the conjunctive use pilot program with Daly City in May 2007, approximately 7,500 af of groundwater was pumped in 2007.

## 4.0 GROUNDWATER PUMPING, USAGE AND DEVELOPMENT - 2008

In 2008, groundwater pumping in the Westside Basin was primarily for municipal supply to Daly City, Cal Water (South San Francisco), and San Bruno, as well as for irrigation and other non-potable uses by the San Francisco Zoo, Golden Gate Park, golf courses, and cemeteries, as described below and summarized in Table 2.

The SFPUC is planning to develop 4 mgd of regular groundwater supply from the North Westside Basin. As part of this plan, a test well was constructed at the South Sunset Playground in June 2007 and a second test well was completed at the West Sunset Playground in 2008. The West Sunset Playground test well is 12-inches in diameter, with a total depth of about 370 feet bgs. The test well is screened from 160 to 200 feet bgs and from 210 to 360 feet bgs.. The well construction permit, as-built construction details, lithologic logs and geophysical logs, and a summary of groundwater quality are presented in Appendix D.

### 4.1 City of Daly City

From its highest historical pumping of around 5,000 afy through most of the 1960's, Daly City's pumping was near constant, around 4,500 afy, through the 1970's and 1980's. Slightly more variable in the 1990's, when it generally declined to around 4,000 afy, Daly City's pumping has been most notably reduced since 2001, when it initially decreased to about 2,700 afy in 2002, followed by further decreases to between 700 and 1,500 afy in 2003 through 2005. The decreases in 2003 through 2005 were associated with the conjunctive use pilot program, which continued in Daly City through May 2007. Groundwater pumping in Daly City during calendar year 2008 totaled about 3,600 af compared to about 2,600 af for 2007 (when Daly City only pumped for a portion of the year). The history of pumping in Daly City is illustrated in Figure 3 and Figure 4.

### 4.2 City of South San Francisco

Municipal groundwater pumping in South San Francisco is provided by Cal Water, which also serves Colma and small parts of Daly City. Historical pumping by Cal Water decreased from the late 1940's through 2002, from about 2,200 afy to about 1,200 afy. As part of the pilot conjunctive use project with the SFPUC, Cal Water discontinued groundwater pumping for water supply purposes in 2003 and 2004. The conjunctive use pilot program ended in South San Francisco in early 2005. Cal Water resumed groundwater pumping in March 2008. Groundwater pumping by Cal Water during calendar year 2008 totaled 206 af.

### 4.3 City of San Bruno

Over the long term, groundwater pumping in San Bruno has generally ranged between about 550 and 3,100 afy since the late 1940's. As part of the conjunctive use pilot program, San

Bruno reduced pumping to approximately 550 af in 2003 and 2004. After cessation of the conjunctive use pilot program in San Bruno in early 2005, groundwater pumping in San Bruno increased to about 1,700 af for that year. Groundwater pumping in San Bruno has amounted to approximately 1,950 af for 2006, 2,350 af for 2007, and 2,100 af for 2008.

### 4.4 San Francisco Zoo

The San Francisco Zoo uses groundwater for irrigation and Zoo operations. Landscape irrigation along part of the Great Highway is also supplied by groundwater. Since the mid-1990s, the water needs of the Zoo and the landscaping along the Great Highway have been met by Well No. 5, which is located at the Zoo and is operated and maintained by the San Francisco Recreation and Park Department. Groundwater meter data started being recorded in February 2005. In 2005 and 2006, annual groundwater pumping was reported at approximately 400 af and approximately 350 af, respectively. For 2008, metered groundwater pumping at the Zoo was approximately 260 af. This amount compares to about 620 af for 2007, and represents a decrease of about 42% compared to 2007 pumping (Table 2). The reason for the significant decrease in pumping at the SF Zoo is not readily apparent. SFPUC and Zoo staff are reviewing 2008 groundwater and surface water use in an attempt to understand these differences in 2008 groundwater use compared to 2007.

### 4.5 Golden Gate Park and Pine Lake

Groundwater is pumped in Golden Gate Park for irrigation and to maintain artificial lakes within the park. The Golden Gate Park wells are operated and maintained by the San Francisco Recreation and Park Department. Groundwater is pumped from three wells located at Elk Glen Lake, near North Lake, and near the South Windmill. Historically groundwater pumping data were not maintained for the Golden Gate Park wells. In 2005 meters were installed in all three production wells to quantify groundwater pumping in the park. Historical groundwater pumping in Golden Gate Park has previously been estimated to be approximately 1,100 afy (Yates, et al., 1990). For 2008, approximately 1,300 af of metered groundwater was pumped at the South Windmill Replacement well, the North Lake well, and the Elk Glen Lake well. This compares to about 830 af pumped from these wells in 2007 and represents an increase of about 57% over 2007 values. Total metered pumping in 2008 was calculated based on weekly flowmeter readings collected by the SFPUC from the three afore mentioned production wells. In accordance with recommendations made in the 2007 Annual Report, the SFPUC coordinated with Rec Park and retained Jensen Instruments (a licensed contractor) to service and calibrate the electronic flow totalizers at the North Lake and South Windmill Replacement wells. Service and calibration was conducted under the observation of SFPUC and Rec Park staff in November 2008.

In addition to Golden Gate Park, we understand that the Recreation and Park Department intends to resume groundwater pumping at the newly rehabilitated Pine Lake well sometime in the near future, to once again augment levels at the Pine Lake. SFPUC will cooperate with the Recreation and Park Department to measure future groundwater pumping from the Pine Lake well.

### 4.6 Golf Courses

There are six (6) golf courses in the Westside Basin that use groundwater for irrigation. These include the Lake Merced Golf Club, the Olympic Club Golf Course, the San Francisco Golf Club, the California Golf Club, the Golden Gate Park Golf Course and the Green Hills Country Club. In 2004, recycled water was made available to Lake Merced Golf Club, the Olympic Club Golf Course, and the San Francisco Golf Club by adding a tertiary level of treatment at the North San Mateo County Sanitation District (a subsidiary of the City of Daly City) Wastewater Treatment Plant and by installing a distribution system from the treatment plant to these respective golf courses.

In 2008, a total of 516 af of recycled water and 91 af of pumped groundwater were used by the Olympic Club Golf Course and the San Francisco Golf Club to meet irrigation needs. According to data provided by the City of Daly City, the Lake Merced Golf Club used about 78 af of recycled water in 2008. Annual pumping data for 2008 was not available from the Lake Merced Golf Club. A summary of golf course water use is presented in Table 1. Groundwater pumping data have not been requested from the California Golf Club for this report. However, based on the Recycled Water Feasibility Study (Carollo Engineers, September 2008), the pumping is estimated at 206 af per year. The Golden Gate Park Golf Course is irrigated with groundwater as part of the overall park irrigation. No pumping data have been requested from the Green Hills Country Club, located in Millbrae, within the southwestern portion of the basin.

### 4.7 Cemeteries

There are about 600 acres of cemeteries in Colma, most of which have historically been, and continue to be, irrigated with groundwater. Based on the Recycled Water Feasibility Study (Carollo Engineers, September 2008), the average annual groundwater pumping by cemeteries in Colma is estimated at 787 afy. Golden Gate National Cemetery has not been irrigated using groundwater for more than 20 years (personal communication on 9/7/07 between Greg Bartow (SFPUC) and Clifford Schem (US Dept. of Veterans Affairs, Nat'l Cemetery Administration)).

### 4.8 Summary

Total 2008 groundwater pumping in the Westside Basin is estimated at 8,500[2] af. Metered water use indicates that the cities of Daly City, South San Francisco, and San Bruno used approximately 5,900 af of groundwater in 2008, while the two metered golf courses in the Lake Merced area used approximately 91 af of groundwater and 516 af of recycled water during calendar year 2008.According to data provided by the City of Daly City, the Lake Merced Golf Course used approximately 78 af of recycled water in 2008. Annual pumping data for 2008 was not available from the Lake Merced Golf Club but is estimated at about 37 af based on 2007 metered groundwater use. A general comparison between the combinations of metered and estimated historical pumping, and more completely metered pumping in 2005, 2006, 2007 and 2008, is presented in Table 1 and 2.

Total 2008 reported metered pumping in the Westside Basin was approximately 8,550 af. This consists of metered pumping at the three wells in Golden Gate Park, the San Francisco Zoo well, Daly City, San Bruno, Olympic Club Golf Course, and San Francisco Golf Club, and estimated groundwater pumping at the Lake Merced Golf Club based on 2007 values. To date the SFPUC and cooperating municipal pumpers have not requested annual pumping information from the other irrigation pumpers in the Westside Basin. However, based on estimates compiled by Carollo Engineers (Carollo Engineers, September 2008), the other pumping in the South Westside Basin is estimated at about 1,000 afy. Pumping within the Westside Basin not described (e.g., private homeowner wells, groundwater remediation extraction wells, and construction dewatering wells) is assumed to be negligible compared to the municipal and large-scale irrigation uses.

## 5.0 GROUNDWATER MONITORING AND TESTING PROGRAM

Groundwater monitoring within the Westside Basin consists of groundwater elevation and water quality monitoring conducted on a semi-annual basis (conducted during the spring and fall each year). Monitoring of groundwater elevations and various water quality parameters is conducted throughout the Westside Basin to evaluate the potential for seawater intrusion, and define lake-aquifer interaction. The monitoring program is also conducted to assess general conditions in the basin resulting from ongoing pumping, the conjunctive use program pilot and the recycled water program. The groundwater elevation monitoring well network is listed in Table 3, and approximate well locations are shown on Figure 5. These include both dedicated monitoring wells and inactive production wells. Measurements are collected manually on a quarterly or semi-annual basis in some wells, and daily through the use of electronic pressure transducers in other wells. Groundwater elevation hydrographs of all the wells monitored in 2008 are presented in Appendix A. All groundwater elevations are presented relative to the North American Vertical Datum of 1988 (NAVD88).

In addition to monitoring groundwater elevation data, groundwater sampling and analysis were conducted from select wells to monitor concentrations of various analytes and physical parameters of groundwater within the Westside Basin. The groundwater quality testing network is shown on Figure 21. Results of these analyses are used to monitor and evaluate the potential for seawater intrusion and general groundwater quality. Groundwater samples collected by the SFPUC for the North Westside Basin were done so in accordance with the "Sampling and Testing Protocol" for the Westside Basin (Appendix C).

Select groundwater samples were tested for some or all of the following constituents:

- General Minerals including: total alkalinity, calcium, magnesium, sodium, potassium, bicarbonate as $CaCO_3$, chloride, and sulfate;
- Iron and manganese (total and dissolved fractions);
- Nitrate;
- General parameters including: specific conductance, pH, total dissolved solids (TDS), and hardness;
- Bromide;
- Orthophosphate, and
- Boron.

Select groundwater elevation data are summarized in hydrographs illustrated on Figures 6 to 15, and groundwater elevation contour maps are presented on Figures 16 to 19. Results of chemical analyses on select groundwater samples are summarized in Tables 6 to 9.

# 6.0 COASTAL AND BAY SIDE WATER LEVEL MONITORING

## 6.1 Coastal Water Level Monitoring

Groundwater level measurements are being collected from a coastal monitoring well network in the western part of the basin, along the Old Great Highway (near Kirkham, Ortega, and Taraval Streets), the north-western part of Golden Gate Park, at the Oceanside Wastewater Treatment Plant, at the San Francisco Zoo, at Fort Funston, and at Thornton Beach. Fieldwork was conducted in accordance with the "Sampling and Testing Protocol for the Westside Basin" presented in Appendix C.

Groundwater elevation hydrographs of the Kirkham, Ortega, Taraval, and Zoo monitoring wells are presented in Figures 6 through 9, respectively. These hydrographs also include chloride concentrations from the water quality monitoring conducted at these wells. The water quality data are further discussed in Section 7.1. Figures 6 through 9 show the history of groundwater levels in the coastal monitoring wells since installation of wells at those four sites.

Groundwater elevations within the Shallow aquifer at all four coastal wells increased slightly or remained virtually unchanged seasonally compared to observed 2007 levels, and continued to trend above sea level in all wells. Groundwater levels within the Primary Production aquifer and Deep aquifer at the following wells increased in 2008 from the observed seasonal low levels of 2007, as follows:

- Kirkham MW-255 (Figure 6b) increased from a seasonal low of 3.2 ft (September 2007) to 5.2 ft (July 22, 2008);
- Kirkham MW-385 (Figure 6c) increased from a seasonal low of 2.9 ft (September 2007) to 5.2 ft (September 22, 2008);
- Kirkham MW-435 (Figure 6d) increased from a seasonal low of -0.5 ft (September 2007) to 2.4 ft (June 2008);
- Groundwater levels in Ortega MW-475 (Figure 7d) increased from a seasonal low of -4.7 ft in September 2007 to 1.0 ft (May 2008).
- Taraval MW-530 (Figure 8d) increased from a seasonal low of -9.0 ft (September 2007) to -2.0 ft (May 2008); and
- Zoo Monitoring Well MW-565 (Figure 9c) increased from a seasonal low of -13.5 ft (September 2007) to -6.0 ft (May 2008);

At their lowest measured levels of 2008, groundwater elevations at Taraval MW-530 (-2.0 ft), and Zoo Monitoring Well MW-565 (-6.0 ft) were below sea level. In addition, observed groundwater levels at the South Windmill monitoring well MW-57 and MW-140 remained below sea level and were similar to the recorded 2007 levels (Appendix A). Groundwater levels in MW-57, located in close proximity to the South Windmill Replacement well, dropped below sea level for the first time in 2007 since water level measurement began in 1989.

The observed increase in water level elevations in the Primary Production and Deep aquifers at the Kirkham, Ortega, Taraval, and Zoo wells, are likely a result of the following factors:

- Decreased pumping of groundwater at the SF Zoo production well, from 616 af in 2007 to 260 af in 2008 (Table 2), resulting in reduced drawdown and impact on the nearby coastal monitoring wells screened in the Primary Production and Deep aquifer;

- Although total groundwater use at the Golden Gate Park increased from about 827 af in 2007 to 1,294 af in 2008 (Table 2), there was a slight shift in pumping patterns caused by the shutdown of the South Windmill Replacement production well to more inland locations at various times in 2008, and

- A corresponding increase in pumping at the North Lake production well in Golden Gate Park resulted in less observed drawdown of water levels in the coastal monitoring wells. Pumping at the North Lake production well increased from about 224 af in 2007 to 645 af in 2008, while pumping at the South Windmill Replacement production well decreased from 596 af in 2007 to 558 af in 2008. Pumping at the Elk Glenn production well located in the central portion of the Golden Gate Park, increased from 7 af in 2007 to 91 af in 2008.

With the exception of the South Windmill monitoring well MW-57 and MW-140, groundwater elevations measured at wells screened within the Shallow aquifer in 2008 were all above sea level. Groundwater elevation contours for the Shallow aquifer measured during the spring and fall 2008 monitoring events are presented on Figures 16 and 17, respectively.

Groundwater levels at coastal monitoring wells screened in the Primary Production aquifer increased in 2008 compared to observed 2007 levels. Groundwater elevation contours for the Primary Production aquifer measured during the spring and fall 2008 monitoring events are presented on Figures 18 and 19, respectively.

Groundwater levels at the two coastal wells screened in the Deep Aquifer (Taraval MW-530, and Zoo MW-565), increased compared to observed 2007 levels but remain below sea level.

In general, coastal groundwater levels in most of the wells on the Pacific Ocean side of the Westside Basin are sufficiently high (above sea level) to indicate a lack of potential for seawater intrusion.  However groundwater levels in monitoring wells near the southwestern corner of Golden Gate Park were below sea level in the Shallow aquifer (South Windmill monitoring well MW-57 and MW-140). In the Shallow and Primary Production aquifers, the continued depression of groundwater levels appears to be the result of increased and concentrated pumping in the western part of Golden Gate Park. In addition, below-normal  winter precipitation in 2006, 2007 and 2008 further reduced aquifer recharge, and increased the need for irrigation pumping. Continued concentrated pumping in Golden Gate Park and the resulting depression of groundwater levels below sea level indicates a potential for seawater intrusion.

Increased water level elevations observed in all monitoring wells screened in the Primary Production and Deep aquifer within the coastal monitoring system for 2008 reinforces the goal for more sustainable and decentralized pumping at the SF Zoo and Golden Gate Park. This would allow previously depressed water levels to continue to rise and reduce the potential for sea water intrusion, and create more sustainable groundwater conditions in the North Westside Basin.

The coastal monitoring wells located at Fort Funston and Thornton Beach have groundwater elevations above sea level.  The aquifers at these locations appear to be hydraulically separated from the main portion of the Westside Basin by faults and resultant steeply dipping geologic units, which act as hydraulic barriers to flow (LSCE, 2004). Groundwater elevations in the Fort Funston monitoring wells (Fort Funston –S and Fort Funston –M) continue to exhibit a generally increasing trend in the Upper Merced Formation and a virtually constant water level elevation in the Middle Merced Formation. Groundwater elevation monitoring at the Thornton Beach well MW 225 (screened in the Primary Production aquifer) and MW 670 (screened in the Deep aquifer) indicates that groundwater levels in both aquifers continue to rise in this area and remain well above sea level. Groundwater hydrographs for all wells monitored in 2008 are presented in Appendix A.

### 6.2 Bay Side Water Level Monitoring

Additional monitoring on the Bay Side of the Westside Basin was implemented by the City of San Bruno in 2006. In the fall of 2006, two new well clusters were installed and monitored by the City of San Bruno at locations in the San Francisco Airport (SFO) and within Burlingame (Figure 5). These wells were positioned to enhance monitoring of groundwater levels and water quality parameters along the San Francisco Bay side of the basin. Details of field activities, well installation activities and resulting monitoring in November 2006 and April 2007, were presented in “San Bruno Groundwater Monitoring Wells: Installation and Monitoring, An AB 303 Project Report”, prepared for the City of San Bruno by WRIME, Inc. and dated April 2007.

In February 2008, groundwater elevations were measured in the two monitoring well clusters: SFO (S and D) and Burlingame (S, M, and D). Groundwater elevations measured during this event in wells SFO-S and SFO-D were 2.29 and -29.18 feet (NAVD88), respectively. Groundwater elevations measured during this event in wells Burlingame (S, M, and D) were 3.37, 1.52, and -3.95 ft (NAVD88), respectively. Groundwater elevations measured during the August 2008 monitoring event in wells SFO-S and SFO-D were 1.78 and -30.07 ft (NAVD88), respectively. Groundwater elevations measured at wells Burlingame –S, M, and D during the August event; were 1.64, -0.82, and -4.65 ft (NAVD88), respectively. Fieldwork was conducted by WRIME Inc in accordance with the "San Bruno Seawater Intrusion Monitoring Wells: Sampling Plan", prepared for the City of San Bruno by WRIME, Inc. dated April, 2007.

### 6.3 Lake Merced and Lake-Aquifer Monitoring

The water level elevations in Lake Merced in 2009 ranged from about 16.27 feet to 18.30 feet (NAVD88 datum). Lake levels are presented on Figure 20. Observed 2008 lake levels are fairly similar to observed levels in 2007, and continue to show a generally upward trend from seasonal low levels in 2002. These lake level elevations are above the 14 to 16 foot (NAVD88) interim lake level range established by the SFPUC.

Lake-aquifer monitoring around Lake Merced is accomplished by a combination of continuous and periodic monitoring of water levels in each of the three lake bodies, and by a combination of continuous and intermittent monitoring of groundwater levels in a network of dedicated monitoring wells around the lake complex, as illustrated in Figure 5.

Measured groundwater elevations in wells screened in the Shallow aquifer around the Lake. during the spring 2008 event, ranged from 13.34 feet (LMMW-9SS) to 29.31 ft above sea level (LMMW-7SS). For the fall 2008 event groundwater elevations ranged from 12.76 feet (LMMW-9SS) to 28.75 feet (LMMW-7SS). In the underlying Primary Production aquifer, groundwater elevations in the vicinity of Lake Merced ranged from -5.75 feet (LMMW-3D) to 14.63 feet (LMMW-2D) during the spring 2008 event. For the fall 2008 event, measured groundwater elevations in the Primary Production aquifer in the vicinity of Lake Merced ranged from -9.01 feet (LMMW-3D) to 13.48 feet (LMMW-2D).

For 2008, Shallow aquifer groundwater elevations around the Lake ranged from about 1.2 ft below to 12.7 ft above the interim Lake levels. Groundwater levels in the Primary Production aquifer around the lake ranged from about 23 ft below to 0.5 ft below the interim Lake levels. Groundwater elevations in the Primary Production aquifer were also in general lower than levels measured in the Shallow aquifer and the lake, indicative of a potential for flow from the Shallow aquifer-Lake system toward the underlying aquifer in which nearby production wells are primarily completed.

Hydrographs of two wells screened in the Shallow and Primary Production aquifers (LMMW-1S and LMMW-1D, respectively) that monitor groundwater elevations in the vicinity of Lake Merced are presented on Figure 12. Groundwater elevations in both aquifers continue to exhibit a generally upward trend from their 2002 levels. However groundwater levels in wells screened in the Primary Production and Deep Aquifer located near the southern portion of Lake Merced (e.g. LMMW-3D) decreased compared to 2007 values (Appendix A). This appears to be a result of increased and continued groundwater pumping by the City of Daly City.

### 6.4 South Westside Basin Water Level Monitoring

As part of the Westside Basin Monitoring Program, water levels in 9 wells screened in the Primary Production aquifer are typically monitored in the South Westside Basin. These wells were initially monitored by the San Mateo County Department of Environmental Health, starting in 2000. Since 2002 these wells have been monitored as part of the SFPUC's groundwater monitoring program. These wells consist of: LMMW-6D, DC 1 (Westlake), DC 8, and Park Plaza (MW-460) located in Daly City; SS1-02 and SS1-20 located in South San Francisco; SB-12 in San Bruno, and UAL 13C and UAL 13D located at the San Francisco International Airport. In 2006, two new well clusters (SFO and Burlingame) were installed by the City of San Bruno to fill data gaps in their own monitoring program. In the summer of 2007 SFPUC installed a monitoring well cluster consisting of 4 wells, at the South San Francisco Linear Park in South San Francisco.

In October 2008, SFPUC installed five new monitoring well clusters at the following locations:

- CUP-10A located within SFPUC Right of Way in Daly City;
- CUP-18 located within SFPUC Right of Way at Colma Blvd in Colma;
- CUP-19 located within SFPUC Right of Way at Serramonte Blvd in Colma;
- CUP-22A located within SFPUC Right of Way at Hickey Blvd at Camaritas Road, in South San Francisco; and
- CUP-36-1 located within SFPUC Right of Way at Southwood Drive in South San Francisco.

The five monitoring well clusters were completed at depths ranging from 151 to 710 feet bgs. These well clusters were installed as part of the Water System Improvement Program, Groundwater Conjunctive Use Project well installation and will be incorporated in the SFPUC's Westside Basin monitoring program. Permits, well construction details, lithologic logs and geophysical logs from these monitoring wells are presented in Appendix D.

Water level measurements for the wells screened within the Primary Production aquifer and monitored during the spring 2008 event [LMMW-6D, DC 1 (Westlake), Park Plaza MW-460, DC 8, SB-12, SS 1-02, and SSFLP MW-220] indicate that groundwater elevations were below sea level. Groundwater elevations ranged from -15.54 feet (LMMW-6D) to -185.23 feet (SB-12 Elm

Avenue) relative to mean sea level during the spring event. Groundwater elevation contours in the Primary Production aquifer for the spring 2008 event are presented on Figure 18. Groundwater elevations during the fall 2008 monitoring event indicate that elevations in these wells ranged from -19.84 feet (LMMW-6D) to –194.94 feet (SB-12 Elm Avenue). Groundwater elevation contours in the Primary Production aquifer for the fall 2008 event are presented on Figure 19. Groundwater elevation hydrographs for all the wells monitored during the spring and fall 2008 events are presented in Appendix A.

## 7.0 GROUNDWATER QUALITY MONITORING

Groundwater quality data for the Westside Basin are primarily from a combination of historical water quality analyses, mostly from municipal supply wells, and from the semi-annual monitoring program that was initiated throughout the basin in May 2000. The program has expanded to include additional wells as they have been constructed. Program wells are illustrated in Figure 21 and listed in Table 5, and they reflect the location of both production and dedicated monitoring wells. Results of groundwater quality monitoring in 2008 are presented below.

### 7.1 Coastal Groundwater Quality

Monitoring of groundwater levels and groundwater quality at the coastal monitoring wells located along the Great Highway near Kirkham, Ortega, and Taraval streets, and at the San Francisco Zoo, as well as in the southwestern portion of Golden Gate Park, is conducted to detect the potential for seawater intrusion. Groundwater samples from these wells were tested for specific conductance, total dissolved solids (TDS) and chloride in the spring and fall 2008. Results of groundwater quality testing for the coastal monitoring wells are presented in Table 6. Chloride concentrations and groundwater elevations in 2008, as well as records since the inception of coastal monitoring (2004), are plotted on hydrographs presented in Figures 6 through 9.

Chloride concentrations for 2008 ranged from 19 mg/l (SF#32-Ortega MW400) to 178 mg/l (SF#57-USGS South Windmill MW-57). Detected chloride concentrations in the coastal monitoring wells generally ranged from 19 mg/l to 69 mg/l, with the exception of the SF#57-USGS South Windmill MW-57, which had concentrations of 150 mg/l (spring 2008) and 178 mg/l (fall 2008). For the shallow coastal wells (screened between 50 to 150 feet), chloride concentrations ranged from 30 mg/l (SF#30-Grt Hyw/Ortega MW-125) to 178 mg/l (SF#57-USGS South Windmill MW-57) (Table 6).

The chloride concentrations measured in 2008 are within historical ranges at all the wells sampled, except for the USGS South Windmill MW-57 well. All chloride concentrations are below the state of California secondary drinking water standard of 250 mg/l and are also well below 500 mg/l, a commonly referenced concentration indicative of seawater intrusion. Although groundwater levels continue to be depressed below sea level in the deeper part of the aquifer system and chloride concentrations at the Zoo, and the USGS South Windmill MW-140 well located in the southwestern portion of Golden Gate Park are slightly higher than the other monitoring locations along the coast, none appear to be suggestive of seawater intrusion at the present time. The total dissolved solids (TDS) concentrations and specific conductance values in these wells are all within historical ranges and below established secondary drinking water standards.

The chloride, TDS and specific conductance values in the USGS South Windmill MW-57 well show an increase in concentration that may be an early indication of seawater intrusion. Efforts are underway between the SFPUC and the SF Recreation and Park Department to develop a recycled water supply for Golden Gate Park, and to distribute groundwater pumping further away from the coast.

### 7.2 General Basin Conditions

Groundwater quality is monitored in a network of production and monitoring wells as described above and illustrated in Figure 21. Groundwater samples were collected from wells used to assess general basin conditions in the spring (April, May, and June) 2008. The analytical results are summarized in Tables 7 and 8. With the exception of nitrate (as $N0_3$) concentrations detected in DC#01 - A St (Daly City) and one of the South San Francisco wells SS#08 - SS 1-19, groundwater quality generally meets the maximum contaminant levels (MCLs) of primary drinking water standards set by California Department of Public Health.

The South San Francisco Linear Park (SSFLP) wells (MW-120, 220, 440, and 520) were sampled and analyzed for iron and manganese in the spring and fall 2008. Detected total iron concentrations ranged from 0.013 mg/l (SSFLP MW-520) to 0.161 mg/l (SSFLP MW-120), while detected total manganese concentrations ranged from 0.147 mg/l (SSFLP MW-220) to 0.825 mg/l (SSFLP MW-120). In addition groundwater samples from the well cluster at the South San Francisco Linear Park were tested for dissolved iron and manganese. Detected dissolved iron concentrations ranged from 0.005 (SSFLP MW-520) to 0.063 mg/l (SSFLP MW-120). Detected dissolved manganese concentrations at these wells ranged from 0.139 mg/l (SSFLP MW-220) to 0.805 mg/l (SSFLP MW-120). Detected concentrations of total and dissolved manganese in these wells exceed the secondary MCL of 0.05 mg/l. Detected iron and manganese concentrations are summarized on Table 8.

The 2008 water quality results for specific conductance, TDS, and chloride for Daly City well (DC#11 – Westlake DC2), South San Francisco well SS#08 - SS 1-19 , and San Bruno well SB#06 - SB-17 Corporation Yard are combined with available historical data and illustrated in Figures 22 through 24, respectively. South San Francisco well SS#05 – SS 1-14, which is typically sampled as part of the monitoring program, was offline. Production well SS#08 – SS 1-19 located within the same well field was sampled instead. Results from this well have been appended to the historical data available from SS 1-14 and are presented in Figure 23 and 25. The 2008 and historical nitrate data for the above wells and the Vale well (Daly City) are illustrated in Figure 25.

### 7.2.1 City of Daly City

In Daly City, the available data extend back to the mid 1970's (Table 7 and Figures 22 and 25), but are too sporadic to derive any substantive conclusions about trends or changes. During the spring 2008 monitoring event, detected nitrate concentrations ranged from 10 mg/l in DC#06 - Jefferson to 131 mg/l in DC#01 - A St. Nitrate concentrations in DC#01 - A St exceeded the primary MCL of 45 mg/l. With the exception of well DC#06- Jefferson, which remained essentially unchanged (from 9.4 to 10 mg/l), detected nitrate concentrations decreased slightly with respect to the 2007 sampling results in three of the four wells sampled during this event. Specific conductance increased slightly in three of the four wells sampled compared to 2007 levels. Chloride concentrations ranged from 56 mg/l (DC#06-Jefferson) to 122 mg/l (DC#11 Westlake DC 2). Except for DC#06- Jefferson, which showed a decrease from 80 to 56 mg/l, detected chloride concentrations increased slightly in all of the Daly City wells sampled during this event. Ongoing monitoring will delineate whether the recent data are indicative of changing, temporary, or anomalous conditions in that area. The monitoring program will continue to examine these trends in subsequent events.

### 7.2.2 City of South San Francisco

For the South San Francisco area, records from Cal Water date back to the late 1950's (Table 7 and Figures 23 and 25). Chloride concentrations for the spring 2008 monitoring event ranged from 63 mg/l (SSFLP 440) to 176 mg/l (SSFLP 120). Chloride concentrations in the South San Francisco area, have consistently been higher than elsewhere in the basin. Historically specific conductance and TDS concentrations in well SS#05 SS 1-14 have fluctuated more than chloride and appeared to exhibit a generally upward trend since the 2000 monitoring event. During the 2008 spring monitoring event, wells SS#05-SS1-14, and SS#10-SS1-21 were undergoing repair and consequently were not sampled. Two other production wells SS #08-SS 1-19 and SS #09-SS 1-20 located in the same well field, were sampled in their place. The specific conductance at the two production wells sampled in South San Francisco during the spring 2008 monitoring event was 993 µmhos/cm (SS#08 – SS 1-19) and 863 µmhos/cm (SS#09 – SS 1-20). Analysis detected 47 mg/l (SS#08 – SS 1-19) and 35 mg/l (SS#09 – SS 1-20) of nitrate respectively. The detected nitrate concentration at well SS#08 – SS 1-19 is slightly above the primary MCL of 45 mg/l (Table 7). Ongoing monitoring will delineate whether the recent data are indicative of changing, temporary, or anomalous conditions in that area.

### 7.2.3 City of San Bruno

In San Bruno, available groundwater quality data extend back to 2000 (Table 7, Figures 24 and 25). Interpretation of the records since 2000 (Figure 24) suggests fairly constant conditions. For 2008, chloride concentrations were 57 mg/l and 84 mg/l at SB 17 Corporation Yard and SB 20

Lions Field Park, respectively. Reported chloride concentrations increased slightly at the SB-17 well and decreased at the Lions Field Park well, but remained within historical ranges. The nitrate concentrations were 6 mg/l and 1 mg/l in SB-17 and SB 20, respectively. Detected nitrate concentrations in the two wells sampled during the spring 2008 event are well below the primary MCL of 45 mg/l (Table 7 and Figure 25). At present, we understand that the City of San Bruno is treating groundwater pumped from well SB#08 - SB 20 for manganese.

As part of the City of San Bruno's Bay side monitoring program, the two well clusters installed in 2006 were sampled by WRIME, Inc in August 2008. A summary of chemical testing results was provided by WRIME Inc on behalf of the City of San Bruno (Figure 7). Chloride concentrations and groundwater elevations beginning in 2006 for the Burlingame and SFO wells are plotted on hydrographs presented in Figures 10 and 11 respectively.

### 7.3 Recycled Water

The initiation of recycled water deliveries in 2004 for golf course irrigation around Lake Merced, which resulted in meeting about most of irrigation demand at the private courses in 2008, had raised a question regarding potential impact of recycled water application on the underlying groundwater. Initial evaluation of this question in 2005 consisted of a comparison between recycled water quality and background (current) groundwater quality in monitoring wells near the golf courses. Groundwater monitoring of these four wells continued in 2008. Available data on recycled water quality collected in 2005, and nearby dedicated monitoring wells sampled at least annually between 2004 and 2008, are presented in Table 9. Based on comparison of those data, the water quality of recycled water and groundwater is sufficiently similar that no substantial change in groundwater quality would appear to be expected as a result of recycled water application. For the available data, constituent concentrations in the recycled water are within, or slightly higher than, those in the underlying groundwater (Table 9). Ongoing monitoring of recycled water quality and underlying groundwater will permit interpretation of changes that may occur in the future.

# 8.0 SUMMARY AND PROPOSED ACTIVITIES FOR 2009

This report is the annual report on groundwater conditions in the Westside Basin, prepared by the SFPUC in cooperation with Daly City, San Bruno, and Cal Water (cooperating agencies).

## 8.1 Groundwater Monitoring

The groundwater monitoring and reporting program will continue to be implemented in accordance with the recommendations presented in the 2005 annual report (LSCE, 2006). Semi annual sampling and various water level measurements will be conducted in 2009 to assess general groundwater conditions in the Westside Basin, as well as to continue to evaluate the adequacy of the entire program. In 2009, the cooperating agencies will assess the need for expanding the monitoring program within the southern part of the Basin, and continue to incorporate water level elevation and water quality data from any future wells installed within these jurisdictions (e.g. the five new well clusters installed in October 2008 in the southern portion of the basin as part of the Conjunctive Use Project). The scope and frequency of the groundwater monitoring program are presented on Tables 10 and 11.

## 8.2 Coastal Monitoring

Continued semi-annual monitoring of coastal water quality (primarily TDS, specific conductance, and chloride) conducted during the spring and fall (Table 11) will be coupled with quarterly-to-daily water level measurements from the existing coastal monitoring well locations (Table 10).

## 8.3 Lake Merced

For 2009 the existing monitoring program at Lake Merced will be continued, with collection of lake level data from South Lake and Impound Lake in accordance with recommendations of the 2005 annual report. Groundwater measurements will be recorded daily and quarterly in accordance with the current program (Table 10). More frequent measurements may be appropriate as part of any artificial water additions to the lake or aquifer hydraulic testing. Such changes will be implemented as necessary.

## 8.4 General Basin Conditions and In-Lieu Conjunctive Use Program

The SFPUC will continue to monitor daily water levels of key wells in the Daly City, South San Francisco, and San Bruno areas (Table 10), along with annual water quality monitoring (Table 11). In the southern portion of the Westside Basin, there remains a need for quantification of pumping at the cemeteries in Colma and at the California Country Club, to complete the current understanding of significant pumping in the Westside Basin.

## 8.5 Recycled Water Program

SFPUC will continue monitoring recycled water quality and groundwater quality in the areas of recycled water use on an annual basis (Table 11). Although initial data show recycled water quality and groundwater quality to be fairly similar, continued monitoring will provide data to evaluate whether any trends develop as a result of the use of recycled water for irrigation purposes. For 2009, we will add testing for nitrate as $N0_3$ to the monitoring of groundwater quality in areas of planned recycled water use (e.g. LMMW -2S and LMMW-2D located at the Harding Park Golf Course in San Francisco).

## 8.6 Bay Side Monitoring

The City of San Bruno will continue to monitor the Bay Side wells in the southeastern portion of the Westside Basin on a semi-annual basis, in general accordance with the Westside Basin monitoring program and transmit this data to the SFPUC for inclusion in the annual groundwater monitoring reports.

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# APPENDIX B SFPUC AGENDA ITEM FOR APPROVAL OF THE WATER SYSTEM IMPROVEMENT PROJECT OCTOBER 31, 2008

# AGENDA ITEM
# Public Utilities Commission
***City and County of San Francisco***

DEPARTMENT Water Enterprise AGENDA NO. ______

MEETING DATE October 30, 2008

## SUMMARY OF PROPOSED COMMISSION ACTION

**Approve** the Phased Water System Improvement Program (Phased WSIP) Goals and Objectives and **Adopt** California Environmental Quality Act (CEQA) Findings, including a statement of overriding considerations and the Mitigation Monitoring and Reporting Program (MMRP).

## DESCRIPTION OF ACTION

Program Approval

The Phased WSIP is a variant of the originally proposed WSIP and includes full implementation of the WSIP facility projects to ensure that the public health, water quality, seismic safety, and delivery reliability goals are achieved, with phased implementation of the water supply portion of the program. Under the Phased WSIP, the SFPUC will establish an interim, mid-term implementation horizon of 2018. The Phased WSIP includes water supply delivery to wholesale and retail customers through 2018.

The Phased WSIP goals and objectives are founded on two fundamental principles pertaining to the existing regional water system: (1) maintain a clean, unfiltered water source from the Hetch Hetchy system and (2) maintain a gravity-driven system.

The overall goals of the Phased WSIP for the regional water system are to:

- Maintain high-quality water and a gravity-driven system
- Reduce vulnerability to earthquakes
- Increase delivery reliability
- Meet customer water supply needs
- Enhance sustainability
- Achieve a cost-effective, fully operational system

**APPROVAL:**

| | | | |
|---|---|---|---|
| PERFORMING ORGANISATION | | FINANCE | Todd Rydstrom |
| COMMISSION SECRETARY | Michael Housh | GENERAL MANAGER | Ed Harrington |

A table presenting the Phased WSIP goals and objectives as they relate to the program goals is included in the Resolution for this action. The system performance objectives describe and, in some cases, more specifically quantify, what the regional water system proposes to achieve under the Phased WSIP. The performance objectives guide the water supply actions, facility improvements, operations, and maintenance requirements included in the Phased WSIP.

To meet the program goals and objectives the Phased WSIP includes the following program elements:

- Full implementation of WSIP facility improvement projects.
- Water supply delivery to regional water system customers through 2018 with an average annual target delivery of 265 mgd originating from the watersheds. This includes 81 mgd for the retail customers and 184 mgd for the wholesale customers.
- Water supply sources include: 265 mgd average annual delivery from the Tuolumne River watershed and the local watersheds plus 20 mgd of conservation, recycled water, and groundwater developed in the service area (10 mgd retail; 10 mgd wholesale).
- Implementation of delivery and drought reliability elements of the WSIP, including dry-year water transfers coupled with the Westside Groundwater Basin Conjunctive Use project, will meet the drought-year goal of limiting rationing to no more than 20 percent on a systemwide basis.
- Reevaluation of 2030 demand projections, potential regional system demand (purchase requests), and water supply options by 2018, and SFPUC decision in 2018 regarding regional water system deliveries after 2018.
- Financial incentives to limit water sales to an average annual amount of 265 mgd from the SFPUC watersheds.

Adoption of CEQA Findings

The City Planning Department prepared and the Planning Commission will be asked to certify on October 30, 2008, a Program Environmental Impact Report (PEIR) for the WSIP as required under CEQA, the CEQA Guidelines and Chapter 31 of the San Francisco Administrative Code. In order to comply with CEQA requirements, as part of the approval of the WSIP, the Commission must adopt the CEQA Findings, including a statement of overriding considerations, and the MMRP, attached to the Resolution as Attachments A and B, respectively.

The Final PEIR (consisting of the Draft PEIR and the Comments and Responses document) identified potentially significant impacts resulting from water supply and system operations and construction of WSIP facility improvement projects. The potentially significant impacts that would result from implementation of the recommended Program, or the "Phased WSIP" are described in Chapter 13 of the Final PEIR and are included in the Findings. The Final PEIR identified mitigation measures to substantially reduce or eliminate many of the significant impacts identified in the PEIR. The CEQA Findings provide for adoption of the mitigation measures by the SFPUC and the MMRP provides information and allocates responsibility for implementing all of the mitigation measures proposed in the Final PEIR for the Phased WSIP.

Significant and unavoidable impacts are described in Section IV of the CEQA Findings attached to the Commission Resolution as Attachment A. Therefore, this Commission will need to adopt a Statement of Overriding Considerations, included in the CEQA Findings Section VI, explaining why the Commission has decided to approve the Phased WSIP notwithstanding these significant and unavoidable environmental impacts.

**RECOMENDATION**

SFPUC staff recommends that the Commission approve the Phased WSIP Goals and Objectives and adopt the CEQA Findings, including the statement of overriding considerations, and the MMRP.

**CONTEXT OF THIS ACTION**

The SFPUC began development of the Water System Improvement Program (WSIP) in the late 1990’s through a series of studies, reports, and authorizations. In 1998, the SFPUC initiated a water supply planning effort, culminating in the Water Supply Master Plan (WSMP), issued in April 2000. The WSMP recommended a water resource strategy of demand management, facilities improvements, and development of additional supplies. Concurrent with the WSMP efforts, reliability studies of the water system facilities were performed to assess their vulnerability to earthquakes, landslides, fire, flood, and power outages.

These efforts led to the preparation of a Long-Term Strategic Plan for Capital Improvements, a Long-Range Financial Plan, and a Capital Improvement Program, approved and adopted by the San Francisco Public Utilities Commission on May 28, 2002 under Resolution No. 02-0101. The Capital Improvement Program identified 37 regional water system projects and 40 local (in-City) projects. The resolution authorized and directed the General Manager (GM) of the SFPUC to proceed with development and implementation of the strategic and financial plans, as well as the capital improvement program with such additions or changes as the GM and Commission deemed necessary or desirable.

Planning efforts for the Water System Improvement Program gained momentum in 2002 with the passage of Propositions A and E, San Francisco ballot measures that approved financing for water system improvements and long-term stewardship of the public utilities. Specifically, Proposition A was a revenue bond authorizing the City of San Francisco to borrow money to pay for improvements to its water system. The improvements cited in the bond measure included: upgrading and retrofitting the system's infrastructure against earthquake damage; upgrading the regional system's ability to store and convey water to the Bay Area; ensuring future water quality standards are met; and increasing water system capacity.

Proposition E was a charter amendment related to Proposition A that reinforced the SFPUC's charge to rehabilitate the aging water system in order to ensure reliable water delivery in the future and provided the agency the ability to finance the improvements. Proposition E's goals and objectives included clauses maintaining SFPUC's stewardship of the system as well as the requirements to provide reliable water, optimize the system's ability to withstand disasters, and improve drinking water quality. In addition, the charter amendment required the development of long-term capital, financial, and strategic plans to ensure accountability by the SFPUC, ensuring that the utility is being operated efficiently in accordance with best public utility practices. Prior to the ballot measures, the SFPUC prepared long-term capital, financial, and strategic plans, which were adopted on May 28, 2002. These initiatives provided the impetus to move the WSIP forward, founding the system performance objectives in the water system reliability requirements of Proposition E.

Also in 2002, the state legislature approved three bills reflecting wholesale customer concerns over risk of failure of the water system in a major earthquake. Governor Davis approved these bills in September of 2002, including Assembly Bill No. 1823, the Wholesale Regional Water System Security and Reliability Act.

Additional studies refined the scope and magnitude of the Water System Improvement Program since completion of the WSMP. A November 2004 technical report on wholesale customer water demand projections updated 2030 planning horizon demands. A 2004 analysis of system performance under various operating conditions also assessed the effectiveness of the proposed regional water projects to meet program objectives. Concurrently, development of a draft regional operational strategy/principles document delineated current and future system operating goals, constraints, and strategies.

From October 2004 to January 2005, the Commission held a series of public workshops to present these studies. At the final workshop the Commission provided direction on system performance objectives for the program. Based upon the system performance objectives the scope, schedule, and budget of the program were refined, allowing the San Francisco Public Utilities Commission (SFPUC) to provide a description of the Water System Improvement Program. On February 28, 2005, the SFPUC endorsed the WSIP.

Subsequently, the San Francisco Planning Department prepared the PEIR to evaluate the potential environmental effects of the WSIP pursuant to and in accordance with California Public Resources Code Sections 21000 et. Seq. (CEQA), Title 14 of the California Code of Regulations Sections 15000 et. seq. (CEQA Guidelines) and the provisions of Chapter 31 of the San Francisco Administrative Code. Attachment A to the Commission's Resolution approving the Program contains detailed information about the CEQA process and preparation of the PEIR.

During the environmental review process, the SFPUC and the Planning Department received many comments expressing strong concern about, and opposition to, a decision now to divert more water from the SFPUC watersheds. The SFPUC staff considered carefully those concerns and the long term needs of the water system, including the customers' needs as well as protection of natural resources. In order to accomplish urgently needed physical rehabilitation and maintenance of the system and to improve asset management and delivery reliability now, the SFPUC staff recommends immediate implementation of all of the WSIP facility improvement projects. In order to carefully consider the long term decision of whether to divert more water from the watersheds, the SFPUC staff believes that the water supply decision should now be a limited one for the next 10 years and then the SFPUC will reconsider the long term water supply decision by 2018. In the next 10 years, the SFPUC will explore and develop other water supply options, including conservation, recycling and groundwater programs.

The Phased WSIP Variant facility improvement projects remain the same irrespective of the water supply decision now and in 2018. To meet the system performance objectives for water quality, seismic reliability and delivery reliability, the SFPUC must implement the Phased WSIP Variant facility improvement projects that provide physical system capacities to meet the performance objectives. Design of WSIP project facilities is driven by all four of the program goals -- the need to improve system performance for seismic reliability and water delivery reliability as well as maintaining high water quality standards and meeting water supply goals. All four of these goals are factored in to the decision on how to size the WSIP's individual facilities. The SFPUC must move forward with the WSIP facilities as proposed, to meet average demand of up to 300 mgd, in order to improve seismic and water delivery reliability, meet current and future water quality regulations, provide for additional system conveyance for maintenance and meet water supply reliability goals for year 2030 and possibly beyond. The SFPUC must consider current needs as well as possible future changes and unplanned outages and design a system that achieves a balance among the numerous objectives, functions and risks a water supplier must face.

The Phased WSIP Variant also includes implementation of delivery and drought reliability elements of the WSIP, including dry-year water transfers coupled with the Westside Groundwater Basin Conjunctive Use project, to meet the drought-year goal of limiting rationing to no more than 20 percent on a systemwide basis. While average annual deliveries from the SFPUC watersheds would be limited to 265 mgd such that there would be no increase in diversions from the Tuolumne River to serve additional demand, there would be a small increase in average annual Tuolumne River diversions of about 2 mgd over existing conditions in order to meet the delivery and drought reliability elements through 2018.

**ATTACHMENTS:**

SFPUC Resolution
Attachment A – CEQA Findings
Attachment B – Mitigation and Monitoring Reporting Program

Contact: Michael Carlin, Assistant General Manager
Water Enterprise

# PUBLIC UTILITIES COMMISSION

City and County of San Francisco

RESOLUTION NO. ____________________

WHEREAS, the San Francisco Public Utilities Commission approved and adopted a Long-Term Strategic Plan for Capital Improvements, a Long-Range Financial Plan, and a Capital Improvement Program on May 28, 2002 under Resolution No. 02-0101; and

WHEREAS, the San Francisco Public Utilities Commission determined the need for the Water System Improvement Program (WSIP) to address water system deficiencies including aging infrastructure, exposure to seismic and other hazards, maintaining water quality, improving asset management and delivery reliability, and meeting customer demands; and

WHEREAS, Propositions A and E passed in November 2002 by San Francisco voters and Assembly Bill No. 1823 was also approved in 2002 requiring the City and County of San Francisco to adopt a capital improvement program designed to restore and improve the regional water system; and

WHEREAS, the San Francisco Public Utilities Commission staff developed a variant to the WSIP referred to as the Phased WSIP; and

WHEREAS, the two fundamental principles of the program are 1) maintaining a clean, unfiltered water source from the Hetch Hetchy system, and 2) maintaining a gravity-driven system; and

WHEREAS, the overall goals of the Phased WSIP for the regional water system include 1) Maintaining high-quality water and a gravity-driven system, 2) Reducing vulnerability to earthquakes, 3) Increasing delivery reliability, 4) Meeting customer water supply needs, 5) Enhancing sustainability, and 6) Achieving a cost-effective, fully operational system; and

WHEREAS, on October 30, 2008, the Planning Commission reviewed and considered the Final Program Environmental Impact Report (PEIR) in Planning Department File No. 2005.0159E, consisting of the Draft PEIR and the Comments and Responses document, and found that the contents of said report and the procedures through which the Final PEIR was prepared, publicized and reviewed complied with the provisions of the California Environmental Quality Act (CEQA), the CEQA Guidelines and Chapter 31 of the San Francisco Administrative Code ("Chapter 31") and found further that the Final PEIR reflects the independent judgment and analysis of the City and County of San Francisco, is adequate, accurate and objective, and that the Comments and Responses document contains no significant revisions to the Draft PEIR, and certified the completion of said Final PEIR in compliance with CEQA, the CEQA Guidelines and Chapter 31 in its Motion No. _____; and

WHEREAS, this Commission has reviewed and considered the information contained in the Final PEIR, all written and oral information provided by the Planning

Department, the public, relevant public agencies, SFPUC and other experts and the administrative files for the WSIP and the PEIR; and

WHEREAS, the WSIP and Final PEIR files have been made available for review by the San Francisco Public Utilities Commission and the public, and those files are part of the record before this Commission; and

WHEREAS, San Francisco Public Utilities Commission staff prepared proposed findings, as required by CEQA, (CEQA Findings) and a proposed Mitigation, Monitoring and Reporting Program (MMRP), which material was made available to the public and the Commission for the Commission's review, consideration and action; and

WHEREAS, the Phased WSIP includes the following program elements: 1) full implementation of all WSIP facility improvement projects; 2) water supply delivery to regional water system customers through 2018; 3) water supply sources (265 million gallons per day (mgd) average annual from SFPUC watersheds, 10 mgd conservation, recycled water, groundwater in San Francisco, and 10 mgd conservation, recycled water, groundwater in the wholesale service area); 4) dry-year water transfers coupled with the Westside Groundwater Basin Conjunctive Use project to ensure drought reliability; 5) re-evaluation of 2030 demand projections, regional water system purchase requests, and water supply options by 2018 and a separate SFPUC decision by 2018 regarding water deliveries after 2018; and, 6) provision of financial incentives to limit water sales to an average annual 265 mgd from the SFPUC watersheds through 2018; and

WHEREAS, the SFPUC staff has recommended that this Commission make a water supply decision only through 2018, limiting water sales from the SFPUC watersheds to an average annual of 265 mgd; and

WHEREAS, before 2018, the SFPUC would engage in a new planning process to re-evaluate water system demands and water supply options. As part of the process, the City would conduct additional environmental studies and CEQA review as appropriate to address the SFPUC's recommendation regarding water supply and proposed water system deliveries after 2018; and

WHEREAS, by 2018, this Commission will consider and evaluate a long-term water supply decision that contemplates deliveries beyond 2018 through a public process; and

WHEREAS, the SFPUC must consider current needs as well as possible future changes, and design a system that achieves a balance among the numerous objectives, functions and risks a water supplier must face, including possible increased demand in the future; now, therefore, be it

RESOLVED, this Commission hereby adopts the CEQA Findings, including the Statement of Overriding Considerations, attached to this Resolution as Attachment A and incorporated herein as part of this Resolution by this reference thereto, and adopts the Mitigation Monitoring and Reporting Program attached to this Resolution as Attachment B and incorporated herein as part of this Resolution by this reference thereto; and, be it

FURTHER RESOLVED, this Commission hereby approves a water system improvement program that would limit sales to an average annual of 265 mgd from the watersheds through 2018, and the SFPUC and the wholesale customers would collectively develop 20 mgd in conservation, recycled water, and groundwater to meet demand in 2018, which includes 10 mgd of conservation, recycled water, and groundwater to be developed by the SFPUC in San Francisco, and 10 mgd to be developed by the wholesale customers in the wholesale service area; and, be it

FURTHER RESOLVED, As part of the Phased WSIP, this Commission hereby approves implementation of delivery and drought reliability elements of the WSIP, including dry-year water transfers coupled with the Westside Groundwater Basin Conjunctive Use project, which meets the drought-year goal of limiting rationing to no more than 20 percent on a system-wide basis; and, be it

FURTHER RESOLVED, This Commission hereby approves the Phased Water System Improvement Program, which includes seismic and delivery reliability goals that apply to the design of system components to improve seismic and water delivery reliability, meet current and future water quality regulations, provide for additional system conveyance for maintenance and meet water supply reliability goals for year 2018 and possibly beyond; and, be it

FURTHER RESOLVED, This Commission hereby approves the following goals and objectives for the Phased Water System Improvement Program:

**Phased WSIP GOALS AND OBJECTIVES**

| Program Goal | System Performance Objective |
|---|---|
| Water Quality – *maintain high water quality* | • Design improvements to meet current and foreseeable future federal and state water quality requirements.<br>• Provide clean, unfiltered water originating from Hetch Hetchy Reservoir and filtered water from local watersheds.<br>• Continue to implement watershed protection measures. |
| Seismic Reliability – *reduce vulnerability to earthquakes* | • Design improvements to meet current seismic standards.<br>• Deliver basic service to the three regions in the service area (East/ South Bay, Peninsula, and San Francisco) within 24 hours after a major earthquake. Basic service is defined as average winter-month usage, and the performance objective for design of the regional system is 229 mgd. The performance objective is to provide delivery to at least 70 percent of the turnouts in each region, with 104, 44, and 81 mgd delivered to the East/South Bay, Peninsula, and San Francisco, respectively.<br>• Restore facilities to meet average-day demand of up to 300 mgd within 30 days after a major earthquake. |

| Program Goal | System Performance Objective |
|---|---|
| Delivery Reliability – *increase delivery reliability and improve ability to maintain the system* | • Provide operational flexibility to allow planned maintenance shutdown of individual facilities without interrupting customer service.<br>• Provide operational flexibility to minimize the risk of service interruption due to unplanned facility upsets or outages.<br>• Provide operational flexibility and system capacity to replenish local reservoirs as needed.<br>• Meet the estimated average annual demand of up to 300 mgd under the conditions of one planned shutdown of a major facility for maintenance concurrent with one unplanned facility outage due to a natural disaster, emergency, or facility failure/upset. |
| Water Supply – *meet customer water needs in non-drought and drought periods* | • Meet average annual water demand of 265 mgd from the SFPUC watersheds for retail and wholesale customers during non -drought years for system demands through 2018.<br>• Meet dry-year delivery needs through 2018 while limiting rationing to a maximum 20 percent system-wide reduction in water service during extended droughts.<br>• Diversify water supply options during non-drought and drought periods.<br>• Improve use of new water sources and drought management, including groundwater, recycled water, conservation, and transfers. |
| Sustainability – *enhance sustainability in all system activities* | • Manage natural resources and physical systems to protect watershed ecosystems.<br>• Meet, at a minimum, all current and anticipated legal requirements for protection of fish and wildlife habitat.<br>• Manage natural resources and physical systems to protect public health and safety |
| Cost-effectiveness – *achieve a cost-effective, fully operational system* | • Ensure cost-effective use of funds.<br>• Maintain gravity-driven system.<br>• Implement regular inspection and maintenance program for all facilities. |

And, be it

FURTHER RESOLVED, This Commission authorizes and directs SFPUC staff to design and develop WSIP facility improvement projects consistent with the Phased WSIP Goals and Objectives.

*I hereby certify that the foregoing resolution was adopted by the Public Utilities Commission at its meeting of* October 30, 2008

_______________________________

*Secretary, Public Utilities Commission*

# APPENDIX C SFPUC WATER SYSTEM IMPROVEMENT PROJECT INFORMATION (PEIR SUMMARY; APRIL TO JULY QUARTERLY REPORT AND WSIP PROGRESS TO DATE)

# SUMMARY



## S.1 Introduction and Purpose of the PEIR (Chapter 1)

The San Francisco Public Utilities Commission (SFPUC) proposes to adopt and implement the Water System Improvement Program (WSIP or proposed program) to increase the reliability of the regional water system that serves 2.4 million people in San Francisco and the San Francisco Bay Area. The WSIP would improve the regional system with respect to water quality, seismic response, water delivery, and water supply to meet water delivery needs in the service area through the year 2030 and would establish level of service goals and system performance objectives. The WSIP would implement a proposed water supply option, modify system operations, and construct a series of facility improvement projects. The proposed program area spans seven counties—Tuolumne, Stanislaus, San Joaquin, Alameda, Santa Clara, San Mateo, and San Francisco.

The San Francisco Planning Department, Major Environmental Analysis (MEA) Division, determined that implementation of the WSIP could have a significant effect on the environment and therefore required preparation of a Program Environmental Impact Report (PEIR) in compliance with the California Environmental Quality Act (CEQA). This PEIR is intended to provide the public and responsible and trustee agencies with information about the potentially significant environmental effects of the proposed program, to identify possible ways to minimize the potentially significant effects, and to describe and evaluate feasible alternatives to the proposed program.

# S.2 Program Description (Chapter 3)

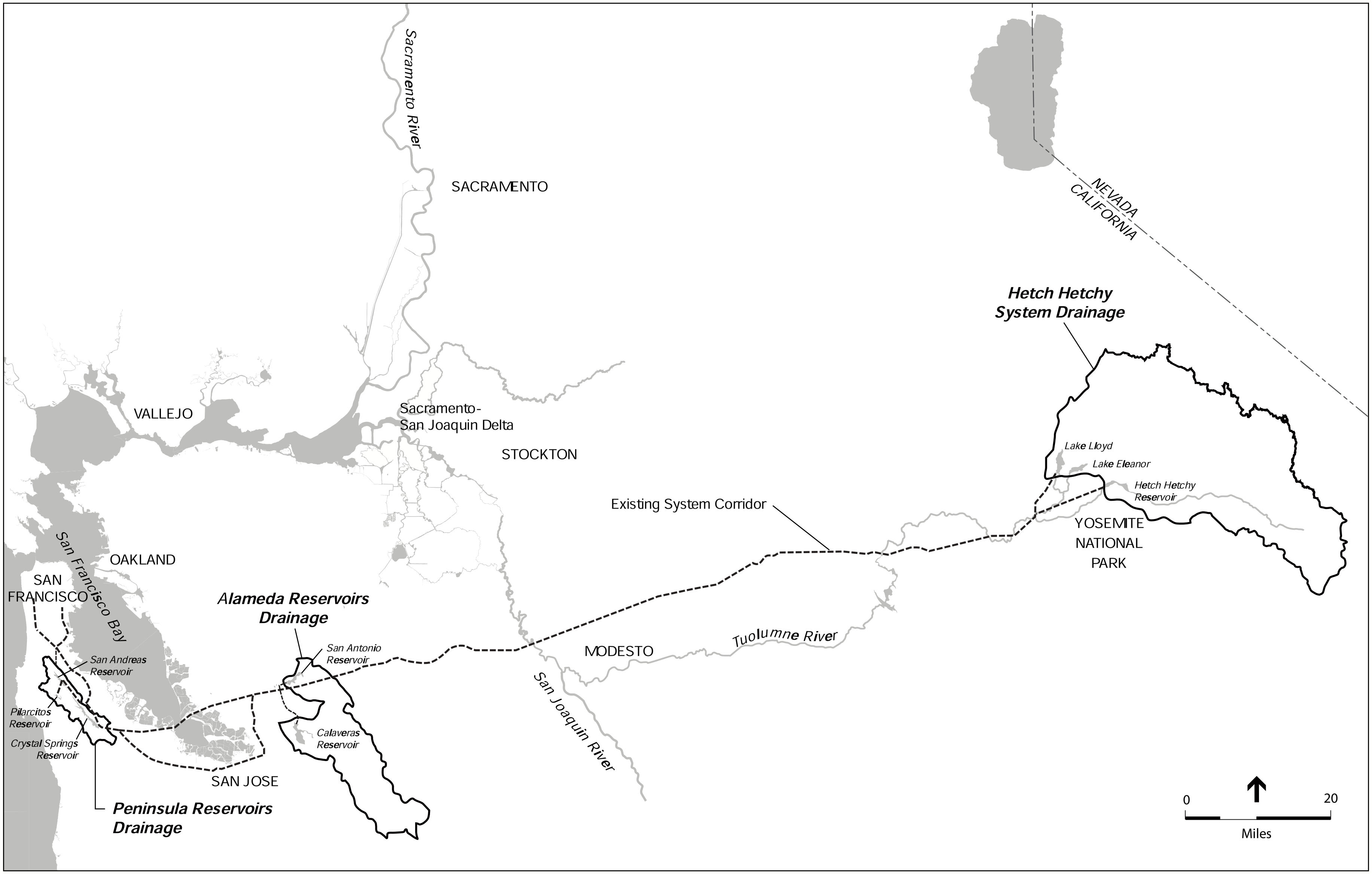
## Need for and Objectives of the Program

The City and County of San Francisco (CCSF), through the SFPUC, owns and operates a regional water system that extends from the Sierra Nevada to San Francisco and serves retail and wholesale customers in San Francisco, San Mateo, Santa Clara, Alameda, and Tuolumne Counties. The existing regional system includes over 280 miles of pipelines, over 60 miles of tunnels, 11 reservoirs, 5 pump stations, and 2 water treatment plants. The SFPUC currently delivers an annual average of about 265 million gallons per day (mgd) of water to its customers. The source of the water supply is a combination of local supplies from streamflow and runoff in the Alameda Creek watershed and in the San Mateo and Pilarcitos Creeks watersheds (referred to together as the Peninsula watersheds), augmented with imported supplies from the Tuolumne River watershed. Local watersheds provide about 15 percent of total supplies and the Tuolumne River provides the remaining 85 percent. **Figure S.1** shows the general location of the SFPUC regional system and water supply watersheds.

The SFPUC serves about one-third of its water supplies directly to retail customers, primarily in San Francisco, and about two-thirds of its water supplies to wholesale customers by contractual agreement. The wholesale customers are largely represented by the Bay Area Water Supply and Conservation Agency (BAWSCA), which consists of 27 total customers, shown in **Figure S.2**. Some of these wholesale customers have other sources of water in addition to what they receive from the SFPUC regional system, while others rely completely on the SFPUC for supply.

While the SFPUC has historically met and is currently serving its customers' water demands, there are numerous factors contributing to the need for a comprehensive, systemwide program such as the WSIP. In order to continue to provide reliable water service to its customers, the SFPUC must plan for the future as well as address existing, known deficiencies, including the following:

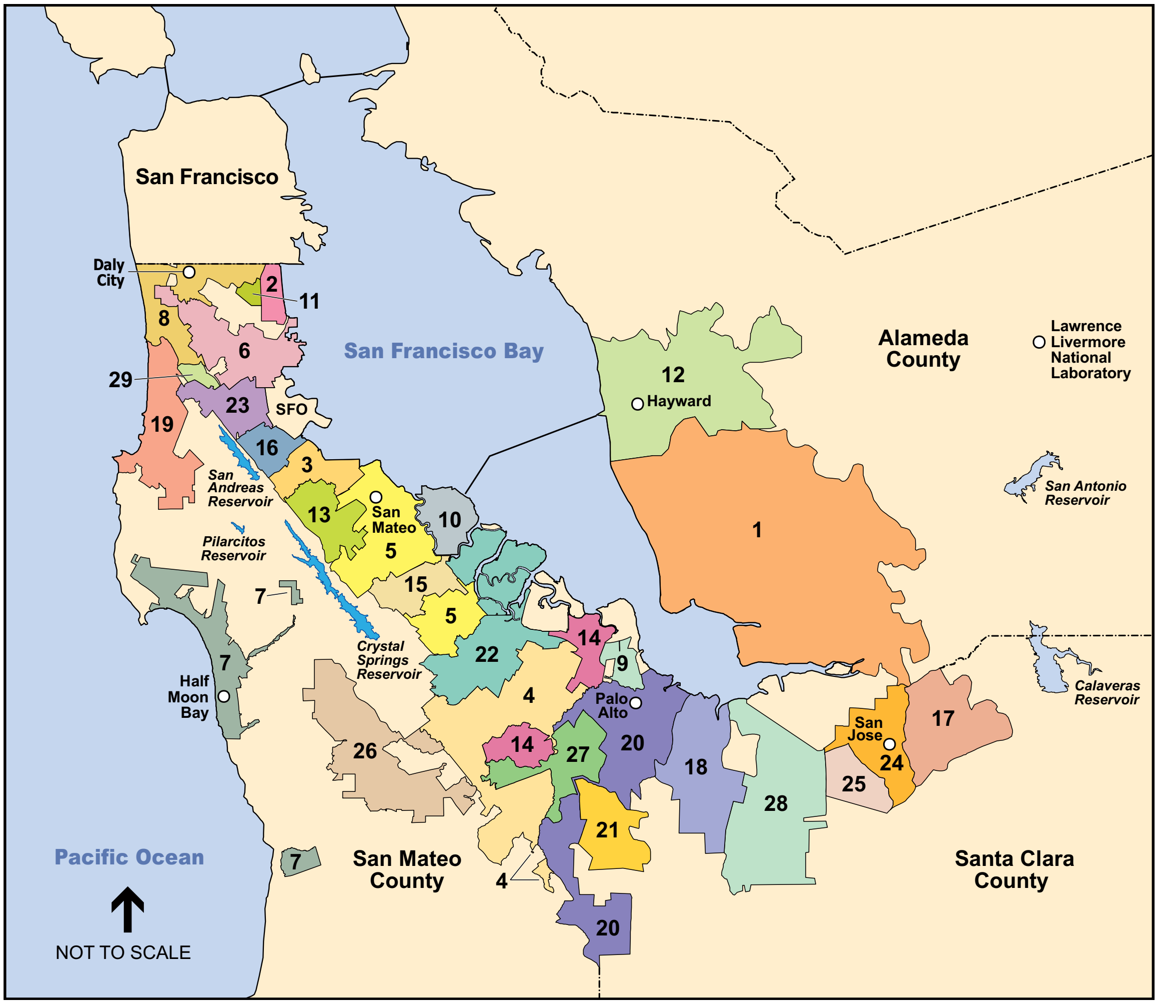
- *Aging Infrastructure*. Many of the components of the SFPUC regional water system were built in the 1800s and early 1900s. As the system ages, its reliability decreases and the risk of failure increases.




SOURCE: ESA + Orion

SFPUC Water System Improvement Program . 203287

**Figure S.1**
Overview of SFPUC Regional Water System and Water Supply Watersheds




## Legend

**(Wholesale customers and members of Bay Area Water Supply and Conservation Agency)**

**1** Alameda County Water District
**2** City of Brisbane
**3** City of Burlingame
**4** CWS – Bear Gulch
**5** CWS – Mid-Peninsula
**6** CWS – South San Francisco
**7** Coastside County Water District
**8** City of Daly City
**9** City of East Palo Alto
**10** Estero Municipal Improvement District
**11** Guadalupe Valley Municipal Improvement District
**12** City of Hayward
**13** Town of Hillsborough
**14** City of Menlo Park
**15** Mid-Peninsula Water District
**16** City of Millbrae
**17** City of Milpitas
**18** City of Mountain View
**19** North Coast County Water District
**20** City of Palo Alto
**21** Purissima Hills Water District
**22** City of Redwood City
**23** City of San Bruno
**24** City of San Jose (North)
**25** City of Santa Clara
**26** Skyline County Water District
**27** Stanford University
**28** City of Sunnyvale
**29** Westborough Water District

NOTE: For the purposes of this PEIR, the California Water Service (CWS) Company is a single wholesale customer with three different water service districts.

SOURCE: BAWSCA, 2006a



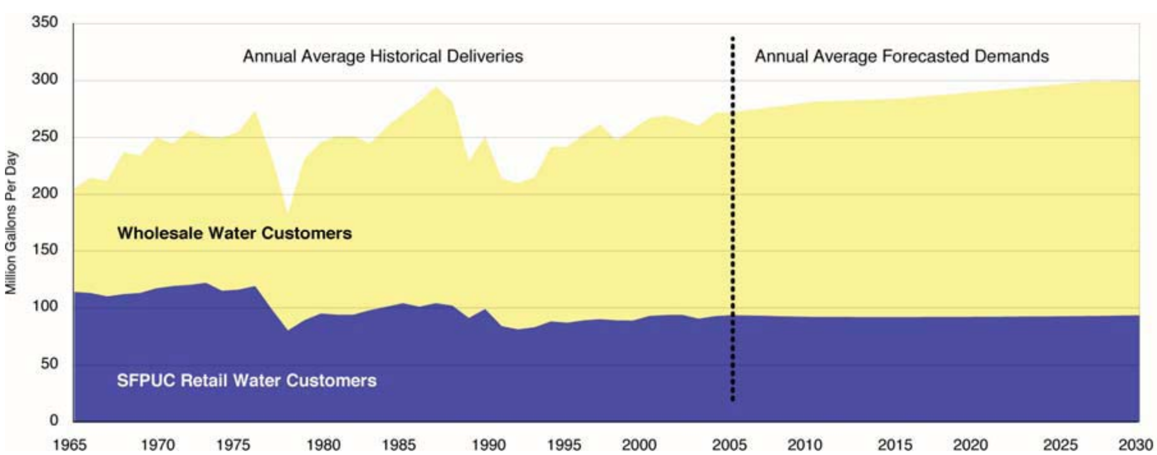
**Figure S.2**
SFPUC Water Service Area - San Francisco and SFPUC Wholesale Customers

- *Exposure to Seismic and Other Hazards*. The system crosses five active earthquake faults, and many of the existing facilities do not meet modern seismic standards. The California Division of Safety of Dams (DSOD) imposed operating restrictions on two of the system's reservoirs, Calaveras and Lower Crystal Springs Reservoirs, due to seismic and flood control safety hazards, respectively. The restricted operations at these reservoirs reduce local storage capacity and impair normal system operations.

- *Water Quality*. The regional system currently meets or exceeds existing water quality standards. However, system upgrades are needed to improve the SFPUC's ability to maintain compliance with current water quality standards and to meet anticipated future water quality standards.

- *Delivery Reliability*. The system requires additional redundancy (i.e., backup) of some critical facilities to ensure sufficient operational flexibility to carry out adequate system inspection and maintenance and to be adequately prepared in the event of an earthquake, system failure, or other emergency. These critical facilities are necessary to meeting day-to-day customer water supply needs, and increased operational flexibility is needed in order to maintain service to all customers during a full range of operating conditions.

- *Customer Water Demand*. The regional system currently has insufficient water supply to meet customer demand during a prolonged drought, and this situation will worsen in the future without the WSIP. Additional supplies are needed to satisfy current demand in drought years as well as to meet future demand. Water demand among SFPUC retail and wholesale customers is projected to increase over the next 25 years, from an average annual demand of about 366 mgd to 417 mgd in 2030. Of this total projected demand in the SFPUC service area, retail and wholesale customers would purchase an annual average of about 300 mgd from the SFPUC system in 2030, compared to 265 mgd in 2005, as shown in **Figure S.3**. Thus, the SFPUC would need to provide additional water supplies to serve a projected average annual increase in purchase requests of 35 mgd by 2030.




SOURCE: SFPUC, 2007b

*SFPUC Water System Improvement Program ▪ 203287*

**Figure S.3**
Annual Average Historical and
Projected Future Customer Purchase Requests

To address these challenges, the SFPUC must replace or upgrade numerous system facilities, add some new facilities, and expand its water supply portfolio—thus the need for the WSIP. In 2005, the SFPUC developed goals and objectives for the WSIP based on a planning horizon through 2030. The goals and objectives are founded on two fundamental principles pertaining to the existing regional water system: (1) maintaining a clean, unfiltered water source from the Hetch Hetchy system, and (2) maintaining a gravity-driven system. The overall goals of the WSIP are to:

- Maintain high-quality water
- Reduce vulnerability to earthquakes
- Increase delivery reliability and improve the ability to maintain the system
- Meet customer water supply purchase requests in nondrought and drought periods
- Enhance sustainability in all system activities
- Achieve a cost-effective, fully operational system

To further these program goals, the WSIP includes objectives that address system performance in the areas of water quality, seismic reliability, delivery reliability, and water supply through the year 2030. **Table S.1** presents the WSIP goals and objectives. The WSIP also includes proposed levels of service for the regional water system, which are intended to further define the system performance objectives through 2030 and provide design guidelines for the facility improvement projects. The levels of service (shown in Table 3.5, in Chapter 3, Program Description) address water quality, seismic response after a major earthquake, delivery during system maintenance, average annual water supply, regional system firm yield, and drought-year rationing.

Key program elements are summarized below and described in more detail in Chapter 3 (also see the SFPUC's 2006 *Water System Improvement Program* and 2007 *Water Supply Options* reports).

- *Water Supply*. Proposed water supply option to meet customer purchase requests during both nondrought and drought years.

- *System Operations*. Proposed system operations strategy to achieve water quality, seismic response, and delivery reliability performance objectives under a range of operating conditions, including the following scenarios: day-to-day, maintenance, unplanned outage, earthquake or other emergencies, and drought.

- *Facilities*. Proposed facility improvement projects to repair, upgrade, and, in some cases, expand the regional system facilities to reliably meet level of service goals and system performance objectives and to provide a cost-effective, fully operational water system.

## Proposed Water Supply

Under the WSIP, the SFPUC proposes to meet the increased 35 mgd in purchase requests by continuing to maximize use of local watershed supplies, increasing diversions from the Tuolumne River under its existing water rights, and developing new local resources consisting of a combination of additional conservation, water recycling, and groundwater supply programs in

**TABLE S.1**
**WSIP GOALS AND OBJECTIVES**

| Program Goal | System Performance Objective |
|---|---|
| Water Quality – *maintain high water quality* | • Design improvements to meet current and foreseeable future federal and state water quality requirements.<br>• Provide clean, unfiltered water originating from Hetch Hetchy Reservoir and filter all other surface water sources.<br>• Continue to implement watershed protection measures. |
| Seismic Reliability – *reduce vulnerability to earthquakes* | • Design improvements to meet current seismic standards.<br>• Deliver basic service to the three regions in the service area (East/South Bay, Peninsula, and San Francisco) within 24 hours after a major earthquake. Basic service is defined as average winter-month usage, and the performance objective for the regional system is 229 million gallons per day (mgd). The performance objective is to provide delivery to at least 70 percent of the turnouts (i.e., water diversion connecting points from the regional system to customers) in each region, with 104, 44, and 81 mgd delivered to the East/South Bay, Peninsula, and San Francisco regions, respectively.<br>• Restore facilities to meet average-day demand of 300 mgd within 30 days after a major earthquake. |
| Delivery Reliability – *increase delivery reliability and improve the ability to maintain the system* | • Provide operational flexibility to allow planned maintenance shutdown of individual facilities without interrupting customer service.<br>• Provide operational flexibility to minimize the risk of service interruption due to unplanned facility upsets or outages.<br>• Provide operational flexibility and system capacity to replenish local reservoirs as needed.<br>• Meet the estimated average annual demand of 300 mgd for 2030 under the conditions of one planned shutdown of a major facility for maintenance concurrent with one unplanned facility outage. |
| Water Supply – *meet customer water needs in nondrought and drought periods* | • Meet average annual water purchase requests of 300 mgd from retail and wholesale customers during nondrought years for system demands through 2030.<br>• Meet dry-year delivery needs through 2030 while limiting rationing to a maximum 20 percent systemwide reduction in water service during extended droughts.<br>• Diversify water supply options during nondrought and drought periods.<br>• Improve use of new water sources and drought management, including use of groundwater, recycled water, conservation, and transfers. |
| Sustainability – *enhance sustainability in all system activities* | • Manage natural resources and physical systems to protect watershed ecosystems.<br>• Meet, at a minimum, all current and anticipated legal requirements for protection of fish and other wildlife habitat.<br>• Manage natural resources and physical systems to protect public health and safety. |
| Cost-effectiveness – *achieve a cost-effective, fully operational system* | • Ensure cost-effective use of funds.<br>• Maintain gravity-driven system.<br>• Implement regular inspection and` maintenance program for all facilities. |

SOURCE: SFPUC, 2005.

San Francisco, as shown in **Figure S.4**. The water recycling and groundwater supply programs would be developed as part of the proposed facility improvement projects. This combination of water supply sources is expected to fully meet customer purchase requests during nondrought years through 2030. However, based on recent experience, these water supply sources would not be adequate during drought periods. The WSIP level of service goals include a policy to limit customer rationing to a maximum of 20 percent systemwide in any one year of a drought.

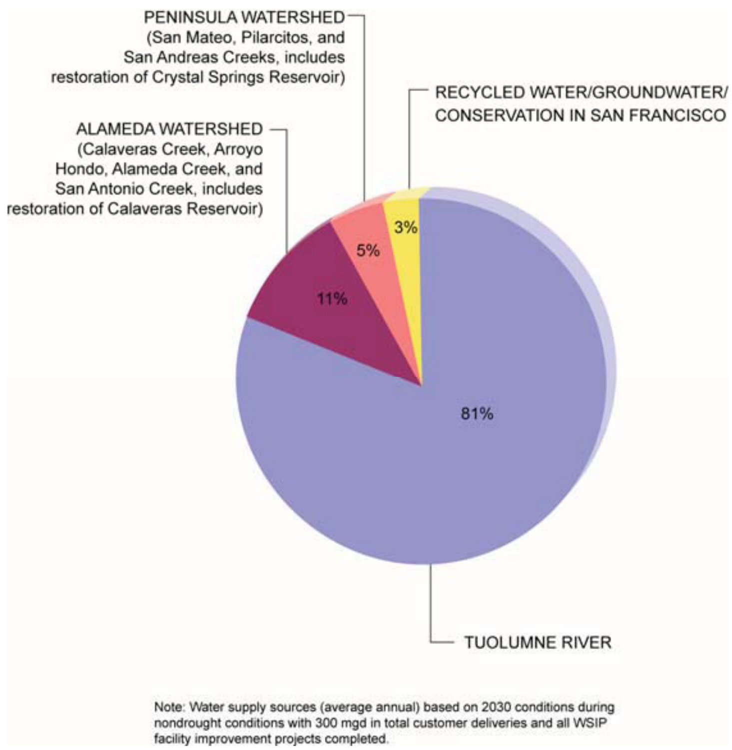



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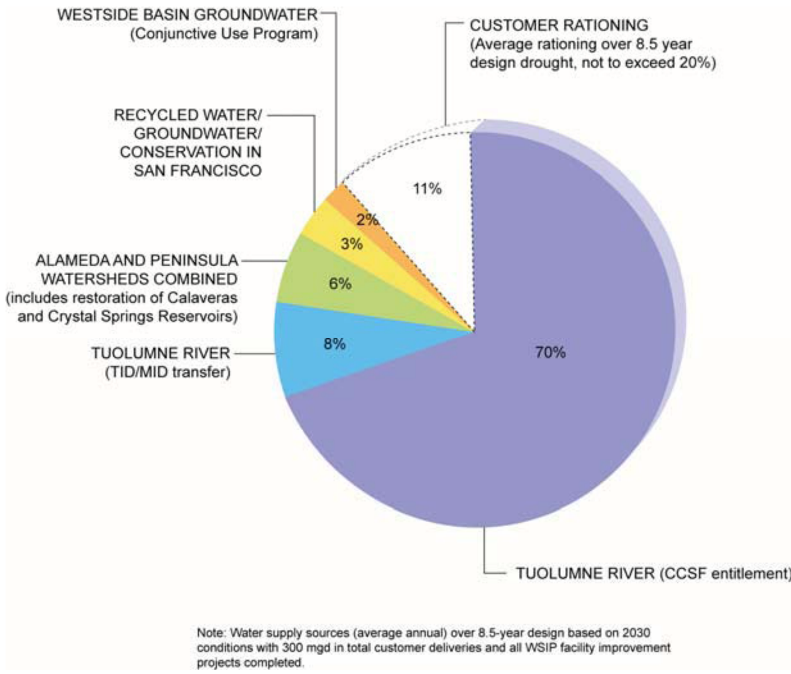
**Figure S.4**
WSIP Water Supply Sources, Nondrought Years

To provide adequate water supply to customers during a prolonged drought, the WSIP includes supplemental sources to augment the nondrought-year water supplies described above. The SFPUC proposes to secure a water transfer with the Turlock Irrigation District (TID) and/or Modesto Irrigation District (MID) to provide supplemental dry-year water from the Tuolumne River. Further, the SFPUC proposes to implement a groundwater banking program in the Westside Groundwater Basin in San Mateo County. Under this program, SFPUC wholesale customers that utilize the Westside Groundwater Basin would use supplemental surface water supplies in nondrought years to reduce their groundwater pumping and allow for in-lieu groundwater banking; these wholesale customers could then increase their groundwater pumping in drought years and reduce their demand for surface water supply in those years. In addition, two of the WSIP facility improvement projects involve the restoration of historical operating capacities at two of the system reservoirs, Calaveras and Lower Crystal Springs Reservoirs, which would further augment drought supplies for the regional system. As shown in **Figure S.5**, during drought years under the WSIP, the SFPUC would also include up to 20 percent systemwide rationing.




SFPUC Water System Improvement Program . 203287

**Figure S.5**
WSIP Water Supply Sources, Drought Years

## Proposed System Operation Strategy

Operation of the regional water system is affected by numerous factors, including fluctuations in customer demand; meteorological and hydrologic conditions; physical facilities and infrastructure capacity and maintenance requirements; and multiple institutional parameters. The WSIP addresses the condition of the physical facilities and infrastructure while planning for and taking into account these various factors. The operating strategy addresses four components of system operation: water supply and storage, water quality, water delivery, and asset management.

Under the WSIP, general day-to-day operation of the regional water system would be similar to existing operations but would provide for additional facility maintenance activities and improved emergency preparedness. Implementation of the program would allow for a refinement of the operations strategy to meet the WSIP goals and objectives and would thereby increase system reliability and provide additional flexibility for scheduling repairs and maintenance. The proposed operations strategy would also include a multistage drought response program during an extended drought. Under the WSIP, regional system operations would continue to comply with all applicable institutional and planning requirements, including:

- Complying with all water quality, environmental, and public safety regulations
- Maximizing the use of water from local watersheds
- Assigning a higher priority to water delivery over hydropower generation
- Meeting all downstream flow requirements

## Proposed Facility Improvement Projects

The WSIP includes 22 facility improvement projects along the regional system, from Oakdale Portal in Tuolumne County on the east end to San Francisco on the west. The projects, described in **Table S.2**, have been identified as necessary to achieve the level of service goals and system performance objectives of the WSIP. **Figure S.6** indicates the location of each facility improvement project.

## Standard Construction Measures

The SFPUC has established standard construction measures that would be implemented as part of all WSIP projects. The main objective of these measures is to minimize potential disruption of surrounding neighborhoods during construction and to reduce impacts on environmental resources to the extent feasible. The construction measures would be implemented individually for the facility improvement projects; some measures might not be applicable to some projects, while some projects would require the development of more detailed construction measures and implementation steps as the individual projects are designed. The standard construction measures to be included in WSIP construction contracts address the following topics: neighborhood notice, seismic and geotechnical studies, onsite air and water quality measures during construction, groundwater, traffic, noise, hazardous materials, biological resources, cultural resources, and project site (i.e., the use of non-CCSF-owned land during construction).

## Proposed Construction Schedule

**Figure S.7** presents a preliminary master schedule of the construction phases for the facility improvement projects. The SFPUC developed the preliminary schedule to assure that water delivery service is maintained throughout construction of the numerous projects, but is preparing schedule refinements and adjustments as the projects are further developed and more information is known about construction requirements. All WSIP projects are scheduled to be completed by the end of 2014. The acquisition of supplemental water supplies during droughts would be implemented as needed to match the water supply needs of the retail and wholesale customers (see Chapter 5, Section 5.1) and is not included on the construction schedule.

**TABLE S.2**
**WSIP FACILITY IMPROVEMENT PROJECTS**

| No.[a] | Project Title | Principal Type of Facility/ Objectives[b] | Location of Preferred Project[c] | Project Description |
|---|---|---|---|---|
| **San Joaquin Region** | | | | |
| SJ-1 | Advanced Disinfection | Treatment / Water Quality | Tesla Portal | This project would provide for the planning, design, and construction of a new advanced disinfection facility for the Hetch Hetchy water supply to comply with the new federal drinking water regulatory requirements contained in the Long Term 2 Enhanced Surface Water Treatment Rule. This regulation is designed to provide treatment for the parasite *Cryptosporidium*. The project is in the planning phase and the SFPUC is evaluating applicable technologies and possible locations to identify the most technologically sound and cost-effective alternative.<br><br>In addition, the project includes planning and conceptual engineering for providing advanced disinfection facilities at the Sunol Valley and Harry Tracy Water Treatment Plants (WTPs). This project may be combined with the Tesla Portal Disinfection Station project along with portal modifications, and the need for the Lawrence Livermore Supply Improvements project may be affected by the location and technology selected for this project. |
| SJ-2 | Lawrence Livermore Supply Improvements | Treatment / Water Quality | Thomas Shaft | This project includes design and construction of treatment upgrades for the water supplied to the Lawrence Livermore Laboratory. The project would construct water treatment facilities from the Thomas Shaft of the Coast Range Tunnel. An advanced disinfection facility planned at an upstream location under the Advanced Disinfection project could affect project design. |
| SJ-3 | San Joaquin Pipeline System | Pipeline / Water Supply, Delivery Reliability | Isolated locations along the existing San Joaquin Pipeline corridor | The preferred project would generally be located within the existing San Joaquin Pipeline (SJPL) right-of-way and would include:<br>• Construction of a new 6.4-mile-long, up to 86-inch-diameter fourth San Joaquin Pipeline parallel to the existing three pipelines at the east end of the pipelines, starting at Oakdale Portal, and associated portal modifications.<br>• Construction of two additional crossover facilities between the San Joaquin Pipelines within the existing right-of-way, both located in Stanislaus County, with one about 20 miles east of Modesto and the other about 15 miles west of Modesto, and improvements at the existing Roselle Crossover.<br>• Construction of a new 10-mile-long, up to 86-inch-diameter fourth San Joaquin Pipeline parallel to the existing three pipelines at the west end of the pipelines ending at Tesla Portal.<br><br>This project would provide additional facilities to upgrade the hydraulic capacity of the San Joaquin Pipeline system to 314 mgd (and a 271-mgd average during system maintenance when a pipeline segment must be taken out of service) and to provide redundancy for prestressed concrete cylinder pipe for reliability. Note: While the current preferred alternative would construct 16 miles of pipeline, as much as 22 miles of pipeline could be constructed depending on the results of a conditions assessment of the existing pipelines. |
| SJ-4 | Rehabilitation of Existing San Joaquin Pipelines | Pipeline / Water Supply, Delivery Reliability | Rehabilitation could occur anywhere along the pipeline corridor, which extends from Oakdale Portal to Tesla Portal | Reconditioning/rehabilitation of the existing San Joaquin Pipelines. There are three existing pipelines, each 47.7 miles long, extending from Oakdale Portal to Tesla Portal:<br>• SJPL-1, riveted steel pipe, 56- to 72-inch internal diameter<br>• SJPL-2, reinforced concrete pipe and welded steel pipe, 61- to 62-inch internal diameter<br>• SJPL-3, prestressed concrete cylinder pipe and welded steel pipe, 78-inch internal diameter |

**TABLE S.2 (Continued)**
**WSIP FACILITY IMPROVEMENT PROJECTS**

| No.[a] | Project Title | Principal Type of Facility/ Objectives[b] | Location of Preferred Project[c] | Project Description |
|---|---|---|---|---|
| **San Joaquin Region (cont.)** | | | | |
| SJ-5 | Tesla Portal Disinfection Station | Treatment / Water Quality, Seismic Reliability | Tesla Portal | This project includes the planning, design, and construction of new disinfection facilities for the Hetch Hetchy water supply. The project would replace and upgrade the existing disinfection facilities at the Tesla Portal Disinfection Facility to meet current seismic, safety/fire, and building code standards. The preferred project would include construction of:<br>• New control building and storage room<br>• Pump houses<br>• Chemical storage tanks and feed equipment and sampling systems<br>• Emergency generator, including primary and standby power supplies<br>• Access road<br>It should be noted that the design and location of the Advanced Disinfection project would affect the design and location of this project. |
| **Sunol Valley Region** | | | | |
| SV-1 | Alameda Creek Fishery Enhancement | Other / Water Supply, Sustainability | Structural Alternatives: Alameda Creek in Sunol Valley, downstream of Calaveras Dam | This project would recapture the water released as part of the Calaveras Dam project and return it back to the regional system for use. A number of structural and non-structural recovery alternatives are under consideration for this project, including: a water recapture facility downstream of the Sunol Valley WTP, conjunctive groundwater use, horizontal collector wells, or other groundwater recovery systems yet to be defined. Other alternative designs for this project could be developed. |
| SV-2 | Calaveras Dam Replacement | Storage / Water Supply, Delivery and Seismic Reliability | Sunol Valley, immediately downstream of existing dam | This project would provide for the planning, design, and construction of a replacement dam at Calaveras Reservoir to meet seismic safety requirements. The new dam would provide for a reservoir with the same storage capacity as the original reservoir (96,800 acre-feet), but the replacement dam would be designed to accommodate enlargement of the dam in the future. The preferred project would include construction of:<br>• New earthfill dam<br>• New intake tower and new outlet valve for water releases for instream flow requirements<br>• New or rehabilitated outlet works for seismic safety and improved operations and maintenance<br>As part of this project, Calaveras Reservoir would be operated to release up to 6,300 acre-feet per year (5.5 mgd) of water to Alameda Creek in support of fisheries. |
| SV-3 | Additional 40-mgd Treated Water Supply | Treatment / Water Quality, Delivery Reliability | Sunol Valley WTP and pipeline to connect to the Alameda Siphons or Irvington Tunnel | This project would provide for the planning, design, and construction of an additional 40 mgd of treatment capacity at the Sunol Valley WTP. The project would increase the sustainable capacity of the Sunol Valley WTP to 160 mgd. The planning-level study would evaluate treatment operations protocol and an alternative treatment process. The project would include either retrofitting the existing facilities with a membrane treatment process or expanding the existing facilities with:<br>• New flocculation and sedimentation system<br>• Upgrade of existing filters or addition of three new filters and a new flow distribution chamber |

**TABLE S.2 (Continued)**
**WSIP FACILITY IMPROVEMENT PROJECTS**

| No.[a] | Project Title | Principal Type of Facility/ Objectives[b] | Location of Preferred Project[c] | Project Description |
|---|---|---|---|---|
| **Sunol Valley Region (cont.)** | | | | |
| SV-3 (cont.) | | | | • New filtered water and backwash piping<br>Additionally, the project would include:<br>• New chemical feed and piping system<br>• Upgrade of the electrical supply system<br>• Miscellaneous piping, valves, and mechanical and electrical work<br>• Approximately two miles of 78-inch-diameter pipe to connect to the Alameda Siphons or Irvington Tunnel |
| SV-4 | New Irvington Tunnel | Tunnel / Delivery and Seismic Reliability | Sunol Valley to Fremont, parallel to and just south of the existing Irvington Tunnel | This project would construct a new tunnel parallel to and just south of the existing Irvington Tunnel to convey water from the Hetch Hetchy system and the Sunol Valley WTP to the Bay Area. The new tunnel would be a redundant water transmission facility to the existing Irvington Tunnel. The preferred project would include construction of:<br>• New 18,200-foot-long, 10-foot-diameter tunnel<br>• New portal at the east end adjacent to the existing Alameda West Portal in the Sunol Valley with connections to the existing Alameda Siphons and proposed new siphon<br>• New portal at the west end adjacent to the existing Irvington Portal in Fremont with connections to the existing Bay Division Pipelines and proposed new pipeline (Bay Division Pipeline Reliability Upgrade)<br>• Valves and equipment to control and monitor flows<br>• Modifications to the existing Alameda West and Irvington Portals |
| SV-5 | SVWTP – Treated Water Reservoirs | Storage and Treatment / Delivery Reliability | North of the Sunol Valley WTP | This project would provide for the planning, design, and construction of new treated water storage reservoirs at the Sunol Valley WTP to comply with requirements of the California Department of Health Services. The preferred project would include construction of:<br>• One 5-million-gallon chlorine contact basin<br>• Two 8.75-million-gallon storage basins<br>• New inlet and outlet piping and reservoir drainage system<br>• Pipe bridge over Alameda Creek<br>• Chemical (ammonia and chlorine) storage and feed system<br>• Backup filter washwater supply and filter washwater supply system<br>• Instrumentation and controls and miscellaneous pumping appurtenances to integrate the reservoirs into the existing treatment plant<br>• Expansion of the existing Sunol Valley WTP electrical substation<br>• Two 750-kilowatt diesel-powered emergency generators |

**TABLE S.2 (Continued)**
**WSIP FACILITY IMPROVEMENT PROJECTS**

| No.[a] | Project Title | Principal Type of Facility/ Objectives[b] | Location of Preferred Project[c] | Project Description |
|---|---|---|---|---|
| **Sunol Valley Region (cont.)** | | | | |
| SV-6 | San Antonio Backup Pipeline | Pipeline / Delivery and Seismic Reliability | Sunol Valley between San Antonio Reservoir and San Antonio Pump Station | This project would consist of three proposed facilities: (1) San Antonio Backup Pipeline, a new pipeline (size undetermined) from San Antonio Reservoir to San Antonio Pump Station, about two miles long; (2) San Antonio Creek discharge facilities (improvements allowing for the discharge of Hetch Hetchy water and associated road improvements); and (3) Alameda East Portal vent overflow pipeline and portal modifications. |
| **Bay Division Region** | | | | |
| BD-1 | Bay Division Pipeline Reliability Upgrade | Pipeline and Tunnel / Water Supply, Delivery and Seismic Reliability | Along existing Bay Division Pipelines Nos. 1 and 2 easement from Fremont to Redwood City | This project would construct a new Bay Division Pipeline No. 5 (BDPL No. 5) from Irvington Tunnel Portal in Fremont to Pulgas Tunnel Portal near Redwood City, consisting of 16 miles of new pipeline and 5 miles of tunnel under San Francisco Bay. Portions of the section of BDPL No. 1 between Edgewood Valve Lot and Pulgas Valve Lot would be removed (approximately 1.4 miles), and existing aboveground and submarine sections of BDPL Nos. 1 and 2 over the five-mile-long section from Newark Valve House to Ravenswood Valve House would be decommissioned (decommissioning is not part of this project). The redundancy provided by the project would increase the overall transmission capacity of the Bay Division Pipeline system. The preferred project would include construction of:<br>• New welded-steel pipeline, approximately 72 inches in diameter, extending along the seven-mile reach from Irvington Portal to Newark Valve Lot, located within the existing SFPUC right-of-way of BDPL Nos. 1 and 2<br>• New “Bay Tunnel” segment of BDPL No. 5, approximately 120 inches in diameter, extending five miles from Newark Valve Lot to Ravenswood Valve Lot, crossing under San Francisco Bay and adjacent marshlands; BDPL Nos. 1 and 2 would tie into the tunnel at both ends and would be decommissioned between Newark and Ravenswood Valve Lots<br>• New welded-steel pipeline, approximately 60 inches in diameter extending along the nine-mile reach from Ravenswood Valve Lot to Pulgas Portal, located within the existing SFPUC right-of-way of BDPL Nos. 1 and 2<br>• New facilities at eight valve vault lots along the alignment, containing new concrete vaults and control structures that house electrical control panels, isolation valves, mechanical equipment, and cross-connections between BDPL No. 5 and the existing Bay Division Pipelines<br>• Two flow metering vaults at or near Mission Boulevard (in Fremont) and Pulgas Portal areas<br>• New Isolation valves and piping for connecting BDPL No. 5 to Irvington and Pulgas Portals |

**TABLE S.2 (Continued)
WSIP FACILITY IMPROVEMENT PROJECTS**

| No.[a] | Project Title | Principal Type of Facility/ Objectives[b] | Location of Preferred Project[c] | Project Description |
|---|---|---|---|---|
| **Bay Division Region (cont.)** | | | | |
| BD-2 | BDPL Nos. 3 and 4 Crossovers | Valve House / Delivery and Seismic Reliability | Three locations adjacent to where BDPL Nos. 3 and 4 traverse Guadalupe River, Barron Creek, Bear Gulch Reservoir | This project would construct three additional crossover facilities along BDPL Nos. 3 and 4 to provide operational flexibility for maintenance or during emergencies. The new crossover facilities would reduce the length of pipe to be removed from service, either for maintenance or for emergencies, and would reduce the duration of outages. Each crossover facility would include construction of:<br>• Four mainline valves and one cross-connect valve<br>• Automatic controlled actuators<br>• Discharge facilities to enable release of water that meets water quality discharge requirements within discrete pipeline segments to surface waters, either for maintenance or emergencies |
| BD-3 | Seismic Upgrade of BDPL Nos. 3 and 4 at Hayward Fault | Pipeline / Seismic Reliability | Along existing BDPL Nos. 3 and 4 in Fremont | This project would provide for the planning, design, and construction of upgraded, seismically resistant sections of the BDPL Nos. 3 and 4 where they cross the Hayward fault. The replacement pipelines would be located between the two new crossover/isolation valves that would be built as part of BDPL Nos. 3 and 4 Crossover/Isolation Valve at Hayward Fault project (a WSIP project determined to be independent of the PEIR). In addition to the replacement pipelines, a new bypass pipeline between the two new crossover/isolation valve vaults could also be built as part of one of the several alternatives being considered for this project. |
| **Peninsula Region** | | | | |
| PN-1 | Baden and San Pedro Valve Lots Improvements | Valve House / Delivery and Seismic Reliability | Baden Valve Lot, South San Francisco, San Pedro Valve Lot, Daly City | This project would upgrade valve vaults, valves, and piping at the existing Baden and San Pedro Valve Lots to meet current seismic standards. Work could also be performed at the Pulgas Pump Station and Pulgas Valve Lot as part of transmission reliability. The project would include a new pressure-reducing valve at one of the locations to allow transfer of water between high and low pressure zones from the Harry Tracy WTP to the Peninsula under an emergency scenario. |
| PN-2 | Crystal Springs/ San Andreas Transmission Upgrade | Pipeline / Delivery and Seismic Reliability | Lower Crystal Springs Reservoir to San Andreas Reservoir, including Crystal Springs Pump Station | This project would consist of seismic improvements of facilities that convey water from Crystal Springs Reservoir to the Harry Tracy WTP. This project would increase the transmission capacity of the existing raw water pipeline from Crystal Springs Reservoir to San Andreas Reservoir in order to reliably supply 140 mgd of raw water for treatment at the Harry Tracy WTP. The project would include:<br>• Repair of Upper Crystal Springs Dam discharge culverts<br>• Upgrade and repair of Lower Crystal Springs Dam outlet structures and tunnels conveying water to Crystal Springs Pump Station<br>• Replacement or refurbishment of Crystal Springs Pump Station<br>• Upgrade and repair of the chemical system and Crystal Springs chlorine emergency feed<br>• Improvements to the Crystal Springs/San Andreas Pipeline, including replacement of approximately 1,350 feet of 66-inch-diameter pipeline, general renewal of the remaining pipeline, and addition of new manholes, blowoff valves, and isolation valves; or construction of a new redundant pipeline along a new alignment. |

**TABLE S.2 (Continued)**
**WSIP FACILITY IMPROVEMENT PROJECTS**

| No.[a] | Project Title | Principal Type of Facility/ Objectives[b] | Location of Preferred Project[c] | Project Description |
|---|---|---|---|---|
| **Peninsula Region (cont.)** | | | | |
| PN-2 (cont.) | | | | • Seismic and hydraulic upgrade and repair of San Andreas outlet facilities<br>• Addition of fish screens on the outlet structures for both Crystal Springs and San Andreas Reservoirs<br>• Repair of two pipelines that convey raw water from San Andreas Reservoir to the Harry Tracy WTP raw water pump station |
| PN-3 | HTWTP Long-Term Improvements | Treatment / Water Quality, Delivery and Seismic Reliability | Harry Tracy WTP | This project would be a seismic retrofit and rehabilitation of the existing building and facility to provide long-term reliability and process improvements. The project would increase the sustained treatment capacity of the plant from 120 to 140 mgd for 60 days. The proposed improvements would include:<br>• Replacement and upgrade of the ozone generation system for primary disinfection<br>• Replacement or upgrade of the existing sedimentation basins at the same location<br>• Improvements to sludge handling facilities<br>• New, redundant pipeline from the treatment works to the finished water storage reservoir<br>• Raw water pump station improvements<br>• Upgrade and replacement of electrical and instrumentation components, including improvements to process and plant security facilities |
| PN-4 | Lower Crystal Springs Dam Improvements | Storage / Water Supply and Delivery Reliability | Lower Crystal Springs Dam | This project would consist of major repairs and improvements to Lower Crystal Springs Dam to provide adequate protection of the dam and downstream areas from the probable maximum flood, as defined by the California Division of Safety of Dams (DSOD). The DSOD has placed operational restrictions on the dam, and the capacity of the reservoir is limited to 58,400 acre-feet. The project would restore the historical reservoir capacity of 69,300 acre-feet. The project would be coordinated with San Mateo County, which is concurrently planning the replacement of the existing county bridge built above the crest of the dam. Project elements would include:<br>• Lowering the existing parapet wall on either side of the existing spillway to lengthen the overflow weir (central spillway) from the reservoir<br>• Raising the remaining parapet walls and adding two new spillway bays, one on each side of the existing central spillway<br>• Enlarging the spillway stilling basin to accommodated the probable maximum flood<br>• Installing four gates (with control building) or installing a fixed weir within the spillway to restore the historical storage capacity |

**TABLE S.2 (Continued)**
**WSIP FACILITY IMPROVEMENT PROJECTS**

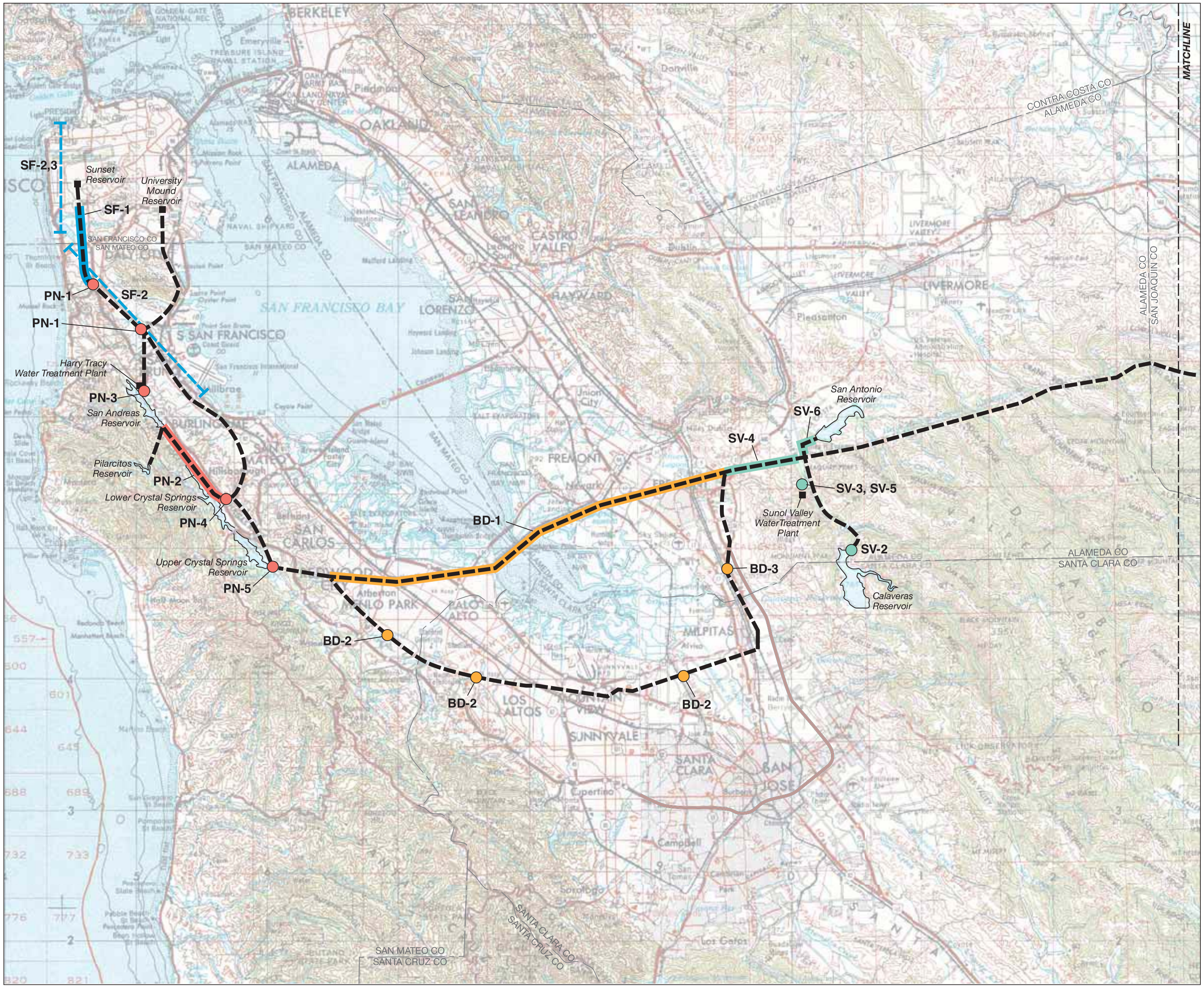
| No.[a] | Project Title | Principal Type of Facility/ Objectives[b] | Location of Preferred Project[c] | Project Description |
|---|---|---|---|---|
| **Peninsula Region (cont.)** | | | | |
| PN-5 | Pulgas Balancing Reservoir Rehabilitation | Storage / Water Quality, Delivery and Seismic Reliability | Pulgas Balancing Reservoir and mouth of Laguna Creek at south end of Upper Crystal Springs Reservoir | This project would provide for the planning, design, and construction of improvements to the existing Pulgas Balancing Reservoir and associated facilities. The project would include:<br>• Modifications to the inlet/outlet piping (Phase 1, currently under construction)<br>• Design and construction to rehabilitate and/or expand the discharge channel to Crystal Springs Reservoir (or to install a parallel channel) (Phase 2)<br>• Geotechnical investigations, design, and construction of recommended seismic improvements, including repair/replacement of the reservoir walls, floor, and roof (Phase 3)<br>• Restoration of a six- to eight-acre sediment catchment basin in Laguna Creek to also serve as sustainable habitat for San Francisco garter snake and California red-legged frog, including culvert replacement, sediment removal, revegetation, and protective measures to avoid impacts on sensitive species (Phase 4)<br>• Modification of the existing dechlorination process, including modifications to the chemical feed system to enable pH adjustment and dechlorination system to operate reliably (Phase 5) |
| **San Francisco Region** | | | | |
| SF-1 | San Andreas Pipeline No. 3 Installation | Pipeline / Delivery and Seismic Reliability | Daly City to San Francisco | This project would replace the out-of-service Baden-Merced Pipeline, which is beyond repair, and would construct a new pipeline extension of the existing San Andreas Pipeline No. 3 from San Pedro Valve Lot in Daly City to Merced Manor Reservoir in San Francisco. It would also connect the existing San Andreas Pipeline No. 2 at Sloat Boulevard in San Francisco and install an additional pipeline to serve the water turnouts along San Andreas Pipeline No. 2. The project would provide seismic reliability and system redundancy for Peninsula and San Francisco customers. The project would include:<br>• New 3.8-mile-long, 36-inch-diameter pipeline<br>• Approximately 0.27 mile of 36-inchdiameter pipeline for three connections between San Andreas Pipelines Nos. 2 and 3<br>• Removal of the Baden-Merced Pipeline where the new San Andreas Pipeline No. 3 alignment matches the Baden-Merced alignment<br>• Less than 0.1 mile of 12- to 16-inch-diameter new pipeline for five branch connections to user turnouts (three turnouts to Daly City, two turnouts to San Francisco distribution lines)<br>• Installation of line valves and vaults, manholes, cathodic protection and monitoring stations, sample taps, air valves, blowoffs, and other pipeline appurtenances |
| SF-2 | Groundwater Projects | Other / Water Supply | West side of San Francisco and northern San Mateo County | This project includes three groundwater projects: Lake Merced, Local Groundwater, and Regional Groundwater.<br>• The Lake Merced project would address raising the level of Lake Merced in San Francisco using a supplemental source of water, such as treated stormwater, recycled water, groundwater, or SFPUC system water. |

**TABLE S.2 (Continued)**
**WSIP FACILITY IMPROVEMENT PROJECTS**

| No.[a] | Project Title | Principal Type of Facility/ Objectives[b] | Location of Preferred Project[c] | Project Description |
|---|---|---|---|---|
| **San Francisco Region (cont.)** | | | | |
| SF-2 (cont.) | | | | • The Local Groundwater Projects would include development of 2 mgd of new local groundwater for blending with water in the potable water system in San Francisco. An estimated four wells and well stations would be constructed to develop this new local groundwater. This project would also include the use of an additional 2 mgd of groundwater through replacement of existing irrigation wells at the San Francisco Zoo, Golden Gate Park, and/or other locations, once recycled water were available for irrigation (to be developed under the Recycled Water Projects). Two existing wells would be modified to enable emergency supply to local residents in the event of a major earthquake or other disaster. This project would include the pipelines, water treatment equipment, and controls needed to add the groundwater to the municipal supply. The additional water supply developed under this project would be used during both nondrought and drought years.<br>• As part of a regional conjunctive-use project, the SFPUC would construct about 10 new groundwater production wells in San Mateo County to develop about 6 mgd of potable groundwater for use as a supplemental drought-year supply. In nondrought years under this project, the SFPUC would provide potable water from the regional system to customers in Daly City, San Bruno, and South San Francisco to substitute for groundwater currently used for municipal purposes, thereby reducing groundwater pumping and allowing the groundwater basin to recharge naturally. In drought years, the groundwater would be available for local use to supplement the regional system water. This project would require agreements with the affected agencies see (Section 3.13). |
| SF-3 | Recycled Water Projects | Other / Water Supply, Sustainability | Various locations on west side of San Francisco | This project includes recycled water projects in San Francisco and other locations. Projects include Westside Baseline and Harding Park/Lake Merced. This project would provide treatment, storage, and distribution facilities for about 4 mgd of recycled water to users on the west side of San Francisco. Primary users would include Golden Gate Park, Lincoln Park, Lincoln Park Golf Course, Harding Park Golf Course, San Francisco Zoo, Sunset Boulevard medians, and San Francisco State University. As described under Groundwater Projects, the SFPUC is also investigating appropriate sources of supply for increasing and maintaining Lake Merced lake levels, including recycled water that has undergone advanced treatment. |

[a] The numbering system is consistent, to the extent possible, with that presented in the Notice of Preparation (NOP) regarding preparation of an environmental impact report on the WSIP issued in September 2005. However, due to a regrouping of the projects after publication of the NOP, some projects have been renumbered.
[b] General types of facilities. Objectives refer to the WSIP objectives met by each project; see Table S.1 for a complete description of WSIP goals and objectives.
[c] See Figure S.6 for the approximate locations of preferred projects; many of the projects are still in development, and the SFPUC may ultimately consider other design options.

SOURCE: SFPUC, 2006.




**SFPUC WATER SYSTEM IMPROVEMENT PROGRAM, FACILITY IMPROVEMENT PROJECTS**

**SUNOL VALLEY REGION**

**SV-1** Alameda Creek Fishery Enhancement (not shown)
**SV-2** Calaveras Dam Replacement
**SV-3** Additional 40-mgd Treated Water Supply
**SV-4** New Irvington Tunnel
**SV-5** SVWTP – Treated Water Reservoirs
**SV-6** San Antonio Backup Pipeline

**BAY DIVISION REGION**

**BD-1** Bay Division Pipeline Reliability Upgrade
**BD-2** BDPL Nos. 3 and 4 Crossovers (3 locations)
**BD-3** Seismic Upgrade of BDPL Nos. 3 and 4 at Hayward Fault

**PENINSULA REGION**

**PN-1** Baden and San Pedro Valve Lots Improvements (2 locations)
**PN-2** Crystal Springs / San Andreas Transmission Upgrade
**PN-3** HTWTP Long-Term Improvements
**PN-4** Lower Crystal Springs Dam Improvements
**PN-5** Pulgas Balancing Reservoir Rehabilitation

**SAN FRANCISCO REGION**

**SF-1** San Andreas Pipeline No. 3 Installation
**SF-2** Groundwater Projects (general geographic area indicated)
**SF-3** Recycled Water Projects (general geographic area indicated)

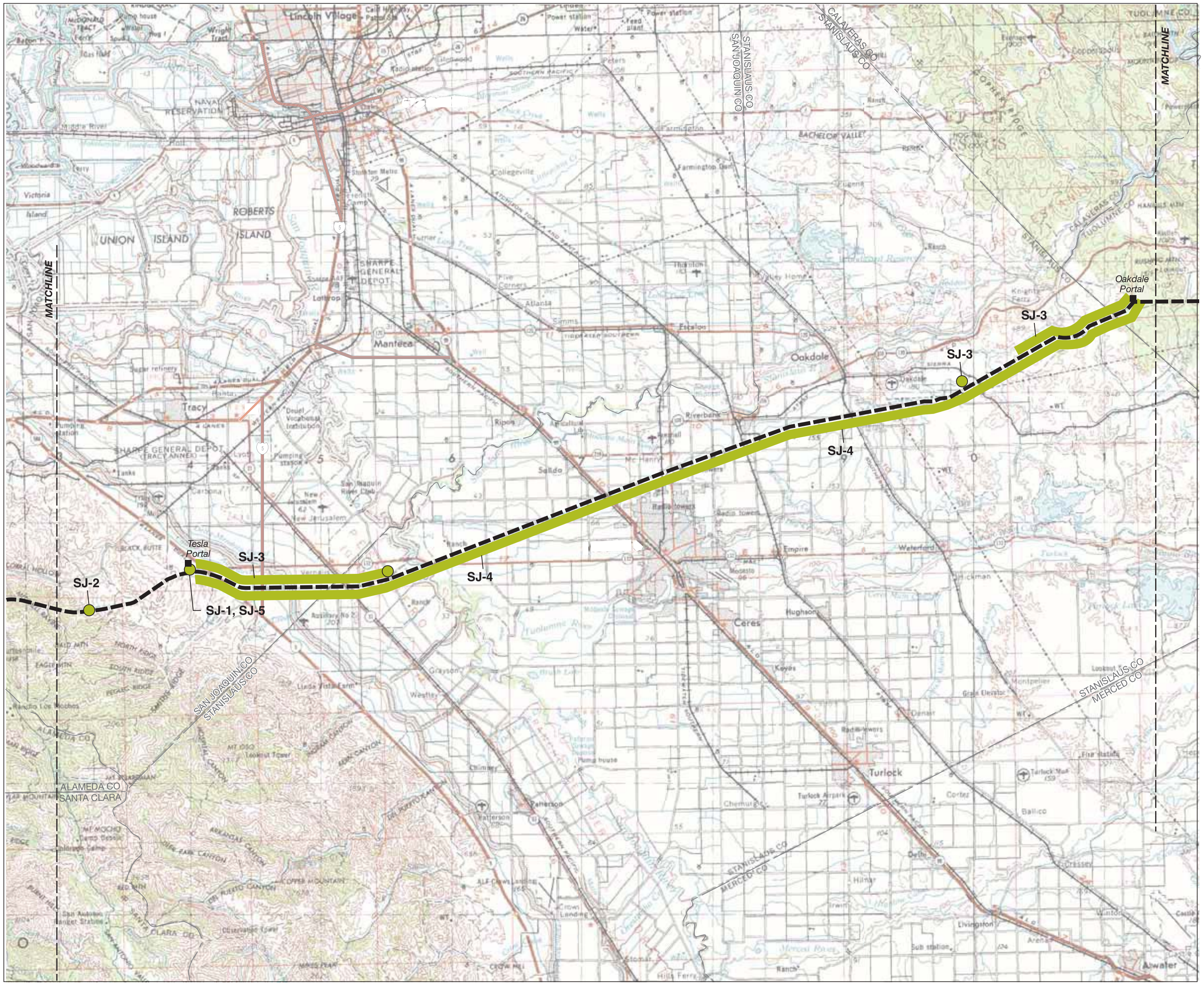
Existing System Corridor
Existing System Facility
Proposed Facility Corridor
Proposed Facility Site
Proposed Facility, General Location

0 5
Miles

SOURCE: ESA + Orion; SFPUC, 2006; USGS 1978

SFPUC Water System Improvement Program . 203287

**Figure S.6a**
Location of WSIP Facility Improvement Projects - Sunol Valley, Bay Division, Peninsula, and San Francisco Regions




**SFPUC WATER SYSTEM IMPROVEMENT PROGRAM, FACILITY IMPROVEMENT PROJECTS**

**SAN JOAQUIN REGION**

**SJ-1** Advanced Disinfection
**SJ-2** Lawrence Livermore Supply Improvements
**SJ-3** San Joaquin Pipeline System
**SJ-4** Rehabilitation of Existing San Joaquin Pipelines
**SJ-5** Tesla Portal Disinfection Station

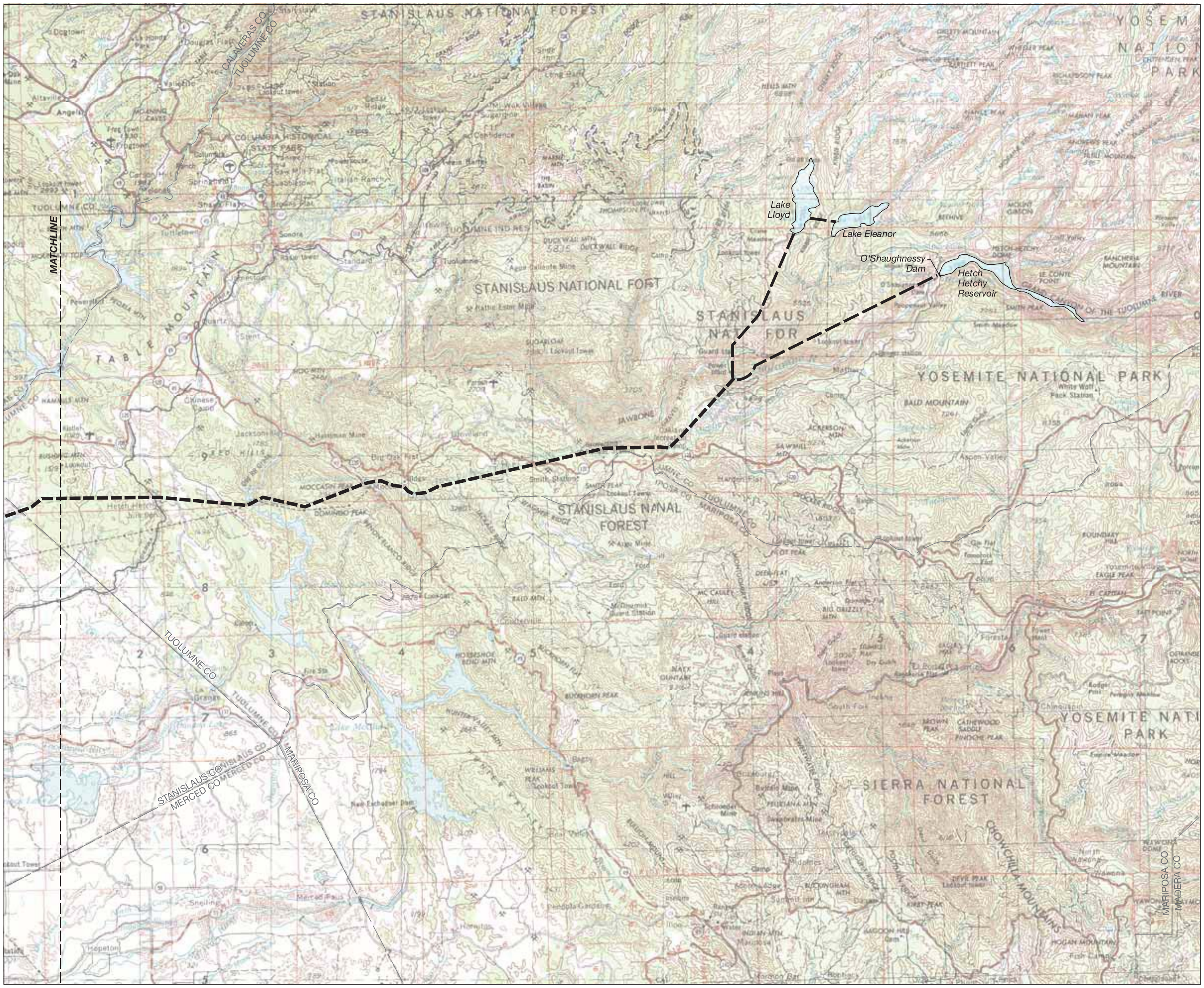
- Existing System Corridor
- Existing System Facility
- Proposed Facility Corridor
- Proposed Facility Site
- Proposed Facility, General Location

0 5
Miles

SOURCE: ESA + Orion; SFPUC, 2006; USGS 1969

SFPUC Water System Improvement Program . 203287

**Figure S.6b**
Location of WSIP Facility Improvement Projects-
San Joaquin Region




**SFPUC WATER SYSTEM IMPROVEMENT PROGRAM, FACILITY IMPROVEMENT PROJECTS**

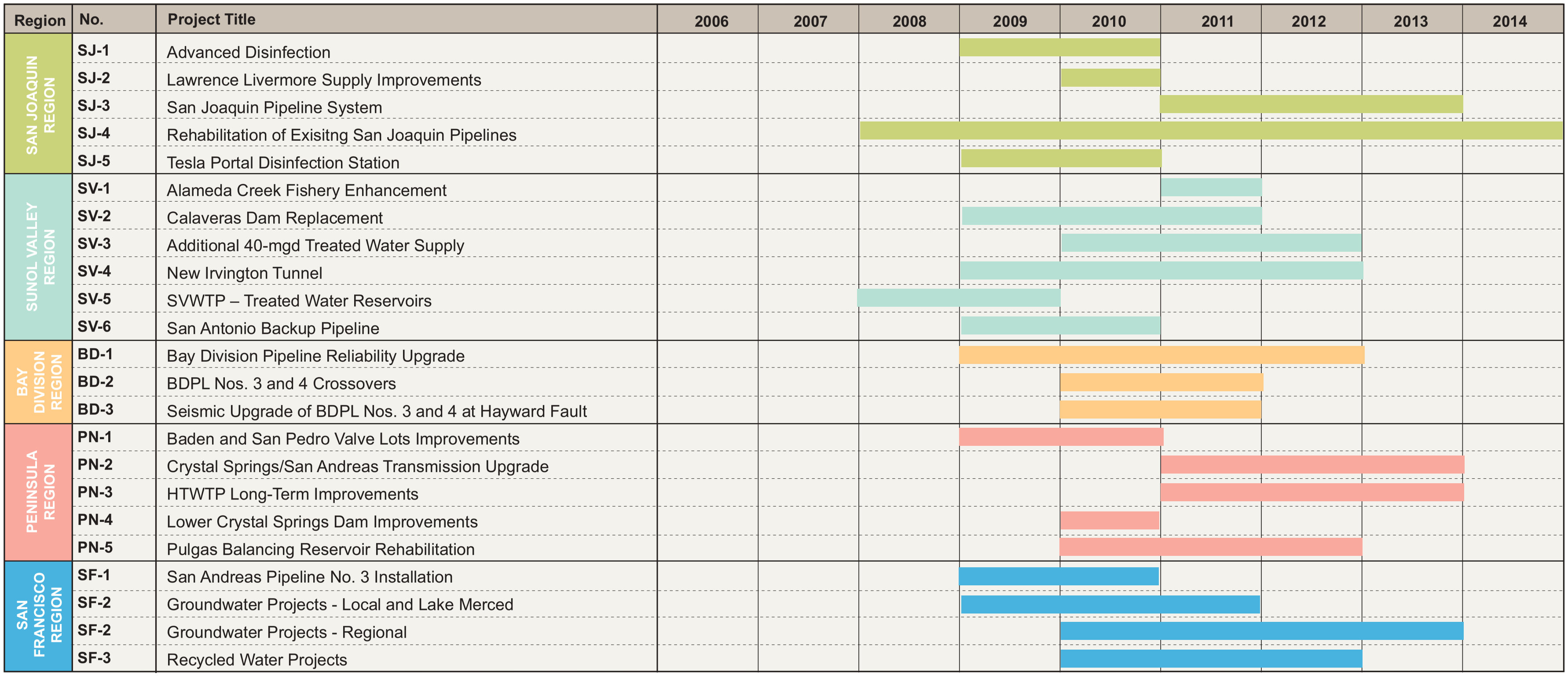
- Existing System Corridor
- Existing System Facility
- Proposed Facility Corridor
- Proposed Facility Site
- Proposed Facility, General Location

*NOTE: No WSIP facilities are proposed in this region.*

SOURCE: ESA + Orion; SFPUC, 2006; USGS 1970

SFPUC Water System Improvement Program . 203287

**Figure S.6c**
Location of WSIP Facility Improvement Projects - Hetch Hetchy Region




SOURCE: SFPUC, 2006

SFPUC Water System Improvement Program . 203287

**Figure S.7**
Preliminary WSIP Construction Schedule

SFPUC
WATER
WASTEWATER
POWER

SAN FRANCISCO PUBLIC UTILITIES COMMISSION

Julie Labonte, Director – Water System Improvement Program
1155 Market Street, 6th Floor, San Francisco, CA 94103 • Tel. (415) 554-1856 • Fax (415) 551-4515



**DATE:** August 20, 2009

**TO:** The Honorable Ann Moller Caen, President
The Honorable F.X. Crowley, Vice President
The Honorable Francesca Vietor
The Honorable Juliet Ellis
The Honorable Anson B. Moran

**THROUGH:** Ed Harrington, General Manager

**FROM:** Michael Carlin, Deputy General Manager
Harlan L. Kelly, Jr., Assistant General Manager
Julie L. Labonte, WSIP Director

**RE:** WSIP Regional Projects Quarterly Report
4th Quarter / Fiscal Year 2008-2009

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Enclosed is the Water System Improvement Program (WSIP) Regional Projects Quarterly Report for the 4th Quarter of Fiscal Year 2008-2009. The primary intent of the report is to provide the Commission, stakeholders and the public with a status summary of the program's regional projects for the period of April 5, 2009 through July 1, 2009.

## Report Organization

The report has three main sections. The *Program Summary* section includes a program overview and performance summary, and a program update on the following topics: program management, planning/design, environmental, right-of-way, construction and project achievements. The *Regional Summary* section provides a regional performance summary for each WSIP region, and an update on each region's planning, environmental, design and construction efforts. The *Project Status* section contains the Quarterly Project Status Reports (PSRs) for all regional projects.

## June 2009 Revised WSIP

This Quarterly Report incorporates all changes to the WSIP Regional Program made in the June 2009 Revised WSIP and approved by the San Francisco Public Utilities Commission (SFPUC) on July 28, 2009, including project name changes, modification of the WSIP organizational structure, the addition of a new regional project, and revised budgets and schedules.

The names of two regional projects were changed as part of the adoption of the June 2009 Revised WSIP. The name changes are as follows:

- Project CUW30103: Groundwater Project C - South Westside Basin changed to Regional Groundwater Storage and Recovery
- Project CUW35201: Alameda Creek Fishery Enhancement changed to Upper Alameda Creek Filter Gallery

In the June 2009 Revised WSIP and as reflected in the enclosed report, all of the WSIP Water Supply Region Projects, except for Project CUW30103: Regional Groundwater Storage and Recovery Project, moved from the Regional Program to the Local Program. Project CUW30101: Regional Groundwater Storage and Recovery Project was moved to the San Francisco Regional Region.

One regional project was added as part of the adoption of the June 2009 Revised WSIP to ensure the program continues to meet the level of service (LOS) goals established for the program. Project CUW36702: Peninsula Pipelines Seismic Upgrade, which was included in the Peninsula Region, will provide the seismic reliability required for key transmission pipelines that transport water from the Harry Tracy Water Treatment Plant (HTWTP).

It should be noted that the approved June 2009 Revised WSIP does not include revisions to all project budgets and schedules. Projects with cost and schedule variances that can potentially be mitigated were not re-baselined (i.e., changes to the budget and schedule of these projects were not made). Therefore the Baseline (Approved) Budget and/or and Baseline (Approved) Schedule for those projects remain the same and cost and/or schedule variances are recorded in the enclosed report based on the latest project forecasts.

Major changes were made to the scope, schedule, and/or budget of four regional projects as part of the June 2009 Revised WSIP. These changes are summarized below.

Significant scope changes were made to the WSIP's two San Joaquin Pipelines (SJPLs) projects to maximize the reliability of the overall system, provide additional maintenance flexibility and facilitate construction.

Project CUW37301: San Joaquin Pipeline System – The revised project scope includes the addition of a 6.7-mile, 78-inch diameter pipeline (referred to as the Eastern Segment) from Oakdale Portal to a new connection point corresponding to the end of the pre-stressed concrete cylinder pipe (PCCP) segment of SJPL No. 3. This change allowed for the downsizing of the 10.3-mile Western Segment from a 96-inch to a 78-inch diameter pipeline. Also added to the project scope are new valve facilities on SJPL Nos. 3 & 4 along the Eastern Segment to allow for better control of system pressure. The project budget has been increased $7,708,570 to $278,055,413. The project approved completion date remains the same (March 25, 2014) and the first construction contract for this project will be advertised in November 2009.

Project CUW37302: Rehabilitation of Existing San Joaquin Pipelines – The benefits provided by the increased scope of the SJPL System Project allowed for a reduction of the scope of this project without compromising levels of service. The revised project scope includes the rehabilitation of the Roselle Crossover Facility, the repair of the system's cathodic protection system, and the upgrade of the system's SCADA system. It also includes more detailed development of the SJPL Condition Assessment and Maintenance Program to enhance system sustainability. Finally, project funding is also set aside for additional priority work on the existing pipelines, which will be identified upon conclusion of the conditions assessment in December 2009. This resulted in a reduction of the project budget of $58,147,236 to $31,852,309. The project approved completion date remains the same (June 30, 2014). Bids for the first construction package for the Roselle Crossover Facility were received in June 2009 and contract award is scheduled for July 2009.

Project CUW37401: Calaveras Dam Replacement – The scope has been revised to include a flow bypass tunnel at the Alameda Creek Diversion Dam to provide minimum bypass flow in Alameda Creek. This additional scope was one of the mitigation requirements adopted as part of the WSIP Programmatic Environmental Impact Report (EIR). Delivery of this project has been impacted significantly by the need to address the potential presence of steelhead trout in the Alameda Creek Watershed and the presence of high concentrations of Naturally Occurring Asbestos (NOA) at the project site. It should be noted that formal consultation with the National Marine Fisheries Service (NMFS) is now required for this project. These issues have a substantial cumulative effect on both ongoing pre-construction activities and upcoming construction work in the field that resulted in a 42-month delay in the project schedule (revised completion date of December 4, 2015), and a $101,688,640 increase in the project budget (revised project budget of $409,444,761). The project schedule calls for publication of the project Draft EIR in September 2009 and advertisement for construction in August 2010.

Project CUW36701: Harry Tracy Water Treatment Plant (HTWTP) Long-Term Improvements – The discovery of a new strand of the Serra Fault in the vicinity of the plant's two treated water reservoirs (TWRs) triggered the need for additional investigations which confirmed that additional improvements were required to address seismic risks and ensure compliance with the program's Levels of Service (LOS) goals. As a result, the following scope revisions were proposed and adopted: abandon two existing TWRs and build a new 11.0 mg TWR, seismically retrofit pipelines in the vicinity of the Serra Fault, and build interim improvements to address short-term seismic risks. The scope changes resulted in a $183,303,228 increase in the project budget (revised project budget of $359,063,409). The project approved completion date remains the same (June 12, 2014). The project EIR is being prepared and 35% design has been completed. Advertisement for construction is scheduled for April 2011.

It is important to underscore that the project scopes in the June 2009 Revised WSIP continue to meet all the LOS goals established for the system. No changes were made to the program's LOS goals to accommodate project scope revisions.

<u>Status and Performance Summary</u>

The program performance metrics for planned and actual performance had to be updated following approval of the June 2009 Revised WSIP. It should be noted that incorporation of the revised schedule and cost baselines resulted in a slight reduction of the planned and actual performance metrics from what was reported in the previous WSIP Quarterly Report. Overall, actual performance (16.6%) on the program is tracking very close to planned performance (16.7%). Planning activities are nearing completion at 96%, whereas environmental, design and construction efforts are 67%, 75% and 6% complete, respectively. As of July 1, 2009, there are two (2) regional projects in the Planning Phase, eleven (11) in the Design Phase, six (6) in the Bid & Award Phase, five (5) in the Construction Phase, two (2) in the Close-Out Phase, eight (8) regional projects have been completed, one (1) project has not been initiated, and eleven (11) are active in multiple phases.

The approved WSIP Regional Program completion date is December 4, 2015 and the current forecast completion date is the same. The approved WSIP Regional Program budget is $3,514,026,000 and the current forecast at completion is $3,532,336,000 ($18,310,000 over the approved budget). The total approved WSIP budget (Local and Regional Programs including Finance Cost) is $4,585,556,000 and the current total forecast at completion is $4,608,583,000 ($23,027,000 over the approved budget).

Major program milestones reached during this reporting quarter include:

*Environmental Approvals:*
- CUW36103: Pulgas Balancing - Structural Rehabilitation and Roof Replacement (Mitigated Negative Declaration)

*Construction Contract Advertised:*
- CUW36103: Pulgas Balancing - Structural Rehabilitation and Roof Replacement
- CUW36401: Lawrence Livermore Water Quality Improvement
- CUW38001: BDPL No. 3 and 4 - Crossovers
- CUW37901: San Andreas Pipeline No. 3 Installation
- CUW38601: San Antonio Pump Station Upgrade

*Construction Contract Awarded:*
- CUW35901: Alameda Siphon #4
- CUW37201: University Mound Reservoir - North Basin
- CUW37901: San Andreas Pipeline No. 3 Installation
- CUW38001: BDPL Nos. 3 and 4 Crossovers

*Construction Notice to Proceed Issued*
- CUW36102: Pulgas Balancing - Discharge Channel Modifications
- CUW39101: Baden & San Pedro Valve Lot Improvements

The WSIP Team continues to work collaboratively with other City Departments, the SFPUC Regional Wholesale customers, and all program stakeholders to ensure the successful delivery of the WSIP.

HETCH HETCHY
WATER SYSTEM IMPROVEMENT PROGRAM

# Quarterly Report

## Q4 FY 2008 | 2009

# Regional Projects

## 4.5.09 - 7.1.09

*Rebuilding Today*
*for a Better Tomorrow*

SFPUC
WATER
WASTEWATER
POWER

Published: 8.20.09

# TABLE OF CONTENTS

# 1.0 PROGRAM SUMMARY

## 1.1 PROGRAM OVERVIEW

The Water System Improvement Program (WSIP) is a multi-billion dollar, multi-year capital program to upgrade the City of San Francisco's regional and local drinking water systems. The program will deliver improvements that enhance the City's ability to provide reliable, affordable, high quality drinking water to its 27 wholesale customers and regional retail customers in Alameda, Santa Clara, and San Mateo Counties, and to 800,000 retail customers in San Francisco, in an environmentally sustainable manner. The proposed WSIP is structured to cost-effectively meet water quality requirements, improve seismic and delivery reliability, and achieve water supply goals.

This Fourth ($4^{th}$) Quarterly Report for Fiscal Year (FY) 2008-2009 presents the progress made on the WSIP regional projects between April 5, 2009 and July 1, 2009. The program's schedule and budget were last approved by the San Francisco Public Utilities Commission (SFPUC or Commission) on July 28, 2009.

June 2009 Revised WSIP:

Consistent with other large and complex infrastructure programs, the WSIP needs to periodically go through a comprehensive review and revision. The process of formally approving new project scopes, schedules and budgets is referred to as re-baselining. Making periodic adjustments in the WSIP through a re-baselining process is required to:

- incorporate the latest available information, including new project scopes, risk mitigation measures and value engineering proposals;
- capture low construction bids in revised project budgets;
- provide more realistic project baselines for performance measurements;
- ensure that adequate funding is available in future supplemental appropriations; and
- ensure compliance with the California Water Code #73500 (Assembly Bills 1823 and 2437).

The adjustments to the program scope, schedule and budget reflected in the June 2009 Revised WSIP were based on an analysis of monthly forecasting and change management data over the past two quarters and a program re-alignment review undertaken by the WSIP Senior Management Team in April 2009. A Notice of Public Hearing describing proposed changes to regional project schedules and scopes was posted on June 26, 2009, in compliance with the notification requirements of the California Water Code. Additional material of proposed cost changes were subsequently posted on July 23, 2009. The June 2009 Revised WSIP was adopted by the SFPUC Commission on July 28, 2009. The approval included an endorsement of recommendations made by the Bay Area Water Supply and Conservation Agency

(BAWSCA). For more information on the program changes adopted by the SFPUC Commission, refer to documents posted on the SFPUC Website under following headings:

Web Address: (http://sfwater.org/detail.cfm/MC_ID/35/MSC_ID/397/C_ID/4660)

- Notice of public Hearing 7/28/09: Proposed Revisions to the WSIP-2
- Notice of public Hearing 7/28/09: Proposed Revisions to the WSIP-1

This Quarterly Report incorporates all changes to the WSIP Regional Program approved as part of the June 2009 Revised WSIP, including project name changes, modification of the WSIP organizational structure, the addition of a new regional project, and revised budgets and schedules.

The name of two regional projects was changed as part of the adoption of the June 2009 Revised WSIP. The name changes are as follows:

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One regional project was added as part of the adoption of the June 2009 Revised WSIP to ensure the program continues to meet the (LOS) goals established for the program. CUW36702 - Peninsula Pipelines Seismic Upgrade, which was included in the Peninsula Region, will provide the seismic reliability required for key transmission pipelines that transport water from the Harry Tracy Water Treatment Plant (HTWTP).

It should be noted that the approved June 2009 Revised WSIP does not include revisions to all project budgets and schedules. Projects with cost and schedule variances that can potentially be mitigated were not re-baselined (i.e., changes to the budget and schedule of these projects were not made). Therefore the Baseline (Approved) Budget and/or and Baseline (Approved) Schedule for those projects remain the same and cost and/or schedule variances continue to be reported based on the latest project forecasts.

# 1.0 PROGRAM SUMMARY

## 1.2 PROGRAM PERFORMANCE

The overall performance of the WSIP at the program and regional level is assessed using the Earned Value Management (EVM) method. EVM has the unique ability to combine measurements of scope, schedule, and cost in a single integrated system. It allows the WSIP Management Team to (1) measure the amount of work actually performed on the program, (2) forecast the program's cost and completion date using historical and statistical projections, (3) determine how well the program is "performing" compared to its original plan, and (4) forecast how well the program will perform in the future. The Earned Value (or Budgeted Cost of Work Performed) is the cost originally budgeted to accomplish the work completed by the report date. In other words, it is the value of the work completed and it is defined as the percent of work accomplished multiplied by the Approved Budget for that work. Planned Value (or Budgeted Cost of Work Scheduled) is the budgeted cost for the work scheduled to be performed by the report date. The Actual Cost (or Actual Cost of Work Performed) is cost incurred to accomplish the work completed by the report date. EVM uses a number of calculations, indices and variances to assess performance. The Schedule Performance Index (SPI) reported herein is a measure of how well the program is doing in terms of following the WSIP approved schedule. It is calculated by dividing the Earned Value by the Planned Value.

At the project-level, WSIP performance is measured using both the EVM and the reporting of schedule and cost variances. These variances are not based on EVM calculations but instead on an overall progress assessment by Project Managers. Appendices D and E include a summary of schedule and cost variances for all WSIP Regional Projects. The "Schedule Variance of WSIP Regional Project" Table in Appendix D summarizes the schedule variance between the projects' Approved Finish Date and the Current Forecast at Completion (or Forecasted Completion Date). The "Cost Variance of WSIP Regional Projects" Table in Appendix E summarizes the cost variance between the projects' Approved Budget and Current Forecast at Completion (or Forecasted Cost at Completion).

### Current Program Performance

WSIP activities during the reporting quarter continued to focus primarily on environmental review and design efforts. To date, planning of the WSIP Regional Program is approximately 96% complete, whereas environmental review/permitting, design and construction efforts are about 67%, 75% and 6% complete, respectively. The Schedule Performance Index (SPI) for the Regional Program is 0.99, indicating that 99% of the overall work planned was performed as of the end of this reporting quarter.

# 1.0 PROGRAM SUMMARY

Earned Value exceeds Actual Cost to date by $31.5 million. The Planned versus Actual % Completion of all phases of the WSIP Regional Program are summarized in Table 1.1.

**Table 1.1 Program Performances** (1, 2)

| | | | July 1, 2009 | |
|---|---|---|---|---|
| | | | **% Planned** | **% Actual** |
| Project Management | | | 42.6% | 42.8% |
| Planning | | | 97.3% | 96.4% |
| Environmental | | | 70.1% | 66.5% |
| Right-of-Way | | | 33.4% | 30.4% |
| Design | | | 75.8% | 74.6% |
| Bid & Award | | | 39.0% | 39.9% |
| Construction Management | | | 6.1% | 6.1% |
| Construction | | | 6.1% | 6.2% |
| Close-Out | | | 23.4% | 21.8% |
| Program Management | | | 36.0% | 35.9% |
| **Program Cumulative** | | | **16.7%** | **16.6%** |

Comparison with last quarter data not provided because program baseline was changed and such comparison would not be meaningful.

Notes:

1. Includes performance from San Joaquin, Sunol Valley, Bay Division, Peninsula, and San Francisco Regional Regions.
2. See Appendix A.2 (Definition and How to Read PSR's) for explanation of percentage calculations.

Overall, the actual performance of the Project Management, Planning, Design, Bid & Award, Construction Management, Construction, and Program Management Phases is tracking planned performance relatively well. The Environmental, Right-of-Way, and Close-out Phases are slightly behind schedule.

The overall Environmental Phase delay is associated with the complex environmental issues to be thoroughly analyzed under the California Environmental Quality Act (CEQA). No delays have been experienced to date in the environmental permits to be issued by various Federal, State and Regional Resource Agencies prior to construction. The delay recorded for the Environmental Phase is due to the addition of a 3rd Admin

# 1.0 PROGRAM SUMMARY

Draft EIR, a screen check review, and extended review periods requested by Division of Major Environmental Analysis for CUW35901 - New Irvington Tunnel, CUW38101 - SVWTP Expansion & Treated Water Reservoir, and CUW35401 – Lower Crystal Springs Dam Improvements Projects. It should be noted that CUW35901 - New Irvington Tunnel and CUW38101 - SVWTP Expansion & Treated Water Reservoir projects were not re-baselined for schedule under the June 2009 Revised WSIP.

The delay recorded for the ROW Phase is to a great extent a carryover from the delay in the Environmental Phase since some land entitlement and encroachment removal actions cannot be initiated until after a project has formally been approved following CEQA certification. It should be noted that the ROW Phase has not delayed any project to date.

The delay recorded for the Close-Out Phase is attributed to 2 projects – CUW37001 – Pipeline Repair & Readiness Improvements, and CUW35801 – Sunset Reservoir – North Basin. In both cases, additional construction work had to be completed, which delayed the Close-Out Phase. It should be noted that both projects were not re-baselined for schedule under the June 2009 Revised WSIP.

The relative progress of the different regions is summarized in Table 1.2.

**Table 1.2 Regional Performance** (1)

| | | | July 1, 2009 | |
|---|---|---|---|---|
| | | | **% Planned** | **% Actual** |
| San Joaquin Region | | | 17.1% | 16.7% |
| Sunol Valley Region | | | 12.3% | 12.0% |
| Bay Division Region | | | 14.6% | 14.8% |
| Peninsula Region | | | 14.8% | 14.8% |
| San Francisco Regional Region | | | 48.7% | 48.5% |
| System-Wide | | | 30.1% | 29.0% |
| **Regional Program Cumulative** | | | **16.7%** | **16.6%** |

Comparison with last quarter data not provided because program baseline was changed and such comparison would not be meaningful.

Notes:

1. See Appendix A.2 (Definition and How to Read PSR's) for explanation of percentage calculations

# 1.0 PROGRAM SUMMARY

All regions are tracking within +/_ 10% of early planned performance, which is considered acceptable. The delay recorded for San Joaquin Region is due to slippage in attainment of the Draft Environmental Impact Report (DEIR) certification for CUW37301 – San Joaquin Pipeline System Project, which was resulted from a couple of weeks delay in completion of response to public review comments. However, the San Francisco Planning Commission certified the EIR for the CUW37301 – San Joaquin Pipeline System Project on 07/14/09. The overall delay recorded for the Sunol Valley Region is due to delays in the Environmental Phase of the CUW35901 - New Irvington Tunnel and CUW38101 - SVWTP Expansion & Treated Water Reservoir Projects. The delay recorded for the San Francisco Regional is due to delay in completion of Close-out phase for CUW35801 – Sunset Reservoir – North Basin. However, the Sunset Reservoir was placed in active service on January 16, 2009. The delay recorded for the System-Wide Region is due to delay in the Planning Phase of CUW39401 – Watershed Environmental Improvement Program. It should be noted that in accordance with the June 2009 Revised WSIP adopted by the SFPUC Commission on July 28, 2009, the baseline (approved) schedules for all above mentioned projects were not changed.

**Project Phase Status**

As of July 1, 2009, there are two (2) projects in the Planning Phase, eleven (11) projects in the Design Phase, six (6) projects in the Bid and Award Phase, five (5) projects in the Construction Phase, two (2) projects in the Close-Out Phase, eight (8) projects are completed, one (1) project has not been initiated, and eleven (11) projects have multiple active phases. As of July 1, 2009, one (1) project has not initiated their Environmental Phase, twenty (20) are undergoing environmental review, and twenty-two (22) have completed their Environmental Phase.

# 1.0 PROGRAM SUMMARY

**Table 1.3 Projects Status**

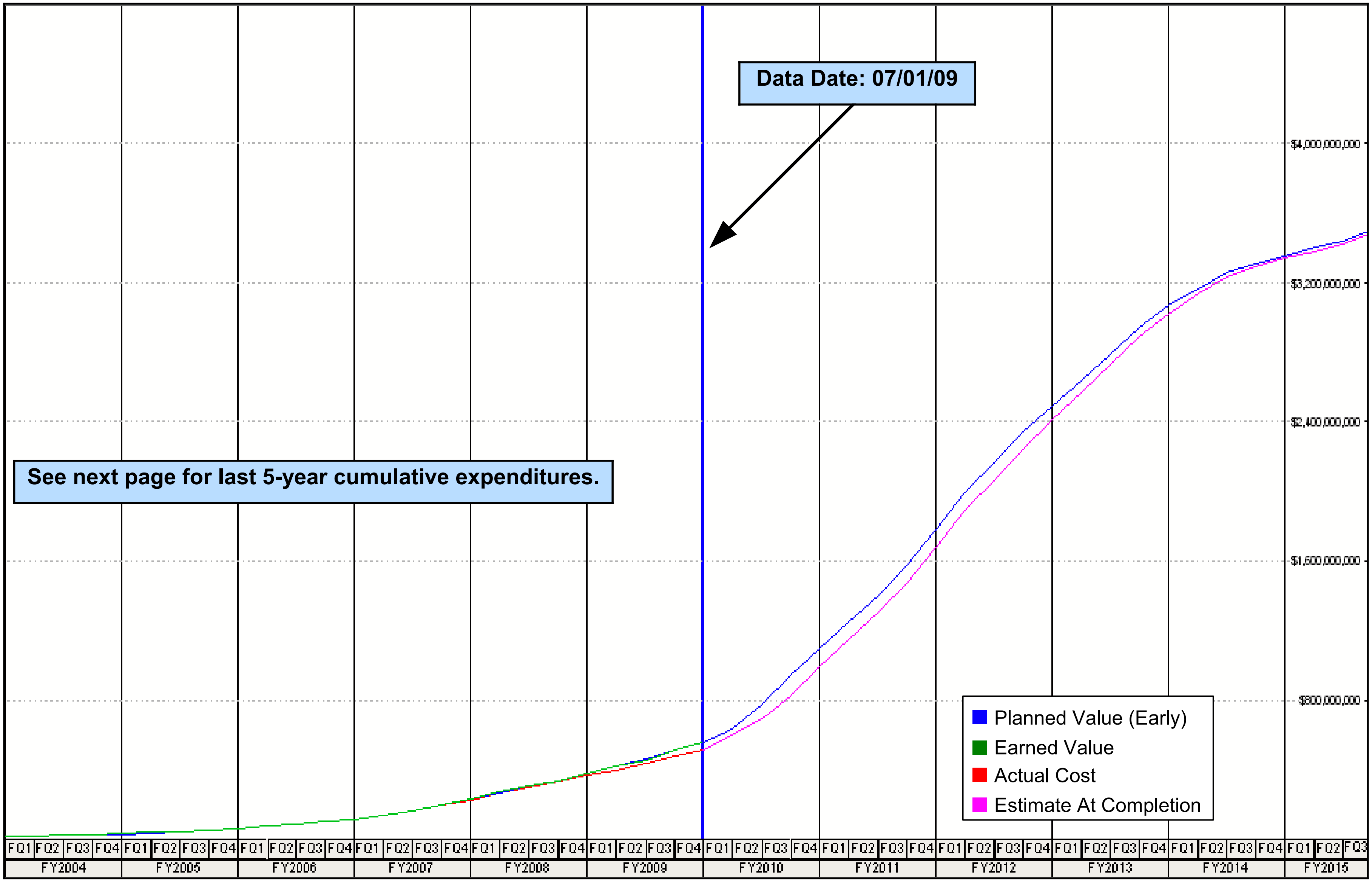
| CUW | Project | Active Phase | Environmental Phase |
|---|---|---|---|
| **San Joaquin Region** | | | |
| 36401 | Lawrence Livermore Water Quality Improvement | Bid & Award | Completed |
| 37301 | San Joaquin Pipeline System | Design | Active |
| 37302 | Rehabilitation of Existing San Joaquin Pipelines | Planning, Design, Bid & Award | Active |
| 38401 | Tesla Treatment Facility | Design, Construction | Completed |
| 38701 | Tesla Portal Disinfection Station (combined with 38401) | Combined with 38401 | Not Applicable |
| **Sunol Valley Region** | | | |
| 35201 | Upper Alameda Creek Filter Gallery | Planning | Active |
| 35501 | Standby Power Facilities - Various Locations | Construction | Completed |
| 35901 | New Irvington Tunnel | Design | Active |
| 35902 | Alameda Siphon #4 | Bid & Award | Active |
| 37001 | Pipeline Repair & Readiness Improvements | Completed | Completed |
| 37401 | Calaveras Dam Replacement | Design | Active |
| 37402 | Calaveras Reservoir Upgrades (Completed) | Completed | Completed |
| 37403 | San Antonio Backup Pipeline | Design | Active |
| 38101 | SVWTP Expansion & Treated Water Reservoir | Design | Active |
| 38102 | SVWTP Calaveras Road (Deleted) | Deleted | Not Applicable |
| 38103 | SVWTP New Pipeline | Combined with 38101 | Not Applicable |
| 38201 | SVWTP Treated Water Reservoir (Combined with CUW38101) | Combined with 38101 | Not Applicable |
| 38601 | San Antonio Pump Station Upgrade | Bid & Award | Completed |
| **Bay Division Region** | | | |
| 35301 | BDPL Nos. 3 & 4 Crossover/Isolation Valves | Close-Out | Completed |
| 35302 | Seismic Upgrade of BDPL Nos. 3 & 4 | Design | Active |

# 1.0 PROGRAM SUMMARY

| CUW | Project | Active Phase | Environmental Phase |
|---|---|---|---|
| 36301 | SCADA System - Phase II | Design, Bid & Award, Construction | Active |
| 36302 | System Security Upgrades | Planning, Design, Bid & Award, Construction | Active |
| 36801 | BDPL Reliability Upgrade - Tunnel | Design, Bid & Award | Active |
| 36802 | BDPL Reliability Upgrade - Pipeline | Design, Bid & Award | Part of 36801 |
| 36803 | BDPL Reliability Upgrade - Relocation of BDPL Nos. 1 & 2 | Bid & Award | Completed |
| 38001 | BDPL Nos. 3 and 4 Crossovers | Bid & Award, Construction | Completed |
| 38901 | SFPUC/EBMUD Intertie | Close-Out | Completed |
| 39301 | BDPL No. 4 Condition Assessment PCCP Sections | Completed | Completed |
| **Peninsula Region** | | | |
| 35401 | Lower Crystal Springs Dam Improvements | Design | Active |
| 35601 | New Crystal Springs Bypass Tunnel | Construction | Completed |
| 35701 | Adit Leak Repair - Crystal Springs/Calaveras (Completed) | Completed | Completed |
| 36101 | Pulgas Balancing - Inlet/Outlet Work (Completed) | Completed | Completed |
| 36102 | Pulgas Balancing - Discharge Channel Modifications | Construction | Completed |
| 36103 | Pulgas Balancing - Structural Rehabilitation and Roof Replacement | Design, Bid & Award | Active |
| 36104 | Pulgas Balancing - Laguna Creek Sedimentation (Closed) | Closed | Completed |
| 36105 | Pulgas Balancing - Modifications of the Existing Dechlorination Facility | Design | Active |
| 36501 | Cross Connection Controls | Completed | Completed |
| 36601 | HTWTP Short-Term Improvements - Demo Filters (Completed) | Completed | Completed |
| 36602 | HTWTP Short-Term Improvements - Remaining Filters (Combined with CUW36603) | Combined with 36603 | Not Applicable |

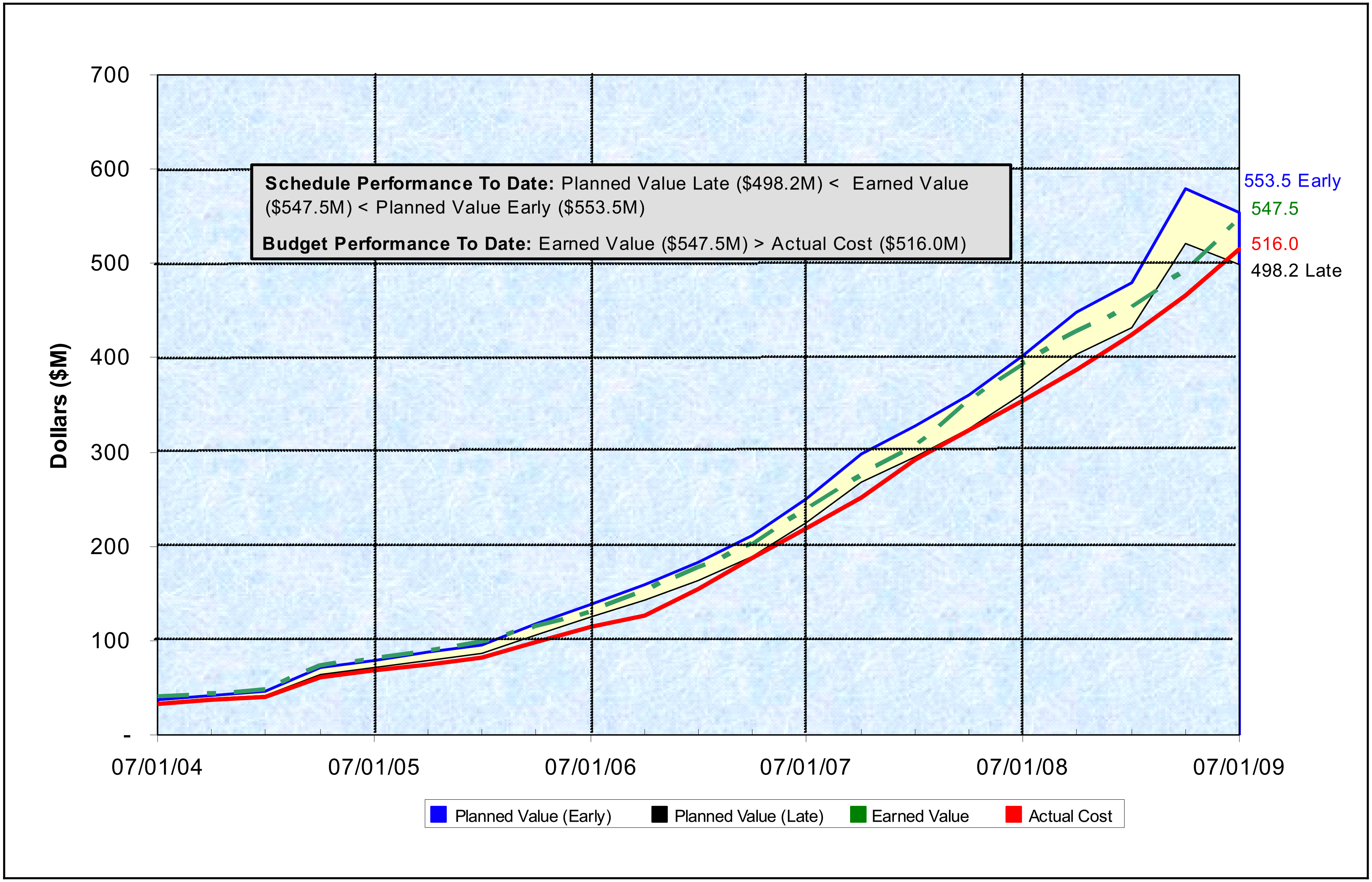
# 1.0 PROGRAM SUMMARY

| CUW | Project | Active Phase | Environmental Phase |
|---|---|---|---|
| 36603 | HTWTP Short-Term Improvements - Coagulation & Flocculation/ Remaining Filters | Construction | Completed |
| 36701 | HTWTP Long-Term Improvements | Design | Active |
| 36702 | Peninsula Pipelines Seismic Upgrade | Not Initiated | Not Initiated |
| 36901 | Capuchino Valve Lot Improvements (Completed) | Completed | Completed |
| 37101 | Crystal Springs/San Andreas Transmission Upgrade | Design | Active |
| 37801 | Crystal Springs Pipeline No. 2 Replacement | Design | Active |
| 37901 | San Andreas Pipeline No. 3 Installation | Bid & Award | Completed |
| 39101 | Baden and San Pedro Valve Lots Improvements | Construction | Completed |
| **San Francisco Regional Region** | | | |
| 30103 | Regional Groundwater Storage and Recovery | Design, Bid & Award, Construction | Active |
| 35801 | Sunset Reservoir - North Basin | Construction, Close-Out | Completed |
| 37201 | University Mound Reservoir - North Basin | Bid & Award | Completed |
| **System-Wide Region** | | | |
| 38801 | Programmatic EIR | Completed | Completed |
| 38802 | Habitat Reserve Program | Design, Construction | Active |
| 39401 | Watershed Environmental Improvement Program | Planning | Not Initiated |



Data Date: 07/01/09
See next page for last 5-year cumulative expenditures.
$4,000,000,000
$3,200,000,000
$2,400,000,000
$1,600,000,000
$800,000,000
Planned Value (Early)
Earned Value
Actual Cost
Estimate At Completion
FQ1 FQ2 FQ3 FQ4
FY2004
FY2005
FY2006
FY2007
FY2008
FY2009
FY2010
FY2011
FY2012
FY2013
FY2014
FY2015

# CUMULATIVE EXPENDITURES (LAST 5 YEARS)



| Phase | Schedule | | | | Budget | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Approved Start | Current Start | Approved Finish | Current Finish | Planned Expenditure To Date | Planned % Complete | Expended To Date | Actual % Expended | Progress % Complete | Earned Value Cost | Approved Budget | Current Forecast |
| Project Management | 03/31/00 | 03/31/00A | 12/04/15 | 12/04/15 | $57,870,000 | 42.6 | $53,302,000 | 39.2 | 42.8 | $58,107,000 | $135,886,000 | $135,323,000 |
| Planning | 03/31/00 | 03/31/00A | 12/30/10 | 12/30/10 | $62,756,000 | 97.3 | $61,403,000 | 94.8 | 96.4 | $62,183,000 | $64,789,000 | $65,053,000 |
| Environmental | 10/14/02 | 10/14/02A | 12/31/12 | 12/31/12 | $62,899,000 | 70.1 | $52,394,000 | 57.3 | 66.5 | $59,689,000 | $91,473,000 | $91,279,000 |
| Right-of-Way | 03/27/06 | 03/27/06A | 09/13/12 | 09/13/12 | $7,823,000 | 33.4 | $6,329,000 | 27.0 | 30.4 | $7,126,000 | $23,406,000 | $23,386,000 |
| Design | 10/01/01 | 10/01/01A | 10/31/12 | 10/31/12 | $155,172,000 | 75.8 | $141,502,000 | 69.1 | 74.6 | $152,655,000 | $204,917,000 | $204,854,000 |
| Bid and Award | 03/05/04 | 03/05/04A | 04/30/13 | 04/30/13 | $2,190,000 | 39.0 | $1,654,000 | 29.3 | 39.9 | $2,238,000 | $5,644,000 | $5,531,000 |
| Construction Management | 01/18/05 | 01/18/05A | 06/03/15 | 06/03/15 | $18,468,000 | 6.1 | $16,306,000 | 5.4 | 6.1 | $18,395,000 | $302,875,000 | $303,327,000 |
| Construction | 07/01/03 | 07/01/03A | 06/03/15 | 06/03/15 | $144,764,000 | 6.1 | $146,030,000 | 5.7 | 6.2 | $145,703,000 | $2,566,573,000 | $2,585,086,000 |
| Close-Out | 10/06/05 | 10/06/05A | 12/04/15 | 12/04/15 | $1,858,000 | 23.4 | $783,000 | 9.9 | 21.8 | $1,732,000 | $7,937,000 | $7,972,000 |
| Program Management | 08/01/05 | 08/01/05A | 12/04/15 | 12/04/15 | $39,747,000 | 36.0 | $36,336,000 | 32.9 | 35.9 | $39,688,000 | $110,525,000 | $110,525,000 |
| **Regional Total** | **03/31/00** | **03/31/00A** | **12/04/15** | **12/04/15** | **$553,548,000** | **16.7** | **$516,039,000** | **14.7** | **16.6** | **$547,516,000** | **$3,514,026,000** | **$3,532,336,000** |
| **Local Total** | **01/02/01** | **01/02/01A** | **10/14/14** | **10/14/14** | **$231,105,000** | **40.5** | **$227,164,000** | **37.9** | **40.3** | **$230,106,000** | **$599,830,000** | **$604,547,000** |
| | | | | | | | | | | **Budgeted Finance Cost:** | **$471,700,000** | **$471,700,000** |
| | | | | | | | | | | **WSIP Total Cost:** | **$4,585,556,000** | **$4,608,583,000** |

# 1.0 PROGRAM SUMMARY

## 1.3 PROGRAM UPDATE

### Program Management

During the reporting quarter, WSIP Program Management efforts continued to focus on several key activities including program level contracts, various ongoing program control initiatives, and system shutdown planning and public and contractor outreach efforts. In addition, efforts were spent on addressing follow up comments provided by regulatory agencies and the Bay Area Water Supply & Conservation Agency (BAWSCA) on the WSIP proposed changes, as well as on a number of other activities related to the implementation of the program.

The 2nd Quarter - Fiscal Year 2008-2009 (Q2-FY08/09) Regional Projects Quarterly Report listed commitments that were made to the California Department of Public Health (CDPH) and the California Seismic Safety Commission (CSSC) in response to their concerns about the program changes approved in 2008. Progress was made during the last quarter on some of the commitments to CDPH that were included in a letter to them from the SFPUC on November 13, 2008, as reported below:

**Conduct independent technical review for the CUW35902 - Alameda Siphon #4 project to assure seismic reliability; investigate potential additional capital and operational response improvements that may increase seismic reliability in the Sunol Valley; create and implement a seismic response strategy for the Sunol Valley, as well as update Operational Response Plans to address response procedures including operation of WSIP facilities following major seismic events.** A review by seismic design experts was performed for the Alameda Siphon #4 project, focusing on the adequacy of the design to withstand a Calaveras design earthquake. In the draft report "Draft: Seismic Review of Alameda Siphon #4 Project" (URS, March 12, 2009), the Review Team concluded that an "acceptable standard of care" was applied to the design, and that the "project uses appropriate technology to achieve the WSIP goals." The report was finalized May 21, 2009. In addition to this review, the Sunol Valley Seismic Reliability Assessment final draft was completed May 2009. It presents the results of various reviews and evaluations that the SFPUC has conducted regarding the level of seismic reliability that will be provided in the Sunol Valley following completion of the WSIP. The intent is to:

- Verify the adequacy of the existing and proposed facilities and operational requirements to meet their intended purposes in satisfying the seismic reliability level of service (LOS) goals.
- Identify potential weaknesses.

- Identify additional improvements that might increase reliability beyond the requirements of the seismic reliability LOS goals.

There has been a significant amount of detailed evaluation and design performed to date on the individual facilities in the Sunol Valley so that these facilities comply with the seismic reliability LOS goals. However, in some cases, reliability may be further increased through a combination of synergistic improvements to multiple projects, including both capital and operational, that would not be achievable by a single project. Key recommendations from the document have been incorporated or are being considered for incorporation in several projects.

Progress was made during the last quarter on the SFPUC's commitments to the CSSC that were included in a letter to the CSSC dated November 13, 2008. During the past quarter, SFPUC facilitated URS Consultants' presentation on their approach to the design of a seismically reliable pipeline at the Bay Division Pipelines Nos. 3 and 4 Hayward Fault crossing to the independent Seismic Safety Task Force (SSTF), as well as AECOM's approach to seismic reliability modeling and analysis. The Seismic Safety Task Force will be following up with written recommendations regarding "Revised General Seismic Requirements for Design of New Facilities and Upgrade of Existing Facilities – Revision 1" (SFPUC, December 22, 2008) in the next quarter. In addition, they will also provide their written recommendations regarding the proposed reduction of redundant seismically reliable pipeline at the Bay Division Pipelines Nos. 3 and 4 Hayward Fault crossing.

SFPUC staffs are scheduling to meet with the SSTF again in the next quarter to follow up on two remaining items:

a) Magnitude of design earthquakes for WSIP projects impacted by the Calaveras Fault;
b) Size and consistency of design fault displacements at pipeline crossings. The SSTF confirmed in a meeting on May 11, 2009 that the size of design fault displacements used for WSIP projects is reasonable and consistency has been maintained among projects, and the SSTF indicated they will be providing written recommendations in the upcoming quarters.

During the CSSC meeting on October 28, 2008, the SFPUC concurred with the CSSC that two issues warranted evaluations by external experts/consultants:

a) **Redundancy of the Alameda Siphon Project and alternative connections between the Sunol Valley Water Treatment Plant and the Irvington Tunnel.** A draft report titled, "Sunol Valley Seismic Reliability Assessment" by CH2M Hill has been completed. The final draft report was completed in May 2009. As discussed above, key recommendations from the document have been incorporated or are being considered for incorporation in several projects.

b) **Faulting and slope stability issues at the Harry Tracy Water Treatment Plant (HTWTP): Status of the two reports for HTWTP is as follows:**
   - "Draft Seismic Risk Assessment for Treated Water Reservoirs" by Exponent Failure Analysis Associates (December 2008). Final draft report was submitted to SFPUC at the end of June 2009. The consultant will issue the final report this quarter.
   - "Supplemental Fault Rupture Hazard Assessment" by William Lettis & Associates, Inc. was finalized in March 2009.

The SFPUC continued to prepare a Preliminary Official Statement in anticipation of issuing the second round of WSIP bonds in August 2009. The expected total bond size is an estimated $375 million in one or more series and proceeds will be used to defease outstanding commercial paper as well as continue funding WSIP capital projects.

During this reporting period, ongoing efforts aimed at improving the WSIP Program Controls System and processes included the following accomplishments: (1) Performing a thorough and systematic analysis of program scope, cost and schedule to generate the proposed program changes; (2) establishing detailed project baselines for monitoring, controlling and reporting purposes; (3) providing online "dashboard" access to the Construction Management Consultants to view respective projects schedule at the program level; and (4) holding cost estimating training sessions.

Planning efforts associated with system shutdowns continued during the reporting quarter. The WSIP Management Team held multiple meetings with the SFPUC Water Enterprise to coordinate the planning, scheduling, staffing, and work-around plans for the WSIP system shutdowns required through 2014. A number of special shutdown meetings were also held to plan for the Coast Range Tunnel shutdown in January 2010. The WSIP Master System Shutdown schedule and a summary of the changes made to the schedule since it was last updated in October 2008 was issued and distributed to the BAWSCA on May 8, 2009.

WSIP Communications orchestrated two major groundbreaking events for regional projects in the Peninsula and San Joaquin Regions during the quarter. These events resulted in significant media coverage regarding WSIP. Additionally, Communications collaborated with the WSIP Construction Management team in the first of several orientation trainings for staff and consultant teams managing WSIP projects in construction. Communications also activated its program consultant to audit Communications planning and execution in all regions and implement new action plans and procedures for WSIP communications in the field.

The groundbreaking for the CUW35601- New Crystal Springs Bypass Tunnel coincided with the anniversary of the 1906 earthquake and was collaboration with US Geological Survey as well as San Mateo Board of Supervisors. The event received widespread media coverage. In May 2009, the USGS prominently displayed WSIP projects and efforts to seismic retrofit the regional water system as part of its annual open house that drew 10,000 guests. In San Joaquin, the Mayor of San Francisco and President of the San Joaquin Board of Supervisors along with representatives of the U.S. Environmental Protection Agency (EPA) broke ground for the CUW38401 - Tesla Treatment Facility Project near Tracy, CA. Again, this event brought significant media attention to WSIP around the state.

San Joaquin regional Communications Liaison coordinated briefings before the Stanislaus and San Joaquin Board of Supervisors, Riverbank City Council and respective Irrigation Districts' Commissions. In the Sunol region, briefings continue with key Alameda County representatives and the Sunol Citizens Advisory Committee. Additionally, Communications is planning an event with the Sunol School to kick-off the first WSIP project in the Sunol Valley: CUW35902 - Alameda Siphon #4. As the Bay Division region prepares for environmental certification hearings, Communications is taking the lead to arrange final meetings with all municipalities and counties on the Memorandums of Understanding (MOU) for CUW36801/36802 - BDPL Reliability Upgrade – Tunnel/Pipeline Projects. In the Peninsula region, Communications is onsite regularly at New Crystal Springs Tunnel site, as well as focusing on outreach around Daly City and Sawyer Camp Trail projects. With final approval of CUW 37901 - San Andreas Pipeline #3 Installation Project, Communications is refining outreach plans for 4.4 mile pipeline between Daly City and San Francisco's Stonestown neighborhood.

Coordination with the Arts Commission Civic Design Review Committee has produced a design charrette for water supply groundwater projects. This innovative solution will help streamline approvals for more than 20 ground well sites in northern San Mateo County and within San Francisco.

Social marketing continues to be an increasingly popular platform to promote the WSIP projects among neighbors and others. Upcoming refinements to the WSIP website will enable visitors to access blogs quicker for project updates. Additionally, WSIP will add an environmental section to highlight environmental management on projects throughout the regions.

Contracting Outreach staff held a successful Contractor's Fair on April 1 in San Mateo, coordinating with both the Peninsula Builder's Exchange and the WSIP Small Business Advisory Committee. More than 75 contractors and primes from the area attended as did San Mateo Supervisor Rose Jacobs Gibson. Throughout the quarter, this team certified 13 new local business enterprise (LBE) contractors and subcontractors in the regions. Since July 1, 2008, 103 LBE contractors have been certified.

Contracting Outreach also assisted with numerous pre-bid conferences for WSIP Projects. In June, the team hosted another successful Contractor's Breakfast with a film highlighting labor's successful involvement within WSIP and the strides SFPUC has made to improve the contracting process. WSIP's presence at Rapid Excavation and Tunneling Conference (RETC), also in June, provided national exposure to several upcoming WSIP projects that will be out for bid in the coming year.

**Planning/Design**

Planning and design efforts continue with most projects achieving their key scheduled milestones. All regional projects with the exception of two projects (CUW35201 – Upper Alameda Creek Filter Gallery and CUW39401 – Watershed Environmental Improvement Program) have now entered the Design Phase. During this reporting period, the Design Phase for the CUW37901 - San Andreas Pipeline No. 3 Installation, and CUW38601 - San Antonio Pump Station Upgrade Projects were completed. The 35% design package for the CUW35302 – Seismic Upgrade of BDPL Nos. 3 & 4 Project, and the 95% design package for the CUW38401 – Tesla Treatment Facility, CUW36301 – SCADA System – Phase II, CUW35401 – Lower Crystal Springs Dam Improvements, CUW38101 – SVWTP Expansion & Treated Water Reservoir, and CUW5901 – New Irvington Tunnel Projects were all completed.

In addition, the construction bid packages for the CUW36401 - Lawrence Livermore Water Quality Improvement, CUW37302 - Rehabilitation of Existing San Joaquin Pipelines (Roselle Crossover), CUW37901 - San Andreas Pipeline No. 3 Installation, CUW36103 -Pulgas Balancing – Structural Rehabilitation and Roof Replacement, and CUW38601 - San Antonio Pump Station Upgrade Projects were advertised.

A Cooperative Agreement with Caltrans District 4 for proposed improvements in connection with WSIP within the State Highway System ROW was executed on February 19, 2009, and will be effective through December 31, 2017. To date, WSIP has received sixteen (16) encroachment permits from Caltrans. As a part of this agreement, the SFPUC agreed to establish a Construction Zone Enhancement Enforcement Program (COZEEP), working with the California Highway Patrol (CHP) for traffic safety on State highways. This quarter, an agreement with the California Highway Patrol (CHP) to provide the COZEEP services during construction of the improvements has been drafted. This agreement will help facilitate construction around State highways by providing supplemental CHP officers to assist the SFPUC and its contractors in the management of traffic in order to enhance the safety of motorists, pedestrians, and construction workers.

To ensure all WSIP projects share a common contract basis, the Engineering Management Bureau (EMB) has completed work on the "baseline template" for the Division 0 (Procurement and Contracting Requirements) and Division 1 (General Requirements) Specifications.

**Environmental**

Keeping the environmental review process on track with scheduled performance has been one of the program's greatest challenges. This challenge encompasses the following factors: (1) the early decision to conduct the Pre-Construction Phases (planning, design, and environmental) for the WSIP in parallel. Although this approach saves time overall and is practiced on major infrastructure programs, it requires several iterations of environmental reviews as design progresses and projects scopes are modified. (2) Preparation of the Draft PEIR in parallel with individual project EIRs. Additional time was needed to accomplish the necessary level of consistency of individual documents with the PEIR. (3) New environmental resource issues surfaced during report preparation that was initially excluded from consideration. For example, Steelhead fisheries analyses, previously anticipated to be completed under a separate permitting process, are now required for completion of the environmental review for the CUW37401 - Calaveras Dam Replacement Project. (4) Inadequate consultant resources have resulted in prolonged document reviews by the Major Environmental Analysis Division of the San Francisco Planning Department (MEA) and termination of two consultant contracts. Having released two consulting firms, the transition to new consultants extended the schedule. (5) Several projects were delayed as a result of the decision by MEA to prepare EIRs instead of Mitigated Negative Declarations (MNDs) on some projects, thus prolonging the Environmental Phase.

The SFPUC Bureau of Environmental Management (BEM) continues to work closely with the SFPUC Water Enterprise, MEA, the Office of the City Attorney and the environmental consultants to mitigate delays in the environmental review process. In addition to hiring new consultants for some projects, additional consultants have been hired to supplement MEA's staff and to supplement some existing consulting contracts.

During the reporting quarter, significant progress was made in certification of several Environmental Impact Reports (EIRs), completion and publication of several Draft EIRs and receipt of other California Environmental Quality Act (CEQA) clearances. Specific CEQA review accomplishments include the following:

The San Francisco Planning Department approved the Mitigated Negative Declaration (MND) for the CUW36103 – Pulgas Balancing - Structural Rehabilitation and Roof Replacement Project on May 14, 2009.

The San Francisco Planning Commission certified the Environmental Impact Report for the CUW37901 – San Andreas Pipeline No. 3 Installation - Project on April 2, 2009

Response to Comments documents were published for the CUW37301 - San Joaquin Pipeline System and CUW36801/CUW36802 – BDPL Reliability Upgrade – Tunnel/ Pipeline Projects on May 14, 2009 and June 18, 2009 respectively.

The Notice of Preparation (NOP) document for the Environmental Impact Report for CUW30103 - Regional Groundwater Storage and Recovery Project was published on June 22, 2009.

Draft Environmental Impact Reports (EIR) were published for the CUW35901 – New Irvington Tunnel and CUW38101 – SVWTP Expansion & Treated Water Projects, both on June 1, 2009.

Resource agency permitting involves the environmental permits that must be obtained prior to construction from the following agencies: US Army Corps of Engineers (USACE), the US Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), the State Historic Preservation Officer (SHPO), the California Department of Fish and Game (CDFG), and the Regional Water Quality Control Board (RWQCB).

Significant progress was made on environmental permitting activities. Specific permitting accomplishments during the reporting period are summarized below.

*Permits Applications Submitted:*

- CUW36801 – BDPL Reliability Upgrade - Tunnel:
    - USACE submitted Letter to SHPO for 106 concurrence

# 1.0 PROGRAM SUMMARY

- CUW 35901 - New Irvington Tunnel:
    - Submitted 404 Application to USACE
    - Submitted Biological Assessment to USFWS
- CUW37401 – Calaveras Dam Replacement:
    - Submitted Draft Biological Assessment to NMFS
    - Submitted Section 404 Individual Permit Application to the USACE
    - Submitted Biological Assessment to USFWS
- CUW 38101 – SVWTP Expansion & Treated Water Reservoir:
    - Submitted 404 Application to USACE
    - Submitted Biological Assessment to USFWS

*Permits Received:*

- CUW35902 – Alameda Siphon #4:
    - Completed 401 Water Quality Certification from the RWQCB
- CUW37401 – Calaveras Dam Replacement:
    - Received Approval on Second Supplemental Wetland Delineation Report for verification

*Environmental Construction Compliance Management*

During this reporting period, the WSIP Environmental Construction Compliance Manager (ECCM) coordinated completion of the Environmental Mitigation Section of the Contract Specifications for one (1) project (CUW36801 – BDPL Reliability Upgrade – Tunnel (East Bay Segment)) and four (4) others are in progress (CUW35901 – New Irvington Tunnel, CUW37301 - San Joaquin Pipeline System, CUW36801 – BDPL Reliability Upgrade – Tunnel (Peninsula Segment), and CUW38101 – SVWTP Expansion & Treated Water Reservoir Projects). Preconstruction planning efforts focused on finalizing environmental construction compliance contracts for Peninsula Region and performing other tasks supporting the environmental compliance program for this region. In addition, agency coordination/reporting and minor project modification approvals supported pre-construction and construction phases for the CUW35601 - New Crystal Springs Bypass Tunnel, CUW38401 - Tesla Treatment Facility, CUW36102-Pulgas Balancing - Discharge Channel Modifications, CUW39101 - Baden and San Pedro Valve Lots Improvements, and CUW38001 – BDPL No. 3 & 4 Crossovers Projects. A training manual for Environmental Inspectors was developed.

**Right-of-Way**

The ROW engineering, surveys and appraisals have been completed for the CUW36801 - BDPL Reliability Upgrade - Tunnel Project. The project passes through the lands of

USFWS, State Lands, Mid-Peninsula Open Space, Sam-Trans and Leslie Salt. Each of these ownerships will involve different and challenging land acquisition processes.

Encroachment removal activities continues for the CUW36802 - BDPL Reliability Upgrade - Pipeline Project. The Right-of-Way (ROW) Team is now focusing on the remaining difficult encroachments and is diligently working with the City Attorney's Office to find solutions for removal which may include litigation if absolutely necessary. The ROW Team is also mapping and appraising the Bay Road parcel and the City of Fremont Access Road.

The appraisal process was completed for the CUW38001 - BDPL No. 3 & 4 - Crossovers Project and the land acquisition process is underway. Negotiations resulted in a successful settlement on the Guadalupe site in Santa Clara. Discussions continue with Cal Water.

The ROW Team received the final alignment for the CUW35901 - New Irvington Tunnel Project and the ROW mapping has been completed. A significant portion of the appraisal work is underway on this project and the Project Team is meeting with the property owners to explain the ROW process. Initial relocation planning has also commenced.

A ROW Encroachment Team was set up for the CUW37301 - San Joaquin Pipeline System Project. Sixty-nine (69) encroachments have been identified and contact has been initiated via letter and personally. ROW engineering and surveys work have commenced and are ongoing. The appraisal process was also initiated on this project.

Overall, the ROW Team is making steady progress; however, delays in the environmental review of some projects have impacted the ROW Team's ability to initiate some tasks that require CEQA approval first.

**Construction**

Significant efforts continued on implementing the construction management (CM) approach, structure, processes, procedures and systems, and recruiting the consultants and staffing required managing all upcoming construction activities.

Pre-construction planning:

Pre-construction planning efforts focused on: (1) finalizing of CM Procedures based on the WSIP CM Plan: 46 out of 49 procedures are posted as final on the WSIP section of the SFPUC website (sfwater.org/WSIP) and the SFPUC network drives; (2) implementing the SFPUC revised construction specifications (Perfectus Version 3 for Division 0 and Division 1) on WSIP projects; (3) updating the CM Staffing Plan to manage consultant needs and internal hiring/re-assignment requirements based on schedule update of several WSIP projects and the transition of City staff to CMB; and (4) implementing the WSIP CM Management Information System (CMIS) to provide efficient and consistent management of various CM processes such as submittals, requests for information, written communications, and changes. Preparation of CM Construction Procedures is 98% complete as of the end of the reporting quarter. A thorough QA review has been completed and revisions to incorporate all comments are currently in progress for the WSIP Business Processes, CM Procedures, and the CM Plan.

Construction Management Information System (CMIS):
The WSIP CMIS continued to be transitioned into use on WSIP projects. The CMIS was implemented on the following projects:

- CUW35601 - New Crystal Springs Bypass Tunnel Project, which had its NTP in December 2008.
- CUW38401 - Tesla Treatment Facility Project, which had its construction NTP in March 2009.
- CUW39101 - Baden and San Pedro Valve Lot Improvements Project, which had its NTP in April 09.
- CUW36102 –Pulgas Balancing - Discharge Channel Modifications Project, which had its NTP in April 09.

As of this reporting quarter, a total of about 80 individuals consisting of construction contractors, CM Consultants and SFPUC WSIP employees had received CMIS training.

CM Contract Agreements and Progress:
Significant efforts were made continuing to select and put in place Construction Management Consultants for the WSIP. As of the end of the quarter, the following CM Contract Agreements were in effect:

- CS-910: Construction Management (CM) Services for WSIP - San Francisco Region/Local;
- CS-912: Construction Management (CM) Services for WSIP - New Crystal Springs Bypass Tunnel Project;
- CS-913: Construction Management (CM) Services for WSIP - Bay Tunnel Project;

- CS-914: Construction Management (CM) Services for WSIP – Bay Division Region;
- CS-917: Construction Management (CM) Services for WSIP - San Joaquin Region

Two other Contract Agreements for CM services were awarded and were in process of negotiations:
- CS-915R: Sunol Regional Construction Management (CM) Services and
- CS-918: Construction Management (CM) services for WSIP - New Irvington Tunnel Project.

An additional contract Agreement for CS-916: Peninsula Regional Construction Management (CM) Services has been advertised and is in the selection process for ranking and award to the most qualified proposer.

Three (3) other Construction Management (CM) services RFPs have yet to be advertised: CS-911R Calaveras Dam, HTWTP Long-term Improvement project and Seismic Upgrade of BDPL No. 3 & 4. (CS numbers have not been assigned to the last two projects).

Partnering/Disputes Review Advisors (DRA)/Disputes Review Boards (DRB):
Formal partnering and informal partnering is being conducted with Project CM teams including CM Consultants, City CM Staff and Construction Contractors. Additionally, alternative dispute resolution methods involving independent third party Disputes Review Advisors or Disputes Review Boards are being put into place on all medium to large WSIP construction contracts.

Supplier Quality Surveillance (SQS):
During this reporting period, Parsons as a part of their Pre-construction services has developed SQS Plans for scoping independent third party quality assurance in SFPUC and Construction Contractor vendor fabrication facilities which are providing permanent plant equipment and materials for WSIP construction projects. This is being done to assure that complex equipment and equipment critically needed as a prerequisite to major system shutdowns is delivered on time and to specified quality requirements. SQS Plans for the following projects were developed this reporting period:
- CUW38401 - Tesla Treatment Facility
- CUW37301 – San Joaquin Pipeline System (Contract 1)
- CUW35902 - Alameda Siphon #4
- CUW38001 - BDPL Nos. Crossovers
- CUW39101 – Baden and San Pedro Valve Lots Improvements

# 1.0 PROGRAM SUMMARY

Program Construction Management:
AECOM began work as Program Construction Management (PCM) team in March, 2009 providing management oversight of construction and implementation of the WSIP CM Plan and processes at the program level. As of June 30, 2009, the PCM team is fully mobilized.

WSIP Construction Management Training:
The first Construction Management (CM) Orientation and Training Session was conducted in June, 2009. The session provided a one-day hands-on workshop to provide a practical overview and working knowledge of the WSIP CM Plan and Procedures, key contractual and regulatory requirements, and the CM role in implementing these in a correct and consistent manner. These sessions will continue to be provided as Project CM teams are mobilized and put in place.

**Project Achievements**

*Planning Phase Completed:*

- None

*Environmental Phase Completed:*

- CUW37901 - San Andreas Pipeline No. 3 Installation
- CUW38801 - Programmatic EIR

*Design Phase Started:*

- None

*Design Phase Completed:*

- CUW37901 - San Andreas Pipeline No. 3 Installation
- CUW38601 - San Antonio Pump Station Upgrade

*Construction Contract Advertised:*

- CUW36103 - Pulgas Balancing - Structural Rehabilitation and Roof Replacement
- CUW36401 - Lawrence Livermore Water Quality Improvement
- CUW38001 – BDPL No. 3 and 4 – Crossovers
- CUW37901 - San Andreas Pipeline No. 3 Installation
- CUW38601 - San Antonio Pump Station Upgrade

*Construction Contract Awarded:*

# 1.0 PROGRAM SUMMARY

- CUW35901 – Alameda Siphon #4
- CUW37201 - University Mound Reservoir - North Basin
- CUW37901 - San Andreas Pipeline No. 3 Installation
- CUW38001 - BDPL Nos. 3 and 4 Crossovers

*Construction Final Completion*:
- None

# 1.0 PROGRAM SUMMARY

# 2.0 SUB PROGRAM SUMMARY

## 2.5 WATER SUPPLY

Overall, the Water Supply projects are on schedule with an actual completion of 8.0% as compared to a planned completion of 8.8%. The Schedule Performance Index (SPI) for the Region is 0.91. This indicates that 91% of the work planned was performed as of the end of the reporting quarter. Earned Value exceeds actual costs to date by $2.1 million. The table below summarizes the overall progress of the Water Supply Sub Program during the reporting quarter.

**Table 2.5 Sub Program Performance – Water Supply**

| | | | July 1, 2009 | |
|---|---|---|---|---|
| | | | **% Planned** | **% Actual** |
| Project Management | | | 26.5% | 24.6% |
| Planning | | | 65.6% | 63.7% |
| Environmental | | | 27.3% | 16.0% |
| Right-of-Way | | | 3.0% | 0.5% |
| Design | | | 7.8% | 7.2% |
| Bid & Award | | | 0.0% | 0.0% |
| Construction Management | | | 2.3% | 2.3% |
| Construction | | | 2.2% | 2.2% |
| Close-Out | | | 0.0% | 0.0% |
| **Program Cumulative** | | | **8.8%** | **8.0%** |

Comparison with last quarter data not provided because program baseline was changed and such comparison would not be meaningful.

In accordance with the June 2009 Revised WSIP adopted by the SFPUC Commission on July 28, 2009, a Water Supply sub program comprising of seven (7) projects was added to the Local projects. The following changes were made to the Baseline (Approved) Budget and Schedule of the seven (7) projects in this sub program:

Projects with Changes to Baseline (Approved) Schedule and Budget

- CUW30201 – San Francisco Westside Recycled Water
- CUW30204 – Harding Park Recycled Water

Projects with Changes to Baseline (Approved) Schedule

# 2.0 SUB PROGRAM SUMMARY

- CUW30102 – San Francisco Groundwater Supply

Projects with Changes to Baseline (Approved) Budget

- CUW30101 – Lake Merced Water Levels Restoration
- CUW30202 – Recycled Water Project – Pacifica (Closed)

Projects with No Changes to Baseline (Approved) Budget and Schedule

- CUW39001 – SF Bay Area Desalination Plant (On Hold)

Additionally, one (1) new project, CUW30205 – San Francisco Eastside Recycled Water was added to this sub program.

Planning
Planning phase is slightly behind schedule with an actual completion of 63.7% versus 65.6% for planned. Planning Phase activities for the CUW30201 – San Francisco Westside Recycled Water–completed the Final Preliminary Project Scope Description. Planning activities for the CUW30101 –Lake Merced Water Levels Restoration involve revision to the Draft CER.

Environmental
Environmental phase is behind schedule with an actual completion of 16.0% versus 27.3% for planned. Environmental Phase activities for the CUW30201 –Recycled Water Project – San Francisco Project resumed this quarter after the scope revision. The Administrative Draft EIR was issued for internal review for CUW30204 – Harding Park Recycled Water.

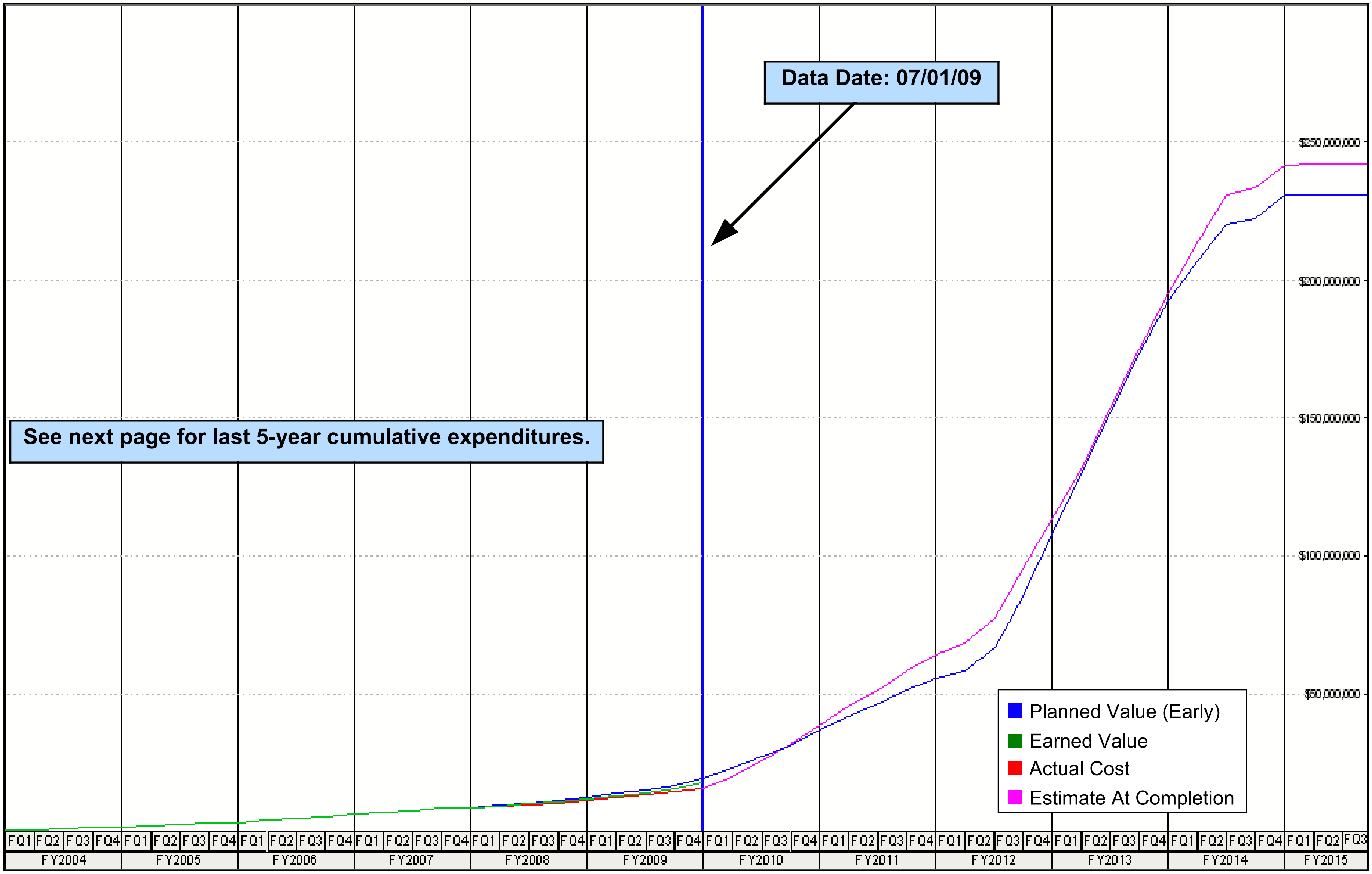
Design
Design phase is behind schedule with an actual completion of 7.2% versus 7.8% for planned. CUW30102 – San Francisco Groundwater Supply project team completed the 35% design milestone this quarter. For CUW30204 – Harding Park Recycled Water, 95% design completion is anticipated by next quarter.

Construction
Construction phase is on schedule with an actual completion of 2.2% versus 2.2% for planned. There were no significant Construction Phase activities on any of the projects in the Water Supply Sub Program.

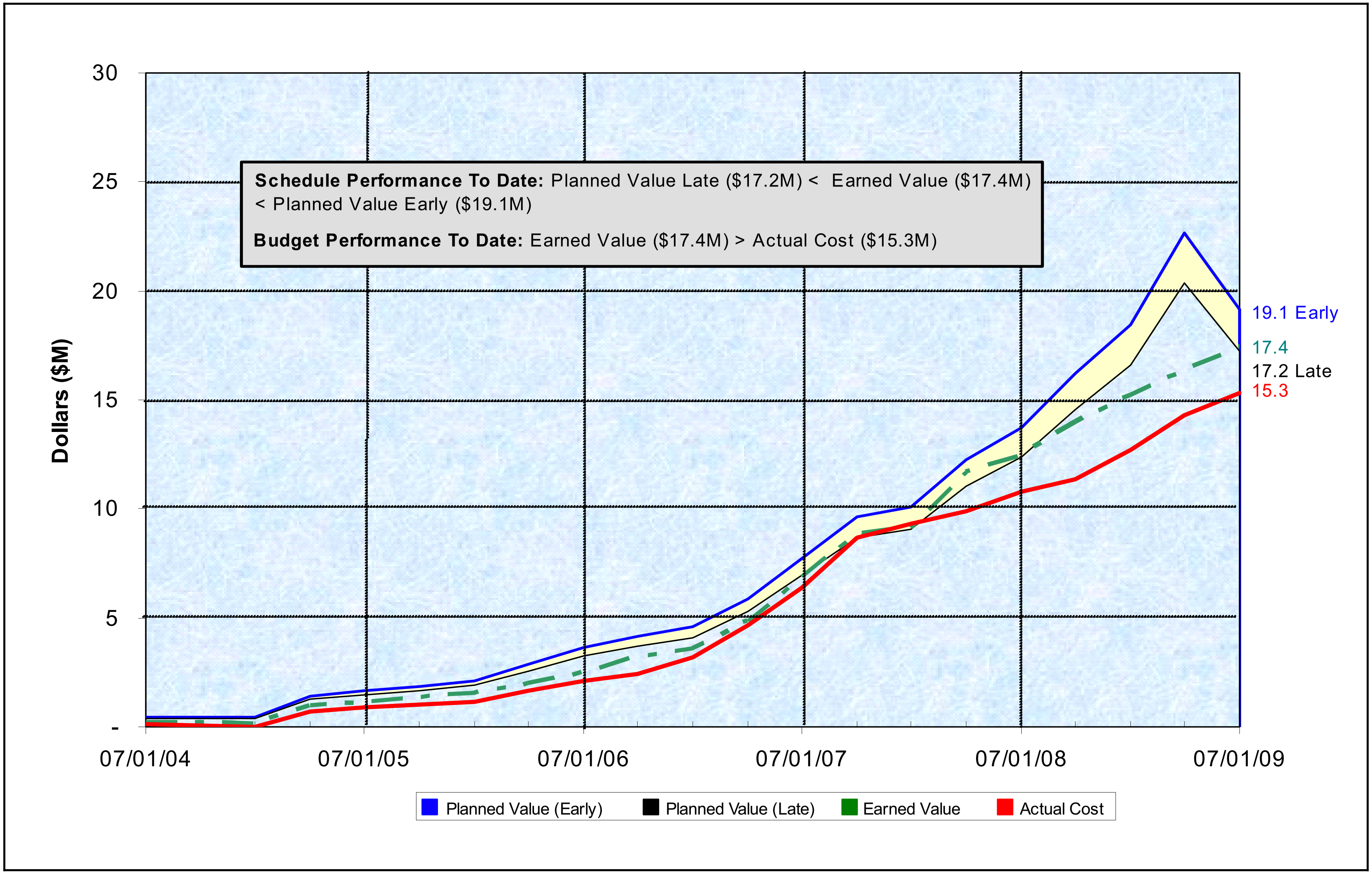
# 2.0 SUB PROGRAM SUMMARY

*Figure 2.7 San Francisco Groundwater Supply Test Well Drilling*

# CUMULATIVE EXPENDITURES



# CUMULATIVE EXPENDITURES (LAST 5 YEARS)



| Phase | Schedule | | | | Budget | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Approved Start | Current Start | Approved Finish | Current Finish | Planned Expenditure To Date | Planned % Complete | Expended To Date | Actual % Expended | Progress % Complete | Earned Value Cost | Approved Budget | Current Forecast |
| Project Management | 01/06/03 | 01/06/03A | 10/14/14 | 10/14/14 | $3,982,000 | 26.5 | $3,493,000 | 23.3 | 24.6 | $3,689,000 | $15,017,000 | $15,017,000 |
| Planning | 01/06/03 | 01/06/03A | 10/03/11 | 10/03/11 | $6,944,000 | 65.6 | $6,208,000 | 58.2 | 63.7 | $6,738,000 | $10,672,000 | $10,672,000 |
| Environmental | 10/13/03 | 10/13/03A | 04/08/13 | 04/08/13 | $2,463,000 | 27.3 | $1,351,000 | 14.4 | 16.0 | $1,447,000 | $9,375,000 | $9,375,000 |
| Right-of-Way | 02/02/07 | 02/02/07A | 05/20/13 | 05/20/13 | $21,000 | 3.0 | $0 | 0.0 | 0.5 | $4,000 | $697,000 | $697,000 |
| Design | 05/12/04 | 05/12/04A | 04/11/13 | 04/11/13 | $2,387,000 | 7.8 | $1,236,000 | 4.0 | 7.2 | $2,205,000 | $30,845,000 | $30,845,000 |
| Bid and Award | 04/18/05 | 04/18/05A | 09/24/13 | 09/24/13 | $0 | 0.0 | $0 | 0.0 | 0.0 | $0 | $450,000 | $450,000 |
| Construction Management | 10/20/04 | 10/20/04A | 04/15/14 | 04/15/14 | $439,000 | 2.3 | $439,000 | 2.3 | 2.3 | $439,000 | $18,802,000 | $18,802,000 |
| Construction | 08/02/04 | 08/02/04A | 04/15/14 | 04/15/14 | $2,896,000 | 2.2 | $2,561,000 | 1.8 | 2.2 | $2,896,000 | $144,501,000 | $149,218,000 |
| Close-Out | 11/05/09 | 06/30/09A | 10/14/14 | 10/14/14 | $0 | 0.0 | $0 | 0.0 | 0.0 | $0 | $730,000 | $730,000 |
| **Water Supply Cumulative** | **01/06/03** | **01/06/03A** | **10/14/14** | **10/14/14** | **$19,133,000** | **8.8** | **$15,289,000** | **6.6** | **8.0** | **$17,418,000** | **$231,088,000** | **$235,805,000** |

# 3.5 WATER SUPPLY

| | |
|---|---|
| Title: **CUW30101 - Lake Merced Water Level Restoration** | PE: Debra Temple, DPW |
| PM: Betsey Eagon | CM: Ben Leung |
| Phone: 415-554-1871 | EPM: Yin Lan Zhang |
| AB1823: No | PCE: JP Torres |

## PROJECT STATUS:

### Project Description:

The project consists of the development of a plan for operations and maintenance; construction of a stormwater treatment wetland, which will yield approximately 315 acre-feet (103 MG) per year for lake augmentation; and installation of up to two groundwater wells that will be used as the secondary water source to fill the lake.

### Planning Status:

* The project is in the conceptual engineering phase. The Draft Conceptual Engineering Report (CER) is currently being revised, and the lake demand and a lake level response model were updated.
* The Final CER and the Planning Phase are expected to be completed by 10/01/09.

### Environmental Status:

* The San Francisco Planning Department determined that this project requires an Environmental Impact Report (EIR).
* Environmental review is underway.

### Right-of-Way Status:

* This project requires no land acquisitions and no encroachment removal actions.
* Discussions are being held with SFPUC Real Estate Services, City Attorney's office, and landowners to determine potential Right-of-Way and land acquisition/leasing issues.

### Design Status:

* The Design Phase was initiated and procurement of the design consultant is underway.
* Bid Advertisement Date: Current Forecast: 04/23/12 / Approved: 10/17/11

### Construction Status:

* Construction NTP Date: Current Forecast: 09/24/12 / Approved: 03/26/12
* The main Construction Phase has yet to be initiated. Construction costs to date reflect installation of an interim lake fill de-chlorination system completed in early 2005.

### Major Issues/Potential Obstacles and Recommended Solutions:

* None at this time.

### Schedule Variances:

**In accordance with the June 2009 Revised WSIP adopted by the SFPUC Commission on July 28, 2009, the baseline (approved) schedule for this project was not changed.**

The following variances are between the Current Forecast Date and Approved Finish Date:

* The 1-month variance for the Planning Phase is due to the additional work required for updating the design criteria and completing the conceptual design.
* The 6-month variance for the Project Management , Bid & Award , Construction Management , Construction and Closeout Phases is due to the inclusion of a Right-of-Way Phase.

### Cost Variances:

* None at this time.

# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW30101 - Lake Merced Water Level Restoration** | PE: Debra Temple, DPW |
| PM: Betsey Eagon | CM: Ben Leung |
| Phone: 415-554-1871 | EPM: Yin Lan Zhang |
| AB1823: No | PCE: JP Torres |

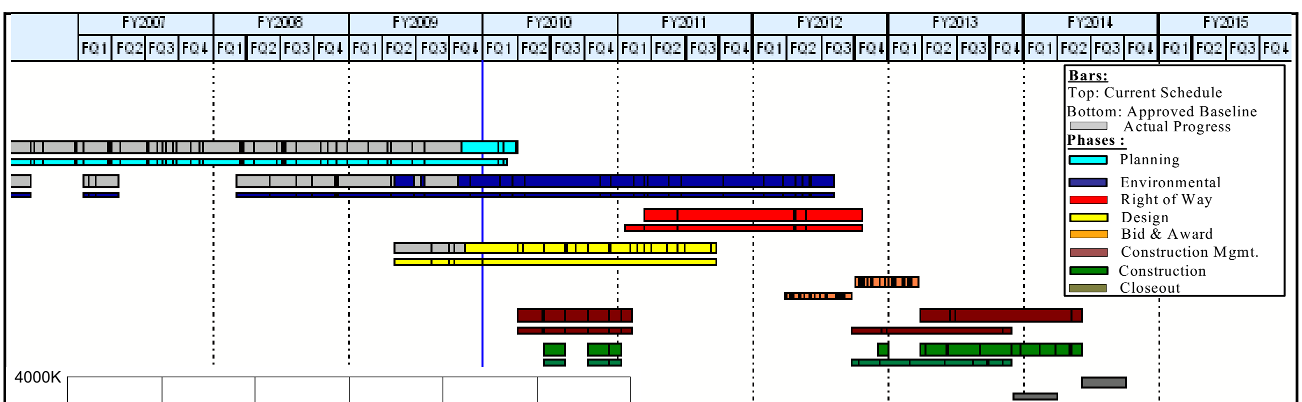
## SCHEDULE:

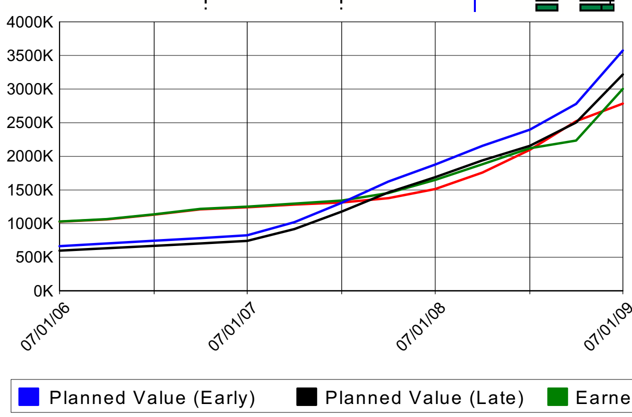
| Project Status-Schedule: | Original Start | Approved Start | Original Finish | Approved Finish | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|
| Project Management | 06/16/03 | 06/16/03 | 07/19/11 | 09/27/13 | 04/04/14 | 04/04/14 |
| Planning | 06/16/03 | 06/16/03 | 08/31/07 | 09/01/09 | 09/01/09 | 10/01/09 |
| Environmental | 10/22/04 | 10/22/04 | 02/18/09 | 02/02/12 | 02/02/12 | 02/02/12 |
| Right-of-Way | | 07/20/10 | | 04/20/12 | 04/20/12 | 04/20/12 |
| Design | 05/12/04 | 05/12/04 | 09/04/09 | 03/24/11 | 03/24/11 | 03/24/11 |
| Bid and Award | 08/27/04 | 09/23/11 | 02/01/10 | 03/23/12 | 09/21/12 | 09/21/12 |
| Construction Management | 10/20/04 | 10/20/04 | 02/01/11 | 05/31/13 | 12/04/13 | 12/04/13 |
| Construction | 10/20/04 | 08/02/04 | 02/01/11 | 05/31/13 | 12/04/13 | 12/04/13 |
| Close-Out | 02/02/11 | 06/03/13 | 07/19/11 | 09/27/13 | 04/04/14 | 04/07/14 |

## BUDGET:

| Project Status - Budget & Expenditures: | Original Budget * | Planned Expenditure To Date | Planned % Complete | Expended to Date | Actual % Expended | Progress % Complete | Approved Budget * | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|---|---|---|
| Project Management | $723,000 | $940,000 | 49.2 | $843,000 | 44.1 | 47.6 | $1,911,000 | $1,911,000 | $1,911,000 |
| Planning | $903,000 | $1,838,000 | 93.1 | $1,493,000 | 75.6 | 90.7 | $1,975,000 | $2,005,000 | $1,975,000 |
| Environmental | $332,000 | $667,000 | 30.2 | $348,000 | 15.5 | 8.6 | $2,250,000 | $2,250,000 | $2,250,000 |
| Right-of-Way | | $0 | 0.0 | $0 | 0.0 | 0.0 | $175,000 | $175,000 | $175,000 |
| Design | $564,000 | $38,000 | 1.7 | $11,000 | 0.5 | 0.9 | $2,418,000 | $2,388,000 | $2,418,000 |
| Bid and Award | $190,000 | $0 | 0.0 | $0 | 0.0 | 0.0 | $50,000 | $50,000 | $50,000 |
| Construction Management | $610,000 | $43,000 | 1.9 | $43,000 | 1.9 | 1.9 | $2,269,000 | $2,269,000 | $2,269,000 |
| Construction | $1,903,000 | $48,000 | 0.2 | $48,000 | 0.2 | 0.2 | $21,409,000 | $21,409,000 | $21,409,000 |
| Close-Out | $38,000 | $0 | 0.0 | $0 | 0.0 | 0.0 | $209,000 | $209,000 | $209,000 |
| Total: | $5,264,000 | $3,574,000 | 11.7 | $2,786,000 | 8.5 | 9.8 | $32,668,000 | $32,668,000 | $32,668,000 |

**Note:** * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).




**Schedule Performance To Date:**
Earned Value ($3.0M) < Planned Value Late ($3.2M) < Planned Value Early ($3.6M)

**Budget Performance To Date:**
Earned Value ($3.0M) > Actual Cost ($2.8M)

**Data Date: 07/01/09**

# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW30102 - San Francisco Groundwater Supply** | PE: Debra Temple, DPW |
| PM: Jeff Gilman | CM: Ben Leung |
| Phone: 415-551-2952 | EPM: Yin Lan Zhang |
| AB1823: No | PCE: JP Torres |

**PROJECT STATUS:**

**Project Description:**

This project consists of two phases, each delivering an annual average of 2 mgd. The first phase consists of building three or four new groundwater well stations in the San Francisco Sunset District or Golden Gate Park. All stations will include a building to house the well pump and electrical equipment, with two stations having an additional room for chemical disinfection. Buried piping will be installed to connect the well stations to the Sunset Reservoir. The second phase, consisting of improvements or replacement of two or more irrigation wells in Golden Gate Park, will be operational when the existing wells are no longer needed for irrigation (after implementation of the CUW30201 – San Francisco Westside Recycled Water Project). The facilities in Golden Gate Park will allow groundwater currently used for irrigation to be used as a potable water source. Improvements to the facilities at the existing San Francisco Zoo Well No. 5 have been completed, allowing this well to serve as an emergency potable water source.

**Planning Status:**

* The Planning Phase was completed on 12/12/06.

**Environmental Status:**

* The San Francisco Planning Department determined that this project requires an Environmental Impact Report (EIR).
* Environmental review is underway.

**Right-of-Way Status:**

* This project requires no land entitlement actions and no encroachment removal actions. However, funding is allocated for encroachment permits and other similar activities.
* Completed a Memorandum of Understanding with the San Francisco Recreation and Park Department (RPD) to address use of existing wells, selection of additional well station sites, pipeline routes and groundwater management in Golden Gate Park.

**Design Status:**

* Completed the 35% design of well stations and pipelines for the South Sunset Playground, West Sunset Playground, and Lake Merced Pump Station (first project phase). The 65% design for this phase is expected to be completed in the next reporting quarter.
* Began review of two existing irrigation wells and well stations in Golden Gate Park (second project phase) and the conceptual design for modifications to use these wells as a potable supply.
* Bid Advertisement Date: Current Forecast: 07/01/11 / Approved: 07/01/11

**Construction Status:**

* Construction NTP Date: Current Forecast: 12/19/11 / Approved: 12/19/11
* The main Construction Phase has yet to be initiated. Construction costs to date reflect installation of coastal groundwater monitoring wells, construction of Zoo Well No. 5 improvements, and construction of test wells at South Sunset Playground, West Sunset Playground and Lake Merced Pump Station.

**Major Issues/Potential Obstacles and Recommended Solutions:**

* Reaching concurrence with the RPD on a new well station site and pipeline routes in Golden Gate Park. Additional meetings with RPD staff and resolution of well site/pipeline routes are anticipated in the next reporting quarter.

**Schedule Variances:**

* None at this time.

**Cost Variances:**

**In accordance with the June 2009 Revised WSIP adopted by the SFPUC Commission on July 28, 2009, the baseline (approved) construction budget for this project was not changed.**

* The $4.7M variance between the Current Forecast Cost and the Approved Budget for the Construction Phase is due to revising the pipeline construction estimates based on increased lengths of pipeline routes and to the escalation associated with the extended environmental review period.

# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW30102 - San Francisco Groundwater Supply** | PE: Debra Temple, DPW |
| PM: Jeff Gilman | CM: Ben Leung |
| Phone: 415-551-2952 | EPM: Yin Lan Zhang |
| AB1823: No | PCE: JP Torres |

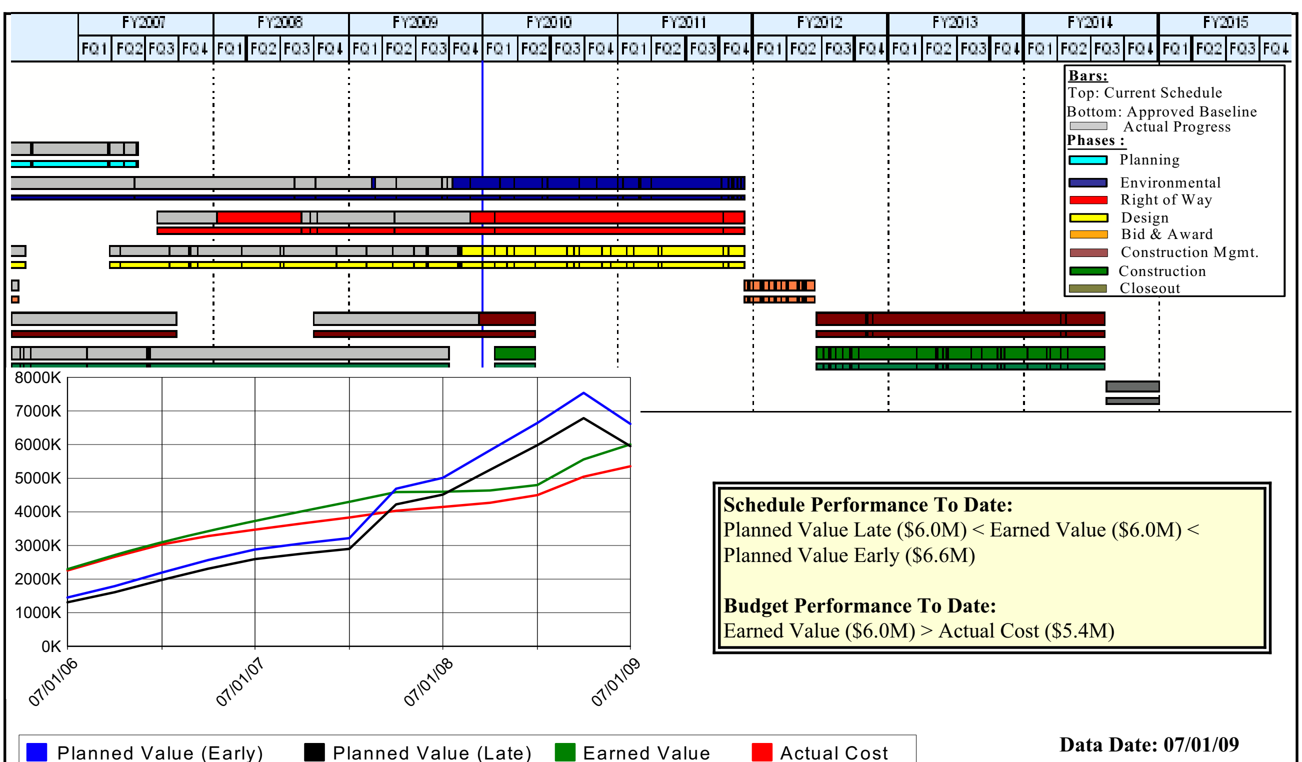
## SCHEDULE:

| Project Status-Schedule: | Original Start | Approved Start | Original Finish | Approved Finish | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|
| Project Management | 07/01/05 | 06/16/03 | 04/30/13 | 07/01/14 | 07/01/14 | 07/01/14 |
| Planning | 07/01/05 | 06/16/03 | 06/01/06 | 12/12/06 | 12/12/06 | 12/12/06 A |
| Environmental | 07/01/05 | 07/01/05 | 05/05/09 | 06/07/11 | 06/07/11 | 06/07/11 |
| Right-of-Way | | 02/02/07 | | 06/09/11 | 06/10/11 | 06/09/11 |
| Design | 10/11/06 | 10/01/04 | 11/19/09 | 06/07/11 | 06/07/11 | 06/07/11 |
| Bid and Award | 11/20/09 | 04/18/05 | 05/18/10 | 12/16/11 | 12/16/11 | 12/16/11 |
| Construction Management | 05/19/10 | 08/15/05 | 11/13/12 | 02/06/14 | 02/06/14 | 02/06/14 |
| Construction | 05/19/10 | 08/15/05 | 11/13/12 | 02/06/14 | 02/06/14 | 02/06/14 |
| Close-Out | 11/15/12 | 02/07/14 | 04/30/13 | 07/01/14 | 07/01/14 | 07/01/14 |

## BUDGET:

| Project Status - Budget & Expenditures: | Original Budget * | Planned Expenditure To Date | Planned % Complete | Expended to Date | Actual % Expended | Progress % Complete | Approved Budget * | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|---|---|---|
| Project Management | $854,000 | $942,000 | 43.4 | $742,000 | 34.2 | 32.8 | $2,170,000 | $2,170,000 | $2,170,000 |
| Planning | $788,000 | $910,000 | 100.0 | $910,000 | 100.0 | 100.0 | $910,000 | $910,000 | $910,000 |
| Environmental | $599,000 | $724,000 | 42.7 | $393,000 | 22.2 | 31.2 | $1,771,000 | $1,771,000 | $1,771,000 |
| Right-of-Way | $0 | $21,000 | 14.4 | $0 | 0.0 | 2.6 | $145,000 | $145,000 | $145,000 |
| Design | $1,677,000 | $886,000 | 25.7 | $514,000 | 14.9 | 20.9 | $3,448,000 | $3,448,000 | $3,448,000 |
| Bid and Award | $88,000 | $0 | 0.0 | $0 | 0.0 | 0.0 | $50,000 | $50,000 | $50,000 |
| Construction Management | $1,707,000 | $396,000 | 8.4 | $396,000 | 8.4 | 8.4 | $4,725,000 | $4,725,000 | $4,725,000 |
| Construction | $18,760,000 | $2,735,000 | 11.7 | $2,399,000 | 9.5 | 11.7 | $25,366,000 | $30,082,000 | $30,082,000 |
| Close-Out | $42,000 | $0 | 0.0 | $0 | 0.0 | 0.0 | $115,000 | $115,000 | $115,000 |
| Total: | $24,513,000 | $6,614,000 | 18.1 | $5,355,000 | 13.8 | 16.4 | $38,700,000 | $43,417,000 | $43,417,000 |

**Note:** * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).




**Schedule Performance To Date:**
Planned Value Late ($6.0M) < Earned Value ($6.0M) < Planned Value Early ($6.6M)

**Budget Performance To Date:**
Earned Value ($6.0M) > Actual Cost ($5.4M)

**Data Date: 07/01/09**

| | |
|---|---|
| Title: **CUW30201 - San Francisco Westside Recycled Water** | PE: L. Wong |
| PM: Barbara Palacios | CM: Ben Leung |
| Phone: 415-554-0718 | EPM: Scott MacPherson |
| AB1823: No | PCE: JP Torres |

## PROJECT STATUS:

### Project Description:

This project consists of a new recycled water treatment facility at the western end of Golden Gate Park (the site of the former Richmond-Sunset Water Pollution Control Plant), along with the associated distribution system components to produce and deliver an annual average of approximately 2 mgd of recycled water to Golden Gate Park, Lincoln Park, and the SF Zoo. The proposed treatment scheme includes membrane filtration, reverse osmosis, and ultraviolet light disinfection. A 1.6 MG recycled water storage reservoir will be located underneath the treatment facility. Distribution pumping facilities will be located at the new facility, and will pump recycled water to the customers through approximately 5 to 6 miles of new pipelines. The project also includes the retrofitting of the existing irrigation systems to bring them in compliance with Title 22 regulations. The treatment facility includes additional capacity to serve potential future customers such as the Presidio Golf Course, although distribution system components to serve the Presidio are not part of the project scope.

### Planning Status:

* SFPUC met with the Recreation & Park Department (RPD) in April 2009 to respond to their comments on the draft Project Scope Description. The Final Preliminary Project Scope Description was completed in June 2009.

### Environmental Status:

* The San Francisco Planning Department determined that this project requires an Environmental Impact Report (EIR).

### Right-of-Way Status:

* This project requires no land entitlement actions and no encroachment removal actions.

### Design Status:

* Work on the 10% Design Report was initiated in May 2009.
* Bid Advertisement Date: Current Forecast: 06/09/11 / Approved: 06/09/11

### Construction Status:

* Construction NTP Date: Current Forecast: 11/21/11 / Approved: 11/21/11
* The Construction Phase has yet to be initiated.

### Major Issues/Potential Obstacles and Recommended Solutions:

* In June 2009, the RPD raised concerns regarding the exact placement of the treatment facility within the Richmond-Sunset site, noting potential visual impacts from nearby recreational areas. Uncertainties in the siting of the facility could delay aspects of the 10% Design effort, if not addressed immediately. The SFPUC will work with RPD to develop a comprehensive site plan that addresses space needs for the new recycled water facility, the existing South Windmill groundwater well facility (to be converted to potable supply as part of the CUW30102 - San Francisco Groundwater Supply Project), and future recreational uses for the site.

### Schedule Variances:

* None at this time.

### Cost Variances:

* None at this time.

# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW30201 - San Francisco Westside Recycled Water** | PE: L. Wong |
| PM: Barbara Palacios | CM: Ben Leung |
| Phone: 415-554-0718 | EPM: Scott MacPherson |
| AB1823: No | PCE: JP Torres |

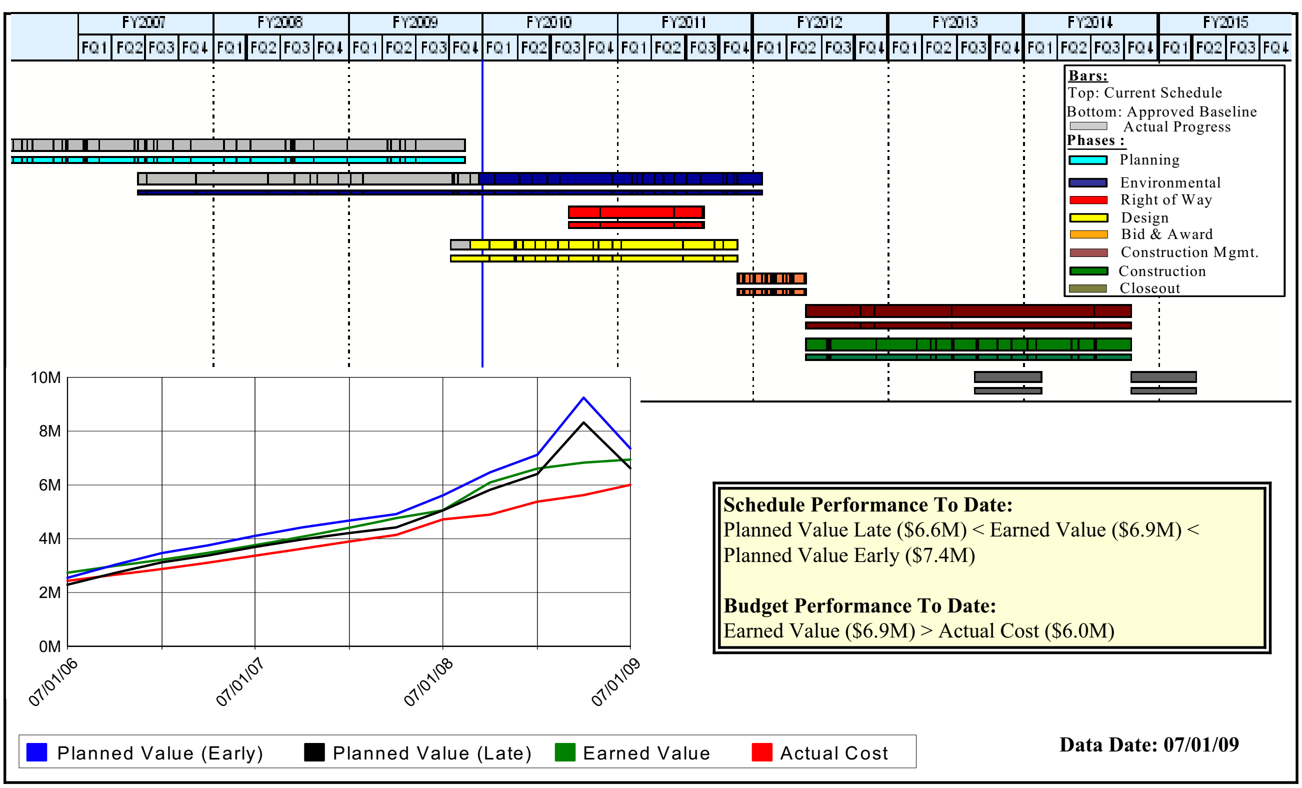
## SCHEDULE:

| Project Status-Schedule: | Original Start | Approved Start | Original Finish | Approved Finish | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|
| Project Management | 03/03/03 | 03/03/03 | 09/04/12 | 10/14/14 | 10/14/14 | 10/14/14 |
| Planning | 07/01/03 | 03/03/03 | 04/18/08 | 05/15/09 | 05/15/09 | 05/15/09 A |
| Environmental | 10/14/03 | 12/12/06 | 02/27/09 | 07/22/11 | 07/22/11 | 07/22/11 |
| Right-of-Way | | 02/18/10 | | 02/14/11 | 02/14/11 | 02/14/11 |
| Design | 04/21/08 | 04/06/09 | 08/20/09 | 05/17/11 | 05/17/11 | 05/17/11 |
| Bid and Award | 08/21/09 | 05/18/11 | 02/26/10 | 11/18/11 | 11/18/11 | 11/18/11 |
| Construction Management | 07/14/06 | 11/21/11 | 03/01/12 | 04/15/14 | 04/15/14 | 04/15/14 |
| Construction | 07/14/06 | 11/21/11 | 03/01/12 | 04/15/14 | 04/15/14 | 04/15/14 |
| Close-Out | 03/02/12 | 02/21/13 | 09/04/12 | 10/14/14 | 10/14/14 | 10/14/14 |

## BUDGET:

| Project Status - Budget & Expenditures: | Original Budget * | Planned Expenditure To Date | Planned % Complete | Expended to Date | Actual % Expended | Progress % Complete | Approved Budget * | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|---|---|---|
| Project Management | $5,889,000 | $1,831,000 | 28.5 | $1,750,000 | 27.2 | 28.4 | $6,424,000 | $6,424,000 | $6,424,000 |
| Planning | $3,682,000 | $4,004,000 | 100.0 | $3,774,000 | 94.3 | 100.0 | $4,004,000 | $4,004,000 | $4,004,000 |
| Environmental | $2,813,000 | $747,000 | 42.4 | $405,000 | 21.5 | 24.3 | $1,880,000 | $1,880,000 | $1,880,000 |
| Right-of-Way | | $0 | 0.0 | $0 | 0.0 | 0.0 | $127,000 | $127,000 | $127,000 |
| Design | $21,045,000 | $774,000 | 6.7 | $73,000 | 0.6 | 5.9 | $11,562,000 | $11,562,000 | $11,562,000 |
| Bid and Award | $328,000 | $0 | 0.0 | $0 | 0.0 | 0.0 | $150,000 | $150,000 | $150,000 |
| Construction Management | $16,474,000 | $0 | 0.0 | $0 | 0.0 | 0.0 | $10,174,000 | $10,174,000 | $10,174,000 |
| Construction | $150,595,000 | $0 | 0.0 | $0 | 0.0 | 0.0 | $91,215,000 | $91,215,000 | $91,215,000 |
| Close-Out | $510,000 | $0 | 0.0 | $0 | 0.0 | 0.0 | $386,000 | $386,000 | $386,000 |
| Total: | $201,334,000 | $7,356,000 | 6.3 | $6,002,000 | 4.8 | 5.9 | $125,923,000 | $125,923,000 | $125,923,000 |

**Note:** * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).



# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW30202 - Recycled Water Project - Pacifica (Closed)** | PE: Sam Young |
| PM: Barbara Palacios | CM: Ben Leung |
| Phone: 415-554-0718 | EPM: To Be Determined |
| AB1823: No | PCE: JP Torres |

## PROJECT STATUS:

### Project Description:

The SFPUC, in partnership with North Coast County Water District, is implementing the Pacifica Recycled Water Project. The primary project elements will include a pump station at the recycling plant, a 400,000 gallon above-ground storage tank, and approximately 17,000 feet of pipe up to 18 inches in diameter. The project will also include site retrofits necessary for the use of the recycled water. North Coast County Water District is responsible for the design, environmental review and construction of this project. This project was closed in October 2008. The final project expenditures have been actualized in this Quarterly Report. The project will be completed using funds from the Water Enterprise capital budget instead of the WSIP budget. (No change from the last Quarterly Report)

CLOSED

# Quarterly Project Status Report

*As of July 1, 2009*

Title: **CUW30202 - Recycled Water Project - Pacifica (Closed)** — PE: Sam Young
PM: Barbara Palacios — CM: Ben Leung
Phone: 415-554-0718 — EPM: To Be Determined
AB1823: No — PCE: JP Torres

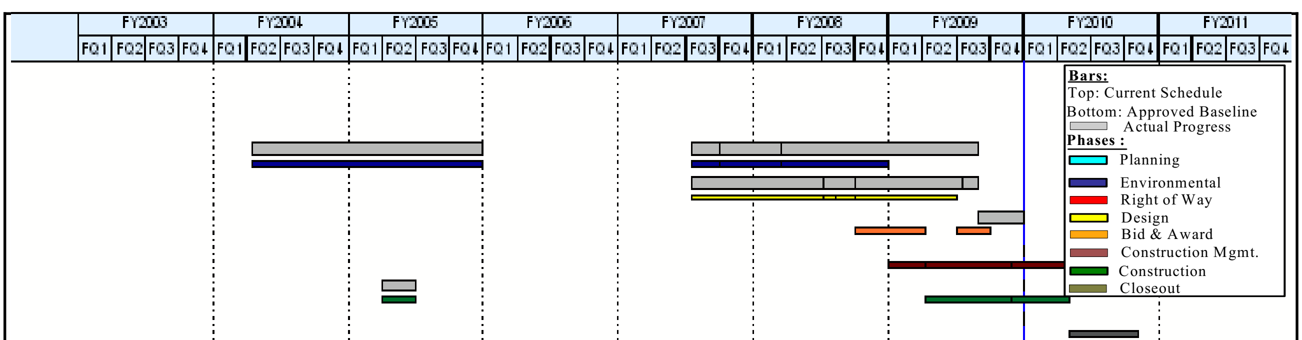
## SCHEDULE:

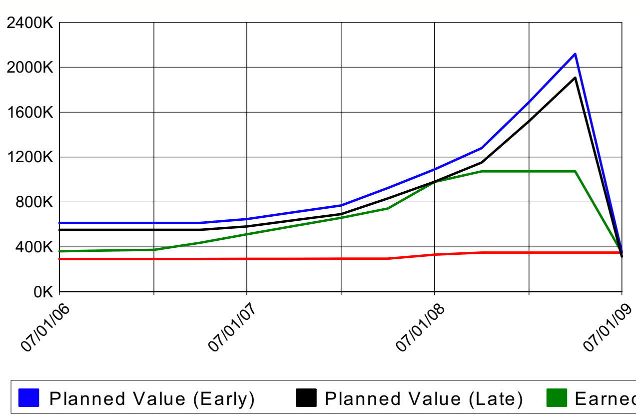
| Project Status-Schedule: | Original Start | Approved Start | Original Finish | Approved Finish | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|
| Project Management | 07/01/03 | 10/13/03 | 02/09/06 | 05/07/10 | 01/12/11 | 06/30/09 A |
| Planning | 07/01/03 | | 10/10/03 | | | |
| Environmental | 10/03/03 | 10/13/03 | 01/31/05 | 07/01/08 | 02/27/09 | 02/27/09 A |
| Right-of-Way | | | | | | |
| Design | 07/01/05 | 01/15/07 | 02/09/06 | 12/31/08 | 02/27/09 | 02/27/09 A |
| Bid and Award | | 04/02/08 | | 04/01/09 | 01/06/10 | 06/30/09 A |
| Construction Management | | 07/02/08 | | 11/04/09 | 07/12/10 | 06/30/09 A |
| Construction | 10/01/04 | 10/01/04 | 12/30/04 | 11/04/09 | 07/12/10 | 06/30/09 A |
| Close-Out | | 11/05/09 | | 05/07/10 | 01/12/11 | 06/30/09 A |

## BUDGET:

| Project Status - Budget & Expenditures: | Original Budget * | Planned Expenditure To Date | Planned % Complete | Expended to Date | Actual % Expended | Progress % Complete | Approved Budget * | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|---|---|---|
| Project Management | $25,000 | $58,000 | 100.0 | $58,000 | 100.3 | 100.0 | $58,000 | $58,000 | $58,000 |
| Planning | $0 | | | | | | | | |
| Environmental | $153,000 | $153,000 | 100.0 | $153,000 | 100.0 | 100.0 | $153,000 | $153,000 | $153,000 |
| Right-of-Way | | | | | | | | | |
| Design | $0 | $25,000 | 100.0 | $25,000 | 100.2 | 100.0 | $25,000 | $25,000 | $25,000 |
| Bid and Award | | $0 | 100.0 | $0 | 100.0 | 100.0 | $0 | $0 | $0 |
| Construction Management | | $0 | 0.0 | $0 | 100.0 | 100.0 | $0 | $0 | $0 |
| Construction | $113,000 | $113,000 | 100.0 | $113,000 | 100.0 | 100.0 | $113,000 | $113,000 | $113,000 |
| Close-Out | | $0 | 0.0 | $0 | 100.0 | 100.0 | $0 | $0 | $0 |
| Total: | $292,000 | $348,000 | 100.0 | $348,000 | 100.1 | 100.0 | $348,000 | $348,000 | $348,000 |

**Note:** * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).




**Schedule Performance To Date:**
Planned Value Late ($313K) < Earned Value ($348K) = Planned Value Early ($348K)

**Budget Performance To Date:**
Earned Value ($348K) = Actual Cost ($348K)

**Data Date: 07/01/09**

# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW30204 - Harding Park Recycled Water** | PE: Sam Young |
| PM: Barbara Palacios | CM: Ben Leung |
| Phone: 415-554-0718 | EPM: Antonia Fairbanks |
| AB1823: No | PCE: Mike Elwin |

**PROJECT STATUS:**

**Project Description:**

The SFPUC, in partnership with the City of Daly City, is implementing the Harding Park Recycled Water Project. This project consists of providing the infrastructure needed to convey water supplied from the existing recycled water facility in Daly City (that is operated by the North San Mateo Sanitation District) to Harding Park. The project consists of approximately 4,700 feet of 18-inch pipe, a 700,000-gallon buried storage reservoir at the park, and two irrigation pumps. The golf course has already been retrofitted to accommodate the use of recycled water; however, some additional retrofits may be required at the park to meet regulatory requirements. The City of Daly City is the agency responsible for the design, environmental review and construction of this project.

**Planning Status:**

* The Planning Phase was completed on 10/07/08.

**Environmental Status:**

* The City of Daly City has determined that this project requires an Environmental Impact Report (EIR).
* The Administrative Draft EIR was issued in June 2009 for internal review.

**Right-of-Way Status:**

* This project requires no land entitlement actions and no encroachment removal actions.

**Design Status:**

* The design team is currently working on the 95% design package, scheduled to be issued in August 2009.
* Bid Advertisement Date: Current Forecast: 11/10/09 / Approved: 11/10/09

**Construction Status:**

* Construction NTP Date: Current Forecast: 04/06/09 / Approved: 04/06/09
* The Construction Phase has yet to be initiated.

**Major Issues/Potential Obstacles and Recommended Solutions:**

* The SFPUC has not been able to secure Phase I/Phase II design approval from the Civic Design Review Committee of the Arts Commission; this could lead to a delay in the completion of the final bid package. The SFPUC will schedule a follow-up meeting with members of the Civic Design Review Committee to better understand their concerns with the architectural design concept, and identify features/concepts that will gain Phase I/II/III design approval in July 2009.

**Schedule Variances:**

* None at this time.

**Cost Variances:**

* None at this time.

# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW30204 - Harding Park Recycled Water** | PE: Sam Young |
| PM: Barbara Palacios | CM: Ben Leung |
| Phone: 415-554-0718 | EPM: Antonia Fairbanks |
| AB1823: No | PCE: Mike Elwin |

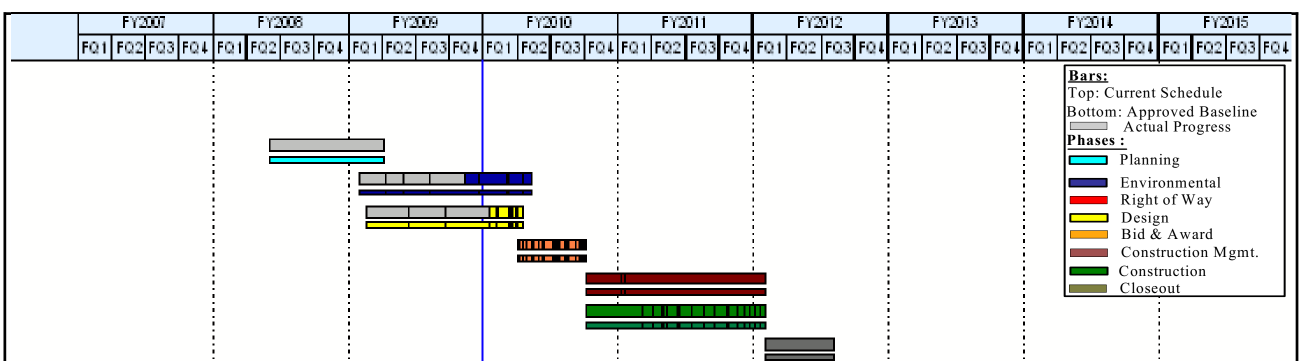
## SCHEDULE:

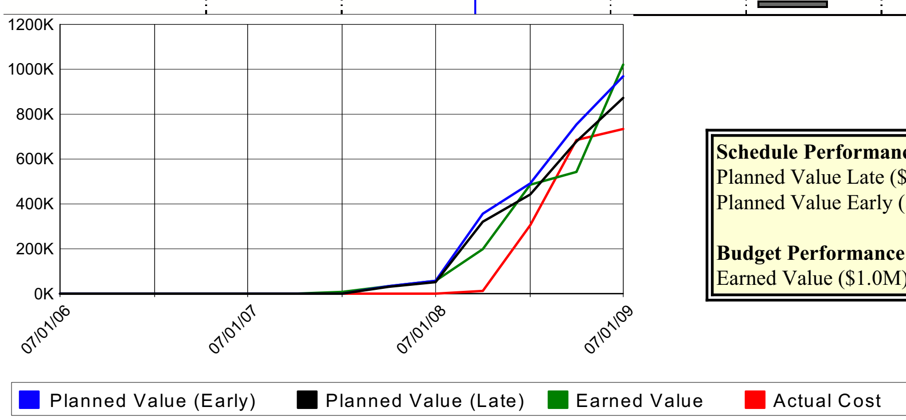
| Project Status-Schedule: | Original Start | Approved Start | Original Finish | Approved Finish | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|
| Project Management | | 12/03/07 | | 02/03/12 | 02/03/12 | 02/03/12 |
| Planning | | 12/03/07 | | 10/07/08 | 10/07/08 | 10/07/08 A |
| Environmental | | 08/01/08 | | 11/10/09 | 11/10/09 | 11/10/09 |
| Right-of-Way | | | | | | |
| Design | | 08/18/08 | | 10/16/09 | 10/16/09 | 10/16/09 |
| Bid and Award | | 09/30/09 | | 04/05/10 | 04/05/10 | 04/05/10 |
| Construction Management | | 04/06/10 | | 08/01/11 | 08/01/11 | 08/01/11 |
| Construction | | 04/06/10 | | 08/01/11 | 08/01/11 | 08/01/11 |
| Close-Out | | 08/02/11 | | 02/03/12 | 02/03/12 | 02/03/12 |

## BUDGET:

| Project Status - Budget & Expenditures: | Original Budget * | Planned Expenditure To Date | Planned % Complete | Expended to Date | Actual % Expended | Progress % Complete | Approved Budget * | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|---|---|---|
| Project Management | | $132,000 | 35.2 | $68,000 | 18.3 | 32.7 | $374,000 | $374,000 | $374,000 |
| Planning | | $0 | 100.0 | $0 | 100.0 | 100.0 | $0 | $0 | $0 |
| Environmental | | $173,000 | 70.7 | $52,000 | 21.4 | 60.0 | $244,000 | $244,000 | $244,000 |
| Right-of-Way | | | | | | | | | |
| Design | | $665,000 | 74.6 | $613,000 | 68.8 | 84.3 | $891,000 | $891,000 | $891,000 |
| Bid and Award | | $0 | 0.0 | $0 | 0.0 | 0.0 | $50,000 | $50,000 | $50,000 |
| Construction Management | | $0 | 0.0 | $0 | 0.0 | 0.0 | $1,634,000 | $1,634,000 | $1,634,000 |
| Construction | | $0 | 0.0 | $0 | 0.0 | 0.0 | $6,398,000 | $6,398,000 | $6,398,000 |
| Close-Out | | $0 | 0.0 | $0 | 0.0 | 0.0 | $19,000 | $19,000 | $19,000 |
| Total: | | $969,000 | 10.7 | $734,000 | 7.6 | 11.3 | $9,612,000 | $9,612,000 | $9,612,000 |

**Note:** * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).




**Schedule Performance To Date:**
Planned Value Late ($0.9M) < Earned Value ($1.0M) =
Planned Value Early ($1.0M)

**Budget Performance To Date:**
Earned Value ($1.0M) > Actual Cost ($0.7M)

**Data Date: 07/01/09**

# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW30205 - San Francisco Eastside Recycled Water** | PE: To Be Determined |
| PM: Barbara Palacios | CM: Ben Leung |
| Phone: 415-554-0718 | EPM: To Be Determined |
| AB1823: No | PCE: Mike Elwin |

**PROJECT STATUS:**

**Project Description:**

This project will plan and design a recycled water treatment facility (or facilities) and distribution system to produce and distribute tertiary recycled water to proposed non-potable water customers on the eastern side of the City of San Francisco. The project is in early planning stages and its scope will be further defined as planning efforts progress.

**Planning Status:**

* The Planning Phase has yet to be initiated.

**Environmental Status:**

* The Environmental Phase has yet to be initiated.

**Right-of-Way Status:**

* This project requires no land entitlement actions and no encroachment removal actions.

**Design Status:**

* The Design Phase has yet to be initiated.
* Bid Advertisement Date: Current Forecast: 05/03/13 / Approved: 05/03/13

**Construction Status:**

* The Construction Phase has yet to be initiated.

**Major Issues/Potential Obstacles and Recommended Solutions:**

* None at this time.

**Schedule Variances:**

* None at this time.

**Cost Variances:**

* None at this time.

# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW30205 - San Francisco Eastside Recycled Water** | PE: To Be Determined |
| PM: Barbara Palacios | CM: Ben Leung |
| Phone: 415-554-0718 | EPM: To Be Determined |
| AB1823: No | PCE: Mike Elwin |

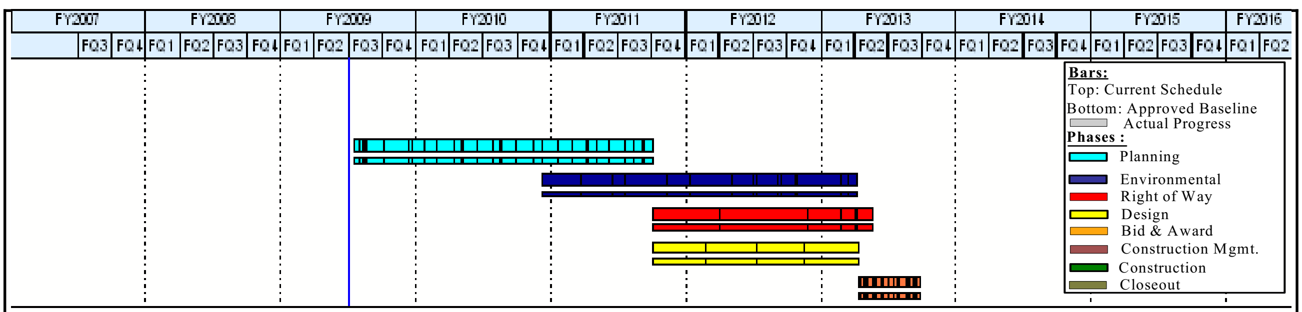
## SCHEDULE:

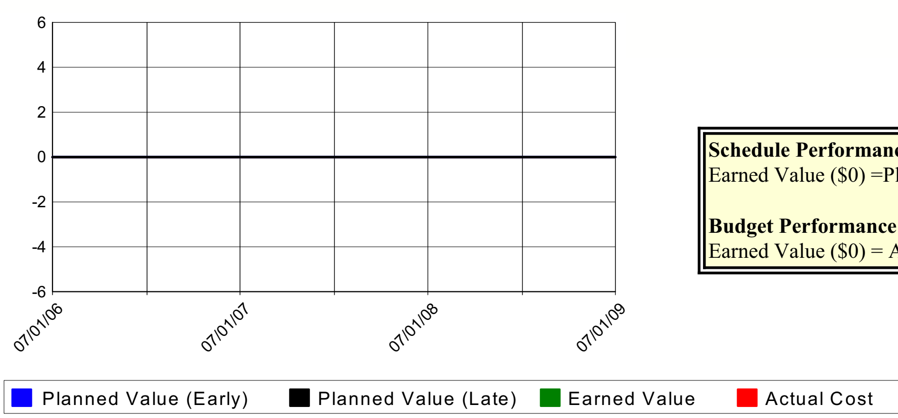
| Project Status-Schedule: | Original Start | Approved Start | Original Finish | Approved Finish | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|
| Project Management | | 07/15/09 | | 09/24/13 | | 09/24/13 |
| Planning | | 07/15/09 | | 10/03/11 | | 10/03/11 |
| Environmental | | 12/08/10 | | 04/08/13 | | 04/08/13 |
| Right-of-Way | | 10/04/11 | | 05/20/13 | | 05/20/13 |
| Design | | 10/04/11 | | 04/11/13 | | 04/11/13 |
| Bid and Award | | 04/12/13 | | 09/24/13 | | 09/24/13 |
| Construction Management | | | | | | |
| Construction | | | | | | |
| Close-Out | | | | | | |

## BUDGET:

| Project Status - Budget & Expenditures: | Original Budget * | Planned Expenditure To Date | Planned % Complete | Expended to Date | Actual % Expended | Progress % Complete | Approved Budget * | Last Forecast | Current Forecast |
|---|---|---|---|---|---|---|---|---|---|
| Project Management | | $0 | 0.0 | $0 | 0.0 | 0.0 | $4,000,000 | | $4,000,000 |
| Planning | | $0 | 0.0 | $0 | 0.0 | 0.0 | $3,500,000 | | $3,500,000 |
| Environmental | | $0 | 0.0 | $0 | 0.0 | 0.0 | $2,500,000 | | $2,500,000 |
| Right-of-Way | | $0 | 0.0 | $0 | 0.0 | 0.0 | $250,000 | | $250,000 |
| Design | | $0 | 0.0 | $0 | 0.0 | 0.0 | $12,500,000 | | $12,500,000 |
| Bid and Award | | $0 | 0.0 | $0 | 0.0 | 0.0 | $150,000 | | $150,000 |
| Construction Management | | | | | | | | | |
| Construction | | | | | | | | | |
| Close-Out | | | | | | | | | |
| Total: | | $0 | 0.0 | $0 | 0.0 | 0.0 | $22,900,000 | | $22,900,000 |

**Note:** * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).




**Schedule Performance To Date:**
Earned Value ($0) =Planned Value Early ($0)

**Budget Performance To Date:**
Earned Value ($0) = Actual Cost ($0)

**Data Date: 07/01/09**

# Quarterly Project Status Report

*As of July 1, 2009*

| | |
|---|---|
| Title: **CUW39001 - SF Bay Area Desalination Plant (Closed)** | PE: To Be Determined |
| PM: Manisha Kothari | CM: To Be Determined |
| Phone: 415-554-3256 | EPM: To Be Determined |
| AB1823: No | PCE: Deepa Rasalkar |

**PROJECT STATUS:**

**Project Description:**

SFPUC, in partnership with EBMUD, Santa Clara Valley Water District (SCVWD), and Contra Costa Water District (CCWD), are investigating the feasibility of developing a joint desalination plant to meet some of the water needs in the agencies' service areas.

**This project is currently on hold pending resolution of funding issues.**

ON HOLD

| | |
|---|---|
| Title: **CUW39001 - SF Bay Area Desalination Plant (Closed)** | PE: To Be Determined |
| PM: Manisha Kothari | CM: To Be Determined |
| Phone: 415-554-3256 | EPM: To Be Determined |
| AB1823: No | PCE: Deepa Rasalkar |

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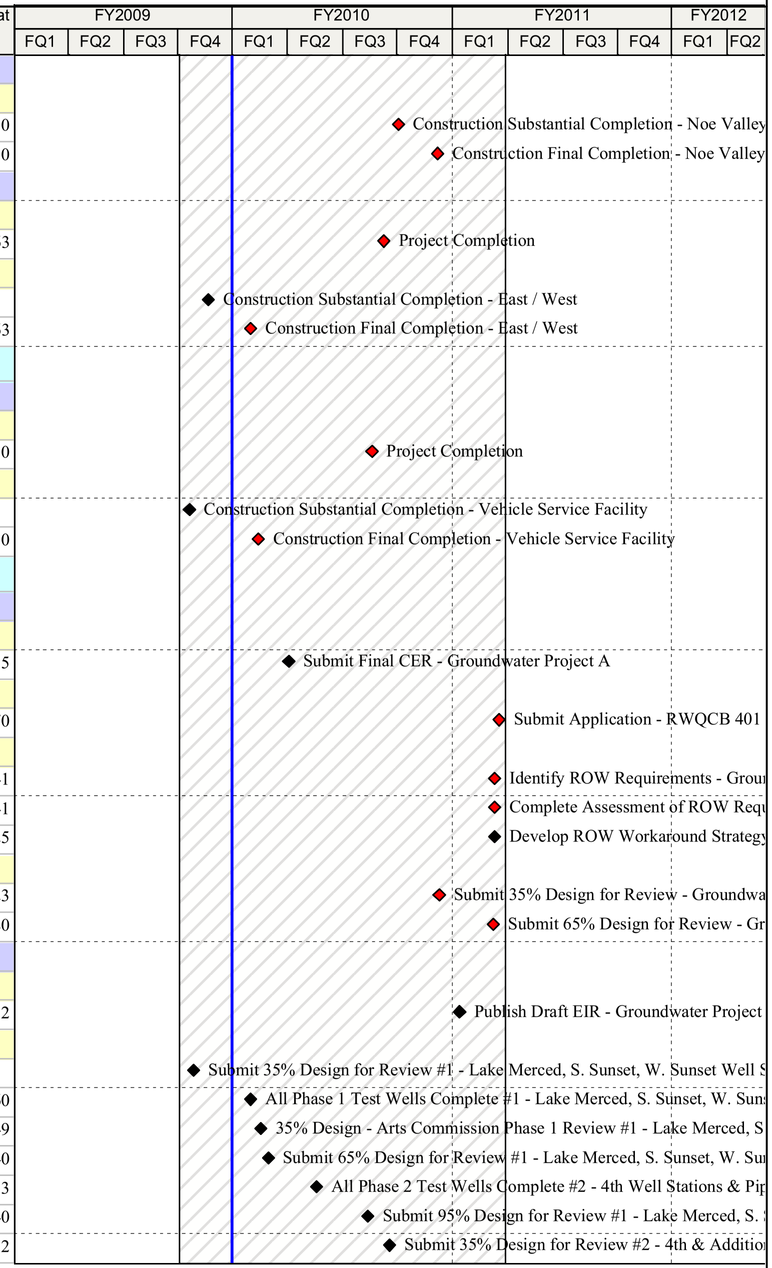
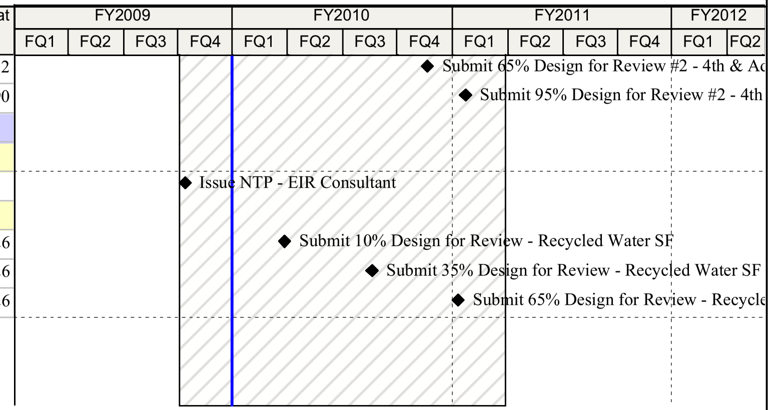
# KEY MILESTONE REPORT - ROLLING SIX QUARTERS (04/05/09- 09/30/10)

| Activity Name | Approved Date | Current Forecast | Variance | Current Late Date | Total Float |
|---|---|---|---|---|---|
| **CUW31301 Noe Valley Transmission Main, Phase 2** | | | | | |
| **Construction** | | | | | |
| Construction Substantial Completion - Noe Valley | 02-Apr-10 | 02-Apr-10 | 0 | 02-Apr-10 | 0 |
| Construction Final Completion - Noe Valley | 07-Jun-10 | 07-Jun-10 | 0 | 07-Jun-10 | 0 |
| **CUW31501 East / West Transmission Main** | | | | | |
| **Project Milestones** | | | | | |
| Project Completion | 09-Mar-10 | 09-Mar-10 | 0 | 04-Dec-09 | -63 |
| **Construction** | | | | | |
| Construction Substantial Completion - East / West | 22-May-09 | 22-May-09A | 0 | 08-Apr-09 | |
| Construction Final Completion - East / West | 31-Jul-09 | 31-Jul-09 | 0 | 01-May-09 | -63 |
| **Miscellaneous** | | | | | |
| **CUW30301 Vehicle Service Facility Equipment Safety Upgrade** | | | | | |
| **Project Milestones** | | | | | |
| Project Completion | 17-Feb-10 | 17-Feb-10 | 0 | 17-Feb-10 | 0 |
| **Construction** | | | | | |
| Construction Substantial Completion - Vehicle Service Facility | 21-Apr-09 | 21-Apr-09A | 0 | 01-Jul-09 | |
| Construction Final Completion - Vehicle Service Facility | 12-Aug-09 | 12-Aug-09 | 0 | 12-Aug-09 | 0 |
| **Water Supply** | | | | | |
| **CUW30101 Lake Merced Water Level Restoration** | | | | | |
| **Project Planning** | | | | | |
| Submit Final CER - Groundwater Project A | 01-Sep-09 | 01-Oct-09 | -21 | 08-Oct-09 | 5 |
| **Environmental Review** | | | | | |
| Submit Application - RWQCB 401 Certification - Groundwat | 17-Sep-10 | 17-Sep-10 | 0 | 15-Jan-10 | -170 |
| **Right of Way** | | | | | |
| Identify ROW Requirements - Groundwater Project A | 08-Sep-10 | 08-Sep-10 | 0 | 18-Feb-10 | -141 |
| Complete Assessment of ROW Requirements - Groundwater I | 08-Sep-10 | 08-Sep-10 | 0 | 18-Feb-10 | -141 |
| Develop ROW Workaround Strategy - Groundwater Project A | 08-Sep-10 | 08-Sep-10 | 0 | 14-Mar-11 | 125 |
| **Design** | | | | | |
| Submit 35% Design for Review - Groundwater Project A | 09-Jun-10 | 09-Jun-10 | 0 | 17-Jul-09 | -223 |
| Submit 65% Design for Review - Groundwater Project A | 07-Sep-10 | 07-Sep-10 | 0 | 18-Dec-09 | -180 |
| **CUW30102 San Francisco Groundwater Supply** | | | | | |
| **Environmental Review** | | | | | |
| Publish Draft EIR - Groundwater Project B | 13-Jul-10 | 13-Jul-10 | 0 | 15-Jul-10 | 2 |
| **Design** | | | | | |
| Submit 35% Design for Review #1 - Lake Merced, S. Sunset, | 29-Apr-09 | 29-Apr-09A | 0 | 17-Jun-10 | |
| All Phase 1 Test Wells Complete #1 - Lake Merced, S. Sunset | 31-Jul-09 | 31-Jul-09 | 0 | 16-Aug-10 | 260 |
| 35% Design - Arts Commission Phase 1 Review #1 - Lake Mo | 17-Aug-09 | 17-Aug-09 | 0 | 16-Aug-10 | 249 |
| Submit 65% Design for Review #1 - Lake Merced, S. Sunset, | 28-Aug-09 | 28-Aug-09 | 0 | 16-Aug-10 | 240 |
| All Phase 2 Test Wells Complete #2 - 4th Well Stations & Pip | 17-Nov-09 | 17-Nov-09 | 0 | 20-Nov-09 | 3 |
| Submit 95% Design for Review #1 - Lake Merced, S. Sunset, | 09-Feb-10 | 09-Feb-10 | 0 | 26-Jan-11 | 240 |
| Submit 35% Design for Review #2 - 4th & Additional Well St | 17-Mar-10 | 17-Mar-10 | 0 | 21-Oct-10 | 152 |



## KEY MILESTONE REPORT - ROLLING SIX QUARTERS (04/05/09- 09/30/10)

| Activity Name | Approved Date | Current Forecast | Variance | Current Late Date | Total Float |
|---|---|---|---|---|---|
| Submit 65% Design for Review #2 - 4th & Additional Well St | 19-May-10 | 19-May-10 | 0 | 29-Dec-10 | 152 |
| Submit 95% Design for Review #2 - 4th & Additional Well St | 23-Jul-10 | 23-Jul-10 | 0 | 28-Apr-11 | 190 |
| **CUW30201 San Francisco Westside Recycled Water** | | | | | |
| **Environmental Review** | | | | | |
| Issue NTP - EIR Consultant | 13-Apr-09 | 13-Apr-09A | 0 | 12-Aug-09 | |
| **Design** | | | | | |
| Submit 10% Design for Review - Recycled Water SF | 25-Sep-09 | 25-Sep-09 | 0 | 03-Nov-09 | 26 |
| Submit 35% Design for Review - Recycled Water SF | 17-Feb-10 | 17-Feb-10 | 0 | 25-Mar-10 | 26 |
| Submit 65% Design for Review - Recycled Water SF | 09-Jul-10 | 09-Jul-10 | 0 | 16-Aug-10 | 26 |



# APPENDIX E COST VARIANCE OF WSIP LOCAL PROJECTS

| Projects | 2009 Approved Budget | Current Forecast | Variance |
|---|---|---|---|
| CUW33301 - Mount Davidson Tank Seismic Upgrade | $2,894,000 | $2,894,000 | - |
| CUW33801 - La Grande Pump Station Upgrades | $7,205,000 | $7,205,000 | - |
| CUW33901 - Potrero Heights Pump Station Upgrades (Completed) | $606,000 | $606,000 | - |
| CUW34001 - Vista Francisco Pump Station Upgrades | $6,951,000 | $6,951,000 | - |
| **Pipeline / Valves** | | | |
| CUW30401 - North University Mound System Upgrade | $12,850,000 | $12,850,000 | - |
| CUW30801 - Key Motorized and Other Critical Valves (Completed) | $10,985,000 | $10,985,000 | - |
| CUW31101 - Sunset Circulation Improvements (Completed) | $6,984,000 | $6,984,000 | - |
| CUW31201 - Lincoln Way Transmission Line | $13,950,000 | $13,950,000 | - |
| CUW31301 - Noe Valley Transmission Main, Phase 2 | $7,382,000 | $7,382,000 | - |
| CUW31501 - East / West Transmission Main | $28,600,000 | $28,600,000 | - |
| CUW31601 - Fulton @ Sixth Ave - 30" Main Replacement (Completed) | $4,708,000 | $4,708,000 | - |
| **Miscellaneous** | | | |
| CUW30301 - Vehicle Service Facility Equipment Safety Upgrade | $4,461,000 | $4,461,000 | - |
| CUW30501 - Fire Protection @ CDD (Completed) | $1,675,000 | $1,675,000 | - |
| **Water Supply** | | | |
| CUW30101 - Lake Merced Water Level Restoration | $32,668,000 | $32,668,000 | - |
| CUW30102 - San Francisco Groundwater Supply | $38,700,000 | $43,417,000 | $4,717,000 |
| CUW30201 - San Francisco Westside Recycled Water | $125,923,000 | $125,923,000 | - |
| CUW30202 - Recycled Water Project - Pacifica (Closed) | $348,000 | $348,000 | - |
| CUW30204 - Harding Park Recycled Water | $9,612,000 | $9,612,000 | - |
| CUW30205 - San Francisco Eastside Recycled Water | $22,900,000 | $22,900,000 | - |
| CUW39001 - SF Bay Area Desalination Plant (Closed) | $938,000 | $938,000 | - |

# APPENDIX D SFPUC WATER SUPPLY AVAILABILITY STUDY (OCTOBER 2009)

# FINAL

# Water Supply Availability Study

# for

# City and County of San Francisco

## Prepared for:

San Francisco Public Utilities Commission
Water Enterprise

## October 2009

Prepared by:

1410 Rocky Ridge Drive, Suite 190
Roseville, CA 95661
916.782.7275

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# SUMMARY AND FINDINGS

## Summary

In an effort to streamline the water supply planning process within the City and County of San Francisco (San Francisco or City), the San Francisco Public Utilities Commission (SFPUC) adopted a resolution in 2002 and 2006 to allow for all development projects requiring a Water Supply Assessment (WSA) under Water Code Section 10910 et seq. to rely solely on the adopted Urban Water Management Plan (UWMP) without having to go through the process of preparing individual WSAs. SB 610 provides a nexus between the regional land use planning process and the environmental review process. The core of this law is an assessment of whether available water supplies are sufficient to serve the demand generated by a project, as well as the reasonably foreseeable cumulative demand in the region over the next 20 years under a range of hydrologic conditions.

The San Francisco Planning Department (SF Planning) and the San Francisco Redevelopment Agency are currently engaged in planning for various proposed land development projects throughout San Francisco that go beyond those future developments considered in the 2005 UWMP update. As a result of these new developments, the SFPUC concluded that its 2005 UWMP no longer accounted for every project requiring a WSA (qualifying project) within San Francisco. Therefore, during this interim period until the 2010 UWMP is prepared, any qualifying projects not accounted in the 2005 UWMP will require preparation of a WSA per Water Code Sections 10910 – 10915 that considers the SFPUC's current and projected supplies when compared to projected demands associated with new growth not covered in the 2005 UWMP.

This Water Supply Availability Study (Study) was developed as an interim period study and follows the format of a WSA. The Study captures the most current water supply planning and demand information, analyzes the various projected change in water demands associated with each qualifying project within San Francisco, evaluates overall supply and demand, assesses the sufficiency of supply, and prepares a conclusion based on the analysis. Upon completion of the Study, a WSA for each qualifying project can rely on the information and conclusions of this Study.

## Findings

The 2009 SF Planning projections result in a Retail demand in 2030 of 93.42 mgd (Section 5.0), which is only slightly greater than the 2030 demand estimates projected in the 2005 UWMP. This increase, however, does not change the results of the 2005 UWMP. The SFPUC can still meet the current and future demand of its Retail customers in years of average or above-average precipitation. During a multiple dry year event;[1] however, it is possible that the SPFUC will not be able to meet 100 percent of the Retail demand in 2030. This Study shows the results of implementation of SFPUC's local supply reliability improvements under all hydrologic

1 Multiple dry-year event is defined as a three-year hydrologic condition of below-normal rainfall per the Urban Water Management Planning Act.

conditions beginning in 2010 and extending to 2030. The ability to meet the demand of the Retail customers is in large part due to the development of 10 mgd of local supplies in the City through implementation of the Water Supply Improvement Program (WSIP). These addition sources of groundwater, recycled water, and conservation supplies are essential to provide the City with adequate supply in dry year periods, as well as improving supply reliability during years with normal precipitation.

In years with normal or above-normal precipitation, the City has sufficient supplies to serve its Retail customers. As shown in Table 6-1 (Section 6.0), the supply shortfall shown in 2010 is the result of reducing the Regional Water System (RWS) supply to 81 mgd per the condition of the Phased WSIP Variant, without full development of the additional 10 mgd of additional local supplies available in 2015. However, Retail demand is currently lower than projected 2010 demand of 91.81 mgd – demand in Fiscal Year 2007-2008 was 83.9 mgd.

During a multiple dry-year event as shown in Table 6-1, it is possible that the SFPUC will not be able to meet the full demands of its Retail customers in 2030, and will therefore have to impose reductions on its Retail supply. Under the Water Supply Allocation Plan (WSAP), Retail customers would experience no reduction in RWS deliveries within a 10 percent RWS shortage. However, during a 20 percent system-wide shortage, the Retail customers would experience a 1.9 percent reduction in Retail deliveries. This difference is due to the development of the additional 10 mgd of local supplies in the Retail service area. These additional local supplies are not subject to a reduction under the WSAP, as the WSAP only allocates water from the RWS.

The qualifying projects (Candlestick Point-Hunters Point Shipyard Phase II (CP-HPS II), Treasure Island-Yerba Buena Island (TI-YBI), and Parkmerced) anticipate developing new recycled water projects to help offset potable demand. These new projects could produce up to 1.5 mgd of recycled water. By reducing potable water demand through the use of recycled water, these projects have the ability to eliminate the City's overall water shortage during multiple dry year periods.

Regarding the availability of water supplies to serve the City, beginning in 2015 the SFPUC finds as follows:

- In years of average and above-average precipitation and including development of SFPUC's local WSIP water supply sources the SFPUC has adequate supplies to serve 100 percent of normal, single dry and multiple dry year demand up to 2030.[2]
- In multiple-dry-year events after 2030, when the SFPUC imposes reductions in its supply, the SFPUC has in place the WSAP and RWSAP to balance supply and demand.

2 The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).

- If recycled water is implemented as proposed at each of the major development project sites, then it is assumed that potable water demands for the City can decrease by up to 1.5 mgd; thereby, eliminating potential multiple dry-year deficit after 2030.
- With the WSAP and Retail Water Supply Allocation Plan (Section 4)in place, and the addition of local WSIP supplies, the SFPUC finds it has sufficient water available to serve the Retail customers including the demand of its Retail existing customers and planned future uses.

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# 1.0 INTRODUCTION

## *1.1 Purpose*

In an effort to streamline the water supply planning process within the City and County of San Francisco (San Francisco or City), the San Francisco Public Utilities Commission (SFPUC) adopted a resolution in 2002 and 2006 to allow for all development projects requiring a Water Supply Assessment (WSA) under SB 610 to rely solely on the adopted Urban Water Management Plan (UWMP)[3] without having to go through the process of preparing individual WSAs. SB 610 Water Code Section 10910 et seq. provides a nexus between the regional land use planning process and the environmental review process. The law also reflects the growing awareness of the need to incorporate water supply and demand analysis at the earliest possible stage in the land use planning process. The core of this law is an assessment of whether available water supplies are sufficient to serve the demand generated by a project, as well as the reasonably foreseeable cumulative demand in the region over the next 20 years under a range of hydrologic conditions.

The City of San Francisco Planning Department (SF Planning) and the San Francisco Redevelopment Agency are currently engaged in planning for various proposed land development projects that go beyond those future developments considered in the 2005 UWMP update. These developments, which include the Candlestick Point-Hunters Point Shipyard Phase II project (CP-HPS II), the Treasure Island-Yerba Island project (TI-TBI) and the Parkmerced project, hereinafter referred to as Projects, along with additional development throughout San Francisco account for 29,787 new dwelling units in 2030. As proposed, the Projects would contribute 27,400 new dwelling units to San Francisco's housing inventory. Additional development throughout the City accounts for the remaining 2,387 new dwelling units hereinafter referred to as Incremental Growth.

As a result of these new developments, the SFPUC concluded that its 2005 UWMP no longer accounted for every project requiring a WSA (qualifying project) within San Francisco. The SFPUC will not be preparing an updated UWMP until 2010. Therefore, during this interim period, any qualifying projects not accounted in the 2005 UWMP will require preparation of a WSA per Water Code Sections 10910 – 10915 that documents the SFPUC's current and projected supplies when compared to projected demands associated with new growth not covered in the 2005 UWMP.

The SFPUC determined that a WSA for the entire City and County service area, prepared pursuant to Water Code Sections 10910-10915, is the preferred method to evaluate supply and demands over a 20-year planning horizon. However, the Water Code Sections pertain to WSAs for qualifying projects, whereas the SFPUC needs a report to document its current and

3 California law requires that UWMPs be prepared and submitted in years ending with fives (5) and zeros (0). Pursuant to Water Code Section 10644(a), the SFPUC prepared and adopted its UWMP in 2005. The next UWMP is due prior to December 31, 2010.

projected supplies when compared to projected demands associated with new growth not covered in the 2005 UWMP. Therefore, this Water Supply Availability Study (Study) was developed and modeled on the format of a WSA. The Study captures the most current water supply planning and demand information, analyzes the various projected change in water demands associated with each qualifying project within San Francisco, evaluates overall supply and demand, assesses the sufficiency of supply, and prepares a conclusion based on the analysis. Upon completion of the Study, a WSA for each qualifying project can rely on the information and conclusions of this Study.

## *1.2 Previous SFPUC Water Resource Studies*

In recent years, the SFPUC has been engaged in numerous water resource planning efforts focused on regional and local supplies options and demand management measures, which could potentially reduce the amount of water the SFPUC imports through the Regional Water System (RWS) to meet its Retail water demands. The current status of major local water supply planning efforts is summarized below:

- **San Francisco Retail Water Demands and Conservation Potential**: In November 2004, the SFPUC prepared the "City and County of San Francisco Retail Water Demands and Conservation Potential" study (Demand Report) to project SFPUC future Retail water demands through the year 2030. The study employed a disaggregated water use forecasting procedure, drawing from actual water use data, and reflects current and projected demographics and employment data, changes in use due to existing plumbing codes, and water use trends. The study also identified water savings and implementation costs associated with a number of water conservation measures. Much of the methodologies in the Demand Report became the backbone of the demand analysis used in the SFPUC's 2005 UWMP.

- **Groundwater Planning**: In April 2005, the SFPUC completed the Final Draft North Westside Basin Groundwater Management Plan (GWMP), which identified opportunities for increasing groundwater production in San Francisco.

- **Recycled Water Master Plan Update**: The SFPUC prepared the 2006 Recycled Water Master Plan for the City and County of San Francisco (RWMP). The plan provided guidance for San Francisco in the development of recycled water projects within the City and County. The 2006 RWMP included an assessment of potential recycled water users City-wide and focused on identifying future recycled water projects in the City.

- **Urban Water Management Plan**: The 2005 UWMP addressed SFPUC's Retail water needs and evaluated sources of water supply, described efficient uses of water, demand management measures, and implementation strategies. The projections in the UWMP employed the demand and conservation estimates contained in the Demand Report, and the potential for groundwater and recycled water developed in the aforementioned studies to help in meeting projected demands. For consistency with the UWMP demand analysis, this Study used some of the same demand methodologies as presented in Section 5.2 of this Study.

- **Sewer Master Plan**: The SFPUC is preparing a Sewer System Master Plan (SSMP). The SSMP will present a long-term strategy for the management of the City's wastewater and storm water and identify capital improvements to be implemented over the next 25 to 30 years. The development of the SSMP will also incorporate proposed recycled water projects in the area. The identification and evaluation of potential wastewater management alternatives include an assessment of opportunities to implement recycled water projects to supply potential recycled water users identified in the 2006 RWMP. Environmental review of the Draft SSMP is anticipated to be complete in 2011.

- **Diversifying Retail Water Supply Portfolios**: In May 2006, the SFPUC prepared the "Diversifying San Francisco's Retail Water Supply Portfolio: Technical Memorandum". The study brought together planning data from existing planning projects, such as the North Westside Basin Groundwater Management Plan and the Recycled Water Master Plan, and summarized the potential local water supply options for San Francisco (including recycled water, groundwater, conservation and desalination projects). The memo also presented the implications of implementing different combinations of these local supply options, in terms of costs, ratepayer impacts and drought impact.

- **Water System Improvement Program (WSIP)**: On October 30, 2008, SFPUC certified the Final PEIR for the WSIP, a multiple year, system-wide capital improvements program. Many aspects of the WSIP are rooted in the 2000 Water Supply Master Plan and various water system vulnerability studies. The WSIP investigated the potential options of developing local water resources such as water recycling, groundwater, desalination and improved conservation to meet SFPUC purchase requests or demands.

## *1.3 Study Outline*

This Study is an assessment of whether available water supplies are sufficient to serve the SFPUC's existing and planned Retail water system future uses within San Francisco, including agricultural and manufacturing uses, over the next 20 years under a range of hydrologic conditions. This Study employs the same disaggregated water use forecasting procedures as the Demand Report but incorporates an update of the end-use numbers presented in the Demand Report based on updated housing and employment projections.

This document is divided into six sections as follows:

1. Introduction
2. Water Supply
3. Potential Impact of Climate Change on SFPUC Supply
4. Drought Planning and Water Supply Reliability

5. San Francisco Growth Projections and Water Demand Analysis

6. Supply and Demand Comparison and Conclusion

# 2.0 WATER SUPPLY

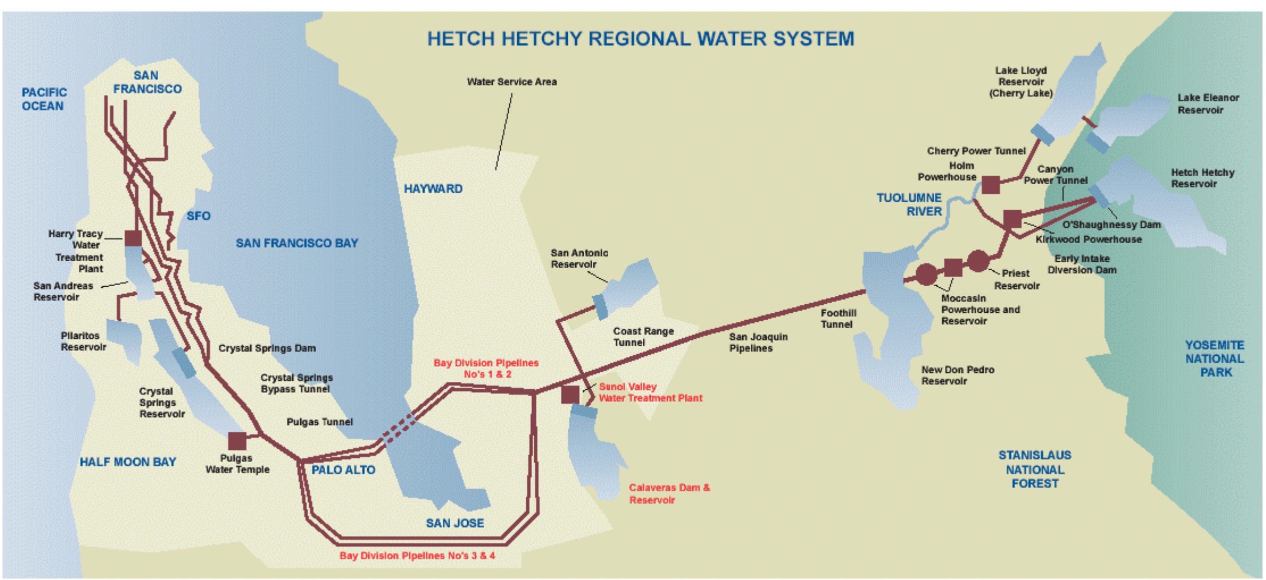
This section reviews San Francisco's existing and projected water supplies. The Regional Water System (RWS) is owned and operated by the City and County of San Francisco, under direction of the SFPUC. Historically, approximately 96 percent of the SFPUC's Retail water demands have been met through deliveries from the RWS. A small portion of San Francisco's water supply portfolio is produced through local groundwater and secondary treated recycled water. The groundwater is used primarily for irrigation at local parks and on highway medians. The recycled water is used mostly at municipal facilities for wastewater treatment process water, sewer box flushing and similar wash down operations.

In 1934, San Francisco combined the Hetch Hetchy system and Spring Valley system to create the SFPUC RWS. The rights to local diversions were originally held by the Spring Valley Water Company, which was formed in 1862.

The RWS currently delivers an annual average of approximately 265 mgd to 2.5 million users in Tuolumne, Alameda, Santa Clara, San Mateo, and San Francisco counties. The RWS is a complex system, shown in Figure 2-1, and supplies water from two primary sources:

- Tuolumne River through the Hetch Hetchy Reservoir, and
- Local runoff into reservoirs in Bay Area reservoirs in the Alameda and Peninsula watersheds.

**Figure 2-1: Regional Water Supply System**



Water from Hetch Hetchy Reservoir, through the Hetch Hetchy facilities represents the majority of the water supply available to the SFPUC. On average, the Hetch Hetchy Project provides over 85 percent of the water delivered to the Bay Area. During droughts the water received from the Hetch Hetchy system can amount to over 93 percent of the total water delivered.

Bay Area reservoirs provide on average approximately 15 percent of the water delivered by the SFPUC RWS. The local watershed facilities are operated to conserve local runoff for delivery. On the San Francisco Peninsula, the SFPUC utilizes Crystal Springs Reservoir, San Andreas Reservoir, and Pilarcitos Reservoir to capture local watershed runoff. In the Alameda Creek watershed, the SFPUC constructed the Calaveras Reservoir and San Antonio Reservoir. In addition to capturing runoff, San Antonio, Crystal Springs, and San Andreas reservoirs also provide storage for Hetch Hetchy diversions. The local watershed facilities also serve as an emergency water supply in the event of an interruption to Hetch Hetchy diversions.

## *2.1 Water Rights*

The City and County hold pre-1914 appropriative water rights to store and deliver water from the Tuolumne River in the Sierra Nevada and locally from the Alameda and Peninsula watersheds. The City and County also divert and store water in the San Antonio Reservoir under an appropriative water right license granted by the State Water Resources Control Board (SWRCB) in 1959.

Appropriative water rights allow the holder to divert water from a source to a place of use not connected to the water source. These rights are based on seniority and use of water must be reasonable, beneficial, and not wasteful. In 1914, California established a formal water rights permit system, which is administered by the SWRCB. The SWRCB has sole authority to issue new appropriative water rights but cannot define property rights created under a pre-1914 appropriative water right.

The 1912 Freeman Report identified the ultimate diversion rate from the Tuolumne River to the Bay Area as 400 mgd and the City used this as the basis for designing the export capacity of the Hetch Hetchy project. The City has sufficient water rights for current diversions and the ultimate planned diversion rate of the Hetch Hetchy Project.

The federal Raker Act, enacted on December 19, 1913, grants to the City certain rights-of-way and public land use on federal property in the Sierra Nevada Mountains to construct, operate and maintain reservoirs, dams, conduits and other structures necessary or incidental to developing and using water and power. It also imposes restrictions on the City's use of the Hetch Hetchy Reservoir, including (among others) the requirement that the City recognize the senior water rights of the Turlock and Modesto Irrigation Districts (TID and MID) to divert water from the Tuolumne River. Specifically, the Raker Act requires the City to bypass certain flows through its Tuolumne River reservoirs to TID and MID for beneficial use. By agreement, the City, TID and MID have supplemented these Raker Act obligations to increase the TID and MID entitlements to account for other senior Tuolumne River water rights and allow the City to "pre-pay" TID and MID their entitlement by storing water in the Don Pedro water bank. The

City is required to bypass inflow to TID and MID sufficient to allow them to divert 2,416 cfs or natural daily flow, whichever is less, at all times (as measured at La Grange), except for April 15 to June 13, when the requirement is 4,066 cfs or natural daily flow as measured at La Grange, whichever is less.

## *2.2 Current Water Supply Sources*

### 2.2.1 The Regional Water System

The RWS, as described above, provides nearly 96% of San Francisco's Retail water supplies from the Hetch Hetchy Reservoir and local Bay Area reservoirs in the Alameda and Peninsula watersheds. On average, the Hetch Hetchy Reservoir provides over 85 percent of the water delivered and Bay Area reservoirs provide approximately 15 percent of the water delivered. The RWS delivers an annual average of 265 mgd – 81 mgd serves the Retail customers within the City and County of San Francisco and the other 184 mgd is delivered to the Wholesale suburban customers on the San Francisco Bay Peninsula.

### 2.2.2 Local Groundwater

San Francisco overlies all or part of seven groundwater basins. These groundwater basins include the Westside, Lobos, Marina, Downtown, Islais Valley, South and Visitation Valley basins. The Lobos, Marina, Downtown and South basins are located wholly within the City limits, while the remaining three extend south into San Mateo County. The portion of the Westside Basin aquifer located within San Francisco is commonly referred to as the North Westside Basin. With the exception of the Westside and Lobos basins, all of the basins are generally inadequate to supply a significant amount of groundwater for municipal supply due to low yield.

Early in its history, San Francisco made significant use of local groundwater, springs, and spring-fed surface water. However, after the development of surface water supplies in the Peninsula and Alameda watersheds by Spring Valley Water Company and the subsequent completion of the Hetch Hetchy Reservoir and aqueduct in the 1930's, the municipal water supply system has relied almost exclusively on surface water from local runoff, the Alameda and Peninsula watersheds, and the Tuolumne River watershed. Local groundwater use, however, has continued in the City primarily for irrigation purposes. The San Francisco Zoo and Golden Gate Park use groundwater for non-potable purposes.

About one mgd of groundwater is delivered to Castlewood Country Club from well fields operated by the SFPUC in Pleasanton and drawn from the Central Groundwater Sub Basin in the Livermore/Amador Valley. These wells are metered and have been in operation for several decades. For purposes of water accounting and billing, these deliveries to Castlewood are accounted for as part of San Francisco's Retail Customer base.

### 2.2.3 Local Recycled Water

From 1932 to 1981, San Francisco's McQueen Treatment Plant provided recycled water to Golden Gate Park for irrigation purposes. Due to changes in regulations the City closed the

McQueen plant and discontinued use of recycled water in Golden Gate Park. Currently in San Francisco, disinfected secondary-treated recycled water from the SFPUC's Southeast Water Pollution Control Plant is used on a limited basis for wash-down operations and is provided to construction contractors for dust control and other nonessential construction purposes. Current use of recycled water for these purposes in San Francisco is less than one mgd.

### 2.2.4 Local Water Conservation

The SFPUC is committed to demand-side management programs and San Francisco's per capita water use has dropped by about one-third since 1977 in part due to these programs. The first substantial decrease came following the 1976-77 drought in which gross per capita water use dropped from 160 to 130 gpcd. Despite continuous growth in San Francisco since then, water demands have remained lower than pre-drought levels.

A second substantial decrease in water use within San Francisco occurred as a result of the 1987-1992 drought when a new level of conservation activities resulted in further water use savings. It is anticipated that through the continuation and expansion of these programs, per capita water use will continue to decrease into the future. Current gross per capita water use within San Francisco is 91.5 gallons per capita per day (gpcd) with residential water use calculated to be approximately 57 gpcd, the lowest use of any major urban area in California.

The SFPUC's demand management programs range from financial incentives for plumbing devices to improvements in the distribution efficiency of the system. The conservation programs implemented by the SFPUC are based on the California Urban Water Conservation Council's list of fourteen Best Management Practices identified by signatories of the Memorandum of Understanding Regarding Urban Water Conservation in California, executed in 1991.

## *2.3 Water System Improvements and New Supply Reliability*

To ensure that the future water needs of its Retail and wholesale customers will be met in a more reliable and sustainable manner, the SFPUC has undertaken water supply projects in the Water System Improvement Program (WSIP) to improve dry-year supplies, and is diversifying San Francisco's water supply portfolio through the development of local water supplies such as increasing recycled water and groundwater production, and bolstering water conservation. Many of the water supply and reliability projects evaluated in the WSIP were originally put forth in SFPUC's Water Master Plan (2000), then summarized in the 2005 UWMP and then investigated further in a Technical Memorandum Diversifying San Francisco's Retail Water Supply Portfolio (May 2006). In addition, specific water resource reports were prepared and released as well. Specifically, in 2005, SFPUC prepared a Recycled Water Master Plan, which updated the 1996 Recycled Water Master Plan and also prepared the North Westside Basin Groundwater Management Plan. Water supply elements of the WSIP are summarized below. The WSIP and its Program Environmental Impact Report are available for review at www.sfwater.org and www.sfgov.org. Sections of the WSIP Phased Variant to support the summaries in this Study are appended hereto.

### 2.3.1 Water System Improvement Program and the Phased WSIP Variant

The WSIP is a multi-billion dollar, multi-year, capital program to upgrade the RWS. The program will deliver improvements that enhance the SFPUC's ability to provide reliable, affordable, high quality drinking water to its 27 wholesale customers and regional Retail customers in Alameda, Santa Clara, and San Mateo counties, and to 800,000 Retail customers in San Francisco, in an environmentally sustainable manner.

As required under CEQA, SF Planning prepared a Program Environmental Impact Report (PEIR) for the WSIP. The PEIR evaluated the potential environmental impacts of the proposed WSIP and identified potential mitigations to those impacts. The PEIR also evaluated several alternatives to meet the SFPUC service area's projected increase in water demand between now and 2030. The water supply improvement options investigated included 10 alternatives using various water supply combinations from the local watersheds; the Tuolumne and Lower Tuolumne; ocean desalination; and additional recycled water, groundwater, and conservation.

The PEIR was certified by the SF Planning Commission on October 30, 2008. On the same day the SFPUC adopted the Phased WSIP Variant option.

#### *2.3.1.1.* Phased WSIP Variant

At the request of the SFPUC, SF Planning studied the Phased WSIP Variant as part of the environmental analysis. The SFPUC identified this variant in order to consider a program scenario that involved full implementation of all proposed WSIP facility improvement projects to insure that the public health, seismic safety, and delivery reliability goals were achieved as soon possible, but phased implementation of a water supply program to meet projected water purchases through 2030. Deferring the 2030 water supply element of the WSIP until 2018 would allow the SFPUC and its wholesale customers to focus first on implementing additional local recycled water, groundwater, and demand management actions while minimizing additional diversions from the Tuolumne River.

The Phased WSIP Variant establishes a mid-term planning milestone in 2018 when the SFPUC would reevaluate water demands through 2030 in the context of then-current information, analysis and available water resources. The SFPUC currently delivers on an annual average approximately 265 million gallons of water per day from local watersheds (Peninsula and Alameda Creek) and the Tuolumne River Watershed. By 2030, demand on the SFPUC system is expected to increase to an annual average of 300 million gallons of water per day. The Phased WSIP Variant would meet the projected 2018 purchase requests of 285 mgd from the RWS by capping purchases from the watersheds at 265 mgd; the remaining 20 mgd would be met through water efficiencies and conservation, water recycling and local groundwater use—10 mgd by Wholesale Customers and 10 mgd in the City and County. Before 2018, the SFPUC and the Wholesale Customers will engage in a new planning process to reevaluate water system demands and supply options, including conducting additional studies and environmental reviews necessary to address water supply needs after 2018.

The Phased WSIP Variant includes the following key program elements:

- Full implementation of all WSIP facility improvement projects.
- Water supply delivery to RWS customers through 2018 only of 265 mgd average annual target delivery originating from the watersheds. This includes 184 mgd for the Wholesale Customers and 81 mgd for the Retail Customers.
- Water supply sources include: 265 mgd average annual from the Tuolumne River and local watersheds and 20 mgd of water conservation, recycled water and local groundwater developed within SFPUC's service area (10 mgd Retail; 10 mgd wholesale).
- Dry-year water transfers of 2 mgd coupled with the Westside Groundwater Basin Conjunctive Use Project.
- Re-evaluation of 2030 demand projections, potential RWS purchase requests and water supply options by December 31, 2018 and a separate SFPUC decision in 2018 regarding RWS water deliveries after 2018.
- The ability to impose financial penalties is included in the new Water Supply Agreement to limit water sales to an average annual of 265 mgd from the watersheds.

The additional 10 mgd of supplies produced in San Francisco by implementation of the WSIP are considered secure and have been included in this Study. This Study assumes the WSIP local supplies will be in place in the timeframes stated in the SFPUC WSIP, with this assumption total Retail supplies increase to 94.50 mgd in 2015 and remain constant over the 20-year planning horizon. Projects related to these efforts are detailed below.

### 2.3.2 Local Groundwater Projects

#### *2.3.2.1.* San Francisco Groundwater Supply Project

The San Francisco Groundwater Supply Project would provide up to 4 mgd of local groundwater water to improve reliability during drought or maintenance conditions, as well as ensure that a reliable, high-quality source of water is available in the case of an earthquake or other emergency. The project proposes the construction of up to six wells and associated facilities in the western part of San Francisco to extract up to 4 mgd of groundwater water from the Westside Groundwater Basin for distribution in the City. The extracted groundwater, which would be used both for regular and emergency water supply purposes, would be disinfected and blended in small quantities with imported surface water before entering the municipal drinking water system. The environmental review for this project will begin in November 2009.

#### *2.3.2.2.* Lake Merced Water Level Restoration Project

The goal of the Lake Merced Water Level Restoration Project is to protect and balance the beneficial uses of Lake Merced by providing a more stable water level regime using groundwater and stormwater, rather than supplies provided through the RWS.

### 2.3.3 Local Recycled Water Projects

The proposed Westside, Harding Park and Eastside Recycled Water Projects would provide up to 4 mgd of recycled water to a variety of users in San Francisco. Recycled water will primarily be used for landscape irrigation, toilet flushing and industrial purposes. The Harding Park Project has completed environmental review, and the Westside Project will begin environmental review in late 2009 or early 2010.

The proposed Westside Project would bring recycled water from the proposed recycled water treatment facility in Golden Gate Park to the San Francisco Zoo, Golden Gate Park, and Lincoln Park Golf Course. Recycled water would be used for irrigation at all three sites; additionally, it would be used for non-potable uses in Golden Gate Park at the California Academy of Sciences. The proposed Harding Park Recycled Water Project would use available recycled water from the North San Mateo County Sanitation District (NSMCSD) located in Daly City, to irrigate Harding Park and Fleming Park golf courses in San Francisco. The SFPUC has partnered with the NSMCSD for this proposed project.

Currently, the SFPUC is conducting a recycled water demand assessment on the Eastside of San Francisco. The assessment examines the potential uses of recycled water for irrigation, toilet flushing, and commercial applications. The WSIP contains funding for planning, design, and environmental review for the San Francisco Eastside Recycled Water Project.

### 2.3.4 Local Water Conservation

The SFPUC has also increased its water conservation programs in an effort to achieve new water savings by 2018. The SFPUC's conservation program is based on the Demand Study (Section 1.2) that identified water savings and implementation costs associated with a number of water conservation and efficiency measures. The Demand Study evaluated the costs and benefits of implementing 48 different conservation measures using an end-use model. The results indicated that local conservation programs implemented through 2030 could cumulatively reduce Retail purchases from the SFPUC RWS by 4.5 mgd in year 2030. These new conservation programs include high-efficiency toilet replacement in low-income communities, plumbing retrofits in compliance with the 1992 California plumbing code and water efficient irrigation systems in municipal parks. Through its conservation program, the SFPUC anticipates reducing gross per capita consumption from 91.5 gpcd to 87.4 gpcd by 2018 for an average daily savings of nearly 4.0 mgd.

### 2.3.5 Summary of Local WSIP Water Supply Programs

As previously discussed, SFPUC anticipates that the expanded groundwater and recycled water production, and increased conservation programs will provide the City with an additional 10 mgd of local water supplies. As quantified in Table 2-1 with implementation of the WSIP, SFPUC expects to have in these local supplies in place by 2015. These programs and projects are reliable in all hydrologic conditions and are not subject to RWSAP reductions or curtailments.

**Table 2-1: WSIP Water Supply Sources (mgd)**

| WSIP Water Supplies | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| Groundwater | 0.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Recycled Water | 0.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Conservation | 0.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| **Total WSIP Local Supplies** | **0.0** | **10.0** | **10.0** | **10.0** | **10.0** |

### 2.3.6 Total SFPUC Retail Water Supplies

Table 2-2 summarizes SFPUC's total water supplies now and over the 20-year planning period. In 2010, prior to the development of the 10 mgd of local supplies, SFPUC can access an annual average 84.50 mgd from all sources discussed above. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.5 mgd. These supplies are assumed to be available in the quantities listed in Table 2-2. SFPUC intends to use these supplies to meet its Retail customer demands.

**Table 2-2: SFPUC Water Supplies 2010 - 2030**

| Current Water Supply Sources | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| SFPUC RWS (Surface water: Tuolumne River, Alameda & Peninsula) (1) | 81.0 | 81.0 | 81.0 | 81.0 | 81.0 |
| Groundwater Sources | | | | | |
| Groundwater (In-City Irrigation Purposes) | 2.5(2) | 0.5(3) | 0.5(3) | 0.5(3) | 0.5(3) |
| Groundwater at Castlewood(4) | 1.0(4) | 1.0(4) | 1.0(4) | 1.0(4) | 1.0(4) |
| Groundwater: Treated for Potable – Previously used for In-City Irrigation purposes(5) | 0.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| **Groundwater Subtotal** | **3.5** | **3.5** | **3.5** | **3.5** | **3.5** |
| **Current Water Supply Subtotal** | **84.5** | **84.5** | **84.5** | **84.5** | **84.5** |
| WSIP Water Supply Sources | | | | | |
| Groundwater Development: Potable from SF GWSP (Westside Groundwater Basin)(6) | 0.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Recycled Water Expansion Irrigation(7) | 0.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Supply Conservation Program | 0.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| **WSIP Supply Subtotal** | **0.0** | **10.0** | **10.0** | **10.0** | **10.0** |
| **Total Retail Supply (Current and WSIP Supplies)** | **84.5** | **94.5** | **94.5** | **94.5** | **94.5** |

(1) RWS surface water supplies are subject to reductions due to below-normal precipitation. This may affect dry year supplies - model shows supply reduction occurs in year 2 of multiple dry year event. (Source: SFPUC 2008 WSIP Phase Variant Supply limitation)

(2) Groundwater serves irrigation to Golden Gate Park, SF Zoo, and Great Highway Median. (Source: 2005 SFPUC UWMP Table 8B page 43)

(3) A Groundwater reserve of 0.5 mgd for irrigation purposes will remain as part of SFPUC's non-potable groundwater supply. (Source: SFPUC 2008 WSIP Phase Variant)

(4) Castlewood current and projected use remains unchanged over 20 year planning horizon. (Source: 2005 SFPUC UWMP Table 8B page 43)

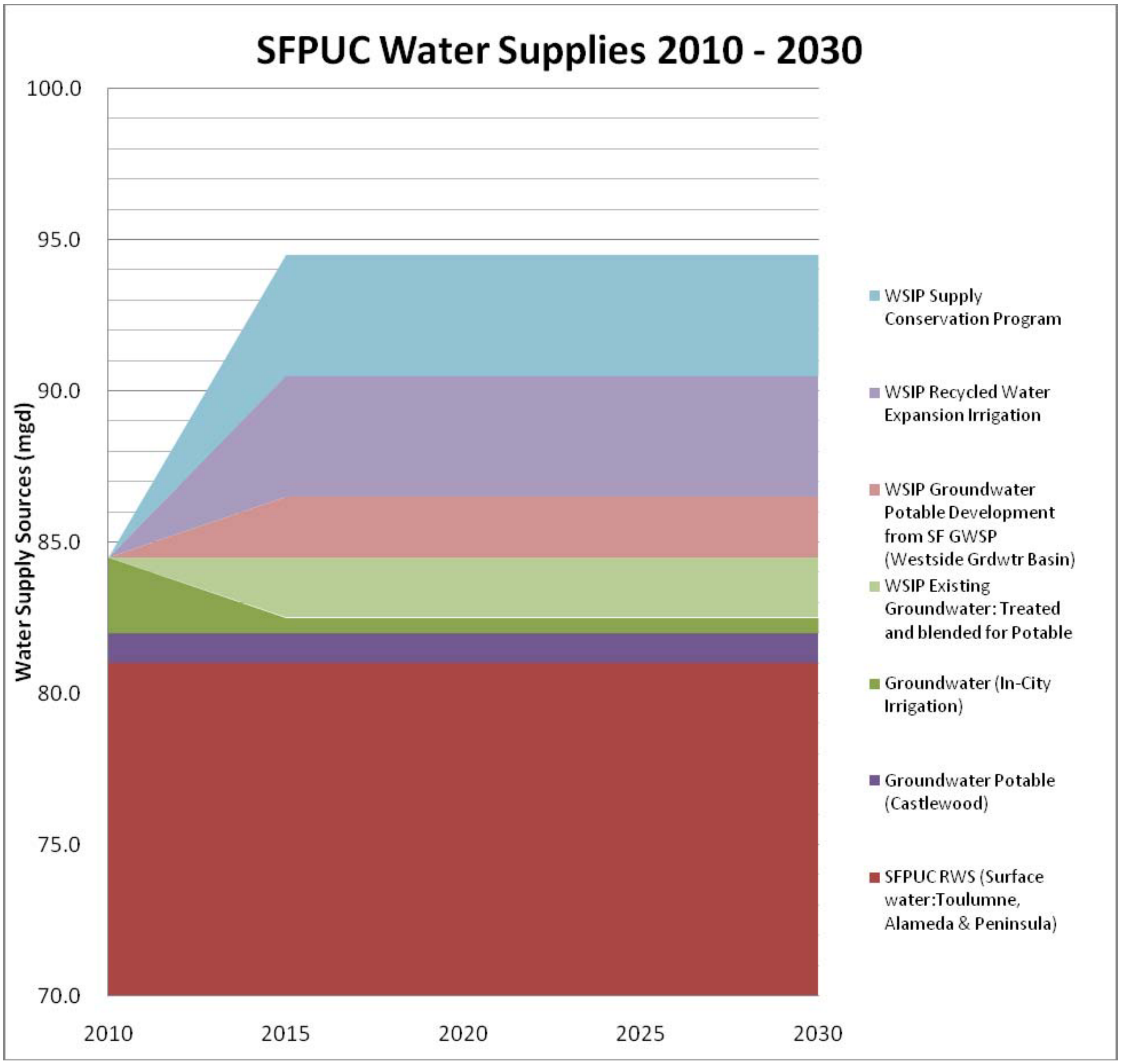
(5) 2.0 mgd of groundwater treated and blended for Potable water supply purposes. (Source: 2005 SFPUC UWMP Table 8B page 43)

(6) 2.0 mgd of new groundwater developed as part of the new local supply target. (Source: SFPUC 2008 WSIP Phase Variant Supply Target)

(7) 2.0 mgd of Recycled used for irrigation at Golden Gate Park, SF Zoo, Great Highway Median, and 2.0 mgd for other non-potable purposes. (Source: SFPUC 2008 WSIP Phase Variant Supply Target)

Figure 2-1 is a graphical representation of the SFPUC's current supply sources and the WSIP local supply sources. As shown in Figure 2-2, the supplies grow from 84.5 mgd in 2010 to 94.5 mgd as the WSIP local supplies are brought into the SFPUC Retail supply system. The figure shows the total supplies increasing in 2015 and holding constant over the 20-year planning horizon.

**Figure 2-2: SFPUC Water Supplies**




### 2.3.7 Dry Year Water Supply Projects

The WSIP water supply program includes development of dry-year supplies for the RWS. The PEIR included an analysis of dry-year water supply transfers from the senior water rights holders on the Tuolumne River (MID and TID); a groundwater conjunctive use project; and a regional desalination project. The latter two projects are described below. The SFPUC is investigating the possibility of a dry-year water transfer with MID and TID for 2 mgd in 2018. The WSIP provides funding for the Groundwater Storage and Recovery Project.

#### *2.3.7.1.* Groundwater Storage and Recovery Project

The proposed Regional Groundwater Storage and Recovery Project would balance the use of both groundwater and surface water to increase water supply reliability during dry years or in emergencies. The proposed project is located in San Mateo County and is sponsored by the SFPUC in coordination with its partner agencies, the California Water Service Company, City of Daly City and City of San Bruno. The partner agencies currently purchase wholesale surface water from the SFPUC and also independently operate groundwater production wells for drinking water and irrigation.

The proposed Regional Groundwater Storage and Recovery Project would extract groundwater from the South Westside Basin groundwater aquifer in San Mateo County. The project would consist of installing up to sixteen new recovery well facilities in northern San Mateo County to pump stored groundwater during a drought. During years of normal or heavy precipitation, the proposed project would provide surface water to the partner agencies in order to reduce the amount of groundwater pumped. Over time, the reduced pumping would result in the storage of approximately 61,000 acre-feet of water (more than the supply contained in the Crystal Springs Reservoir on the SFPUC Peninsula Watershed.) This would allow recovery of this stored water at a rate of up to 7.2 million gallons per day for a 7.5-year dry period. The water would be in compliance with the California Department of Public Health requirements for drinking water supplies. The proposed project would include construction of well pump stations, disinfection units, and piping. The proposed project is currently undergoing environmental review.

#### *2.3.7.2.* Desalination

The SFPUC's investigations of desalination as a water supply source have focused primarily on the potential for regional facilities. The proposed Bay Area Regional Desalination Project is a joint venture between the SFPUC, Contra Costa Water District, East Bay Municipal Utility District, and the Santa Clara Valley Water District.

The regional desalination project would provide an additional source of water during emergencies, provide a supplemental water supply source during extended droughts, allow other major water facilities to be taken out of service for maintenance or repairs, and increase supply reliability by providing water supply from a regional facility. The Bay Area Regional Desalination Project would have an ultimate total capacity of up to 65 mgd.[4]

4 EBMUD, "Desalination Project", http://www.ebmud.com/water_&_environment/water_supply/current_projects/desalination_project/default.htm, accessed July 30, 2009.

# 3.0 POTENTIAL IMPACT OF CLIMATE CHANGE ON SFPUC SUPPLY AVAILABILITY

The issue of climate change has become an important factor in water resources planning in the State, and it is being considered during planning for the RWS. There is evidence that increasing concentrations of greenhouse gases have caused and will continue to cause a rise in temperatures around the world, which will result in a wide range of changes in climate patterns. Moreover, there is evidence that a warming trend occurred during the latter part of the 20th century and will likely continue through the 21st century. These changes will have a direct effect on water resources in California, and numerous studies on climate change have been conducted to determine the potential impacts water resources. Based on these studies, climate change could result in the following types of water resource impacts, including impacts on the RWS and associated watersheds:

- Reductions in the average annual snowpack due to a rise in the snowline and a shallower snowpack in the low- and medium-elevation zones, such as in the Tuolumne River basin, and a shift in snowmelt runoff to earlier in the year,
- Changes in the timing, intensity, and variability of precipitation, and an increased amount of precipitation falling as rain instead of as snow,
- Long-term changes in watershed vegetation and increased incidence of wildfires that could affect water quality,
- Sea level rise and an increase in saltwater intrusion,
- Increased water temperatures with accompanying adverse effects on some fisheries,
- Increases in evaporation and concomitant increased irrigation need, and
- Changes in urban and agricultural water demand.

However, other than the general trends listed above, there is no clear scientific consensus on exactly how global warming will quantitatively affect State water supplies, and current models of State water systems generally do not reflect the potential effects of global warming.

The SFPUC staff performed an initial evaluation of the effect on the Regional Water System of a 1.5-degree Celsius (°C) temperature rise between 2000 and 2025. The temperature rise of 1.5°C is based on a consensus among many climatologists that current global climate modeling suggests a 3°C rise will occur between 2000 and 2050 and a rise of 6°C will occur by 2100. The evaluation predicts that an increase in temperature of 1.5°C will raise the snowline approximately 500 feet every twenty-five years. The elevation of the watershed draining into Hetch Hetchy Reservoir ranges from 3,800 to 12,000 feet above mean sea level, with about 87 percent of the watershed area above 6,000 feet. In 2000 (a normal hydrologic year in the 82-year period of historical record), the average snowline in this watershed was approximately 6,000 feet during the winter months. Therefore, the SFPUC evaluation indicates that a rise in temperature of 1.5°C between 2000 and 2025 will result in less or no snowpack between 6,000 and 6,500 feet and faster melting of the snowpack above 6,500 feet. Similarly, a temperature rise of 1.5°C between 2025 and 2050 will result in less or no snowpack between 6,500 and 7,000 feet and faster melting of the snowpack above 7,000 feet.

The SFPUC climate change modeling indicates that about 7 percent of the runoff currently draining into Hetch Hetchy Reservoir will shift from the spring and summer seasons to the fall and winter seasons in the Hetch Hetchy basin by 2025. This percentage is within the current interannual variation in runoff and is within the range accounted for during normal runoff forecasting and existing reservoir management practices. The additional change between 2025 and 2030 is not expected to be detectible. The predicted shift in runoff timing is similar to the results found by other researchers modeling water resource impacts in the Sierra Nevada due to warming trends associated with climate change.

Based on these preliminary studies and the results of literature reviews, the potential impacts of global warming on the RWS are not expected to affect the water system operations through 2030. SFPUC hydrologists are involved in ongoing monitoring and research regarding climate change trends and will continue to monitor the changes and predictions, particularly as these changes relate to water system operations and management of the RWS. The SFPUC has developed a workplan to further advance its research on the effects of climate change on the RWS.

# 4.0 DROUGHT PLANNING AND WATER SUPPLY RELIABILITY

The SFPUC water supply system reliability is expressed in terms of its ability to deliver water during droughts. Reliability is defined by the amount and frequency of water delivery reductions required to balance customer demands with available supplies in droughts. The SFPUC has a reliability goal of meeting dry-year delivery needs while limiting rationing to a maximum 20 percent system-wide reduction in water service during extended droughts.

The total amount of water the SFPUC has available to deliver to its Retail and wholesale customers during a defined period of time is dependent on several factors. These include the amount of water that is available to the SFPUC from natural runoff, the amount of water in reservoir storage, and the amount of water that must be released from the SFPUC's system for commitments to purposes other than customer deliveries, such as releases below Hetch Hetchy reservoir to meet the Raker Act and fishery purposes.

The SFPUC operates its system to optimize the reliability and quality of its water deliveries. Hetch Hetchy Reservoir operations are guided by two principal objectives: collection of Tuolumne River water runoff for diversion to the Bay Area; and fulfillment of the SFPUC's downstream release obligations. To conserve runoff, Hetch Hetchy Project reservoirs are drawn down beginning in early winter, relying on the recurrence and forecast of snow melt to guide drawdown releases. Similarly, the Regional Water System Bay Area reservoirs are operated to conserve watershed runoff. As such, reservoirs are drawn down during the winter period to capture storms and reduce the potential for spilling water out of the reservoirs. In the spring, excess Hetch Hetchy water supply (snowmelt) is transferred to three of the Bay Area reservoirs, capable of receiving the water, to fill any unused reservoir storage.

Prior to the late 1970's, droughts did not seriously affect the ability of the SFPUC to sustain full deliveries to its customers. However, as the 1987-1992 droughts progressed and reservoir storage continued to decline, it became apparent that continued full deliveries could not be sustained without the risk of running out of water before the drought ended.

To provide some level of assurance that water could be delivered continuously throughout a drought (although at reduced levels), the SFPUC adopted a drought planning sequence and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in SFPUC reservoirs. Each year, during the snowmelt period, the SFPUC evaluates the amount of total water storage expected to occur throughout the RWS. If this evaluation finds the projected total water storage to be less than an identified level sufficient to provide sustained deliveries during drought, the SFPUC may impose delivery reductions or rationing.

## 4.1 Water Shortage Allocation Plan (WSAP)

During a drought, it is expected that the Retail and wholesale customers would experience a reduction in the amount of water received from the RWS. The amount of this reduction has been dictated by existing contractual agreements between the SFPUC and the Wholesale Customers, as detailed in the existing WSAP. The WSAP provides specific allocations of available water between the Retail and wholesale customers collectively associated with different levels of system-wide shortages, as shown in Table 4-1.

**Table 4-1: WSAP Allocation**

| Level of System-Wide Reduction in Water Use Required | Share of Available Water | |
|---|---|---|
| | SFPUC Share | Wholesale Customers Share (collectively) |
| 5% or less | 35.5% | 64.5% |
| 6% through 10% | 36.0% | 64.0% |
| 11% through 15% | 37.0% | 63.0% |
| 16% through 20% | 37.5% | 62.5% |

In addition to providing an allocation method, the plan also includes provisions for transfers, banking and excess use charges.

Under the WSAP, SFPUC Retail customers would experience no reduction in deliveries at a 10 percent shortage. However, during a 20 percent system-wide shortage, the Retail customers would experience a 1.9 percent reduction in Retail deliveries. This assumes the full development of the additional 10 mgd of local WSIP supplies in the Retail service area. These 10 mgd of local supplies are not subject to reduction under the WSAP as the WSAP only allocates water supplies from the RWS. Table 4-2 shows SFPUC RWS Retail supply schedule during normal, single dry year, and multiple dry year periods.

The WSAP has been carried forward in the new Water Supply Agreement for system-wide shortages of up to 20 percent. For shortages in excess of this amount, the Water Supply Agreement provides that the SFPUC may allocate water in its discretion.

## 4.2 Retail Water Shortage Allocation Plan

San Francisco's Retail Water Shortage Allocation Plan (RWSAP) was adopted to formalize a three-stage program of action to be taken in San Francisco to reduce water use during a drought. In accordance with the RWSAP, prior to the initiation of any water delivery reductions in San Francisco, whether it be initial implementation of reduction delivery or increasing the severity of water shortage, the SFPUC would outline a drought response plan that would address the following: the water supply situation; proposed water use reduction objectives; alternatives to water use reductions; methods to calculate water use allocations and adjustments; compliance methodology and enforcement measures; and budget considerations.

**Table 4-2: 2005 – 2030 SFPUC Retail Allocations in Normal, Dry and Multiple Dry Years**

| | Normal Year | | Single Dry Year | | Multiple Dry Year Event[(2)] Year 1 | | Year 2 | | Year 3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | mgd | % | mgd | % | mgd | % | mgd | % | mgd | % |
| 2010[(1)] | 81.0 | 100 | 81.0 | 100.0 | 81.0 | 100.0 | 79.5 | 98.1 | 79.5 | 98.1 |
| 2015 | 81.0 | 100 | 81.0 | 100.0 | 81.0 | 100.0 | 79.5 | 98.1 | 79.5 | 98.1 |
| 2020 | 81.0 | 100 | 81.0 | 100.0 | 81.0 | 100.0 | 79.5 | 98.1 | 79.5 | 98.1 |
| 2025 | 81.0 | 100 | 81.0 | 100.0 | 81.0 | 100.0 | 79.5 | 98.1 | 79.5 | 98.1 |
| 2030 | 81.0 | 100 | 81.0 | 100.0 | 81.0 | 100.0 | 79.5 | 98.1 | 79.5 | 98.1 |

(1) In 2010 the Retail allocation of RWS supply is reduced to 81 mgd to reflect the Retail allocation under the 2018 Phased WSIP Variant. 10 mgd of recycled water, groundwater, and conservation will be implemented by 2015 to make up for the loss in RWS supply. The 10 mgd of local supply is not subject to reduction under the WSAP.

(2) Under the WSAP, the SFUPC Retail allocations at a 10 percent shortage are 85.86 mgd. However, due to the Phased WSIP Variant, only 81 mgd of RWS supply is shown. The remaining supply can be transferred from or to the Wholesale Customers under the terms of the Water Supply Agreement.

Source: San Francisco Public Utilities Commission. 2005. Urban Water Management Plan for the City and County of San Francisco. p. 54-57 and discussions with SFPUC staff.

This drought response will be presented at a regularly scheduled SFPUC Commission meeting for public input. The meeting will be advertised in accordance with the requirements of California Water Code Section 6066 of the Government Code, and the public will be invited to comment on the SFPUC's intent to reduce deliveries.

Depending on the level of water demand and the desired objective for water use reduction, one, two or all three stages of the RWSAP may be required.

Stage 1 (Voluntary)

- System-wide demand reductions of 5-10 percent experienced
- Voluntary rationing request of customers
- Customers are alerted to water supply conditions
- Remind customers of existing water use prohibitions
- Education on, and possible acceleration of, incentive programs

Stage 2 (Mandatory)

- System-wide demand reductions of 11-20 percent experienced
- All Stage 1 actions implemented
- All customers receive an "allotment" of water based on the Inside/Outside allocation method (based on base year water usages for each account)
- Water use above the "allocation" level will be subject to excess use of flow restrictor devices and shut-off of water

Stage 3 (Mandatory)

- System-wide demand reductions of 20 percent or greater experienced
- Same actions as in Stage 2 with further reduced allocations

# 5.0 SAN FRANCISCO GROWTH PROJECTIONS AND WATER DEMAND ANALYSIS

This section shows the calculated water demand projections for San Francisco based on recent housing and employment forecasts.

## *5.1 Revised City of San Francisco Growth Projections*

The SFPUC has recently evaluated projected demands and incorporated the updated San Francisco Planning projections for residential and non-residential growth contained in a memorandum from SF Planning to SFPUC dated July 9, 2009 (Appendix A). This analysis results in a 2030 growth projection that differs from the 2005 UWMP. Table 5-1 compares 2030 growth projections between the 2005 UWMP and the 2009 growth projections developed by the SF Planning department. As shown in Table 5-1 new residential growth is expected to increase by 29,787 units. The 27,400 new residential units proposed in three Projects account for the majority of new residential growth in 2030. In contrast, the 2009 employment projections result in net loss of 47,300 new employment opportunities in 2030.

**Table 5-1: 2030 SF Planning Projections for Households and Employment**

| Residential Units | | 2030 Projection |
|---|---|---|
| 2005 UWMP[1] | | 373,513 |
| 2009 SF Planning Projections[2] | | 403,300 |
| | **Net Change** | **29,787**[3] |
| **Non-Residential Population** | | **2030 Projection** |
| 2005 UWMP[4] | | 795,400 |
| 2009 SF Planning Projections[5] | | 748,100 |
| | **Net Change** | **-47,300** |

(1) 2005 Urban Water Management Plan residential projections were based on ABAG Projections 2002 and Citywide Policy Analysis and Planning, San Francisco Planning Department, Land Use Allocations 2002.

(2) 2009 Residential Projections were developed by the San Francisco Planning Department and designed to closely match the recently adopted ABAG Projections 2009 target, but taking into account local knowledge of projects currently in various stages of the entitlement process, commonly referred to as the Development Pipeline. (Appendix A)

(3) Of the new residential units the Projects account for 27,700 units and new incremental growth accounts for 2,387 units.

(4) 2005 Urban Water Management Plan non-residential projections were based on ABAG 2030 employment projections and linearly extrapolated for 2020 and 2030.

(5) Revised 2009 Non-Residential Projections were developed by the San Francisco Planning Department and based on ABAG 2009 Employment projections for 2030. (Appendix A)

### *5.1.1 2009 Residential Projections*

As stated previously, the SF Planning and the San Francisco Redevelopment Agency are currently engaged in planning for various proposed land development projects. These Projects, as well as Incremental Growth throughout San Francisco, account for 29,787 new dwelling units in 2030. As proposed, the Projects would contribute 27,400 new dwelling units to San Francisco's housing inventory. The Incremental Growth throughout the City accounts for the remaining 2,387 new dwelling units (Appendix B).

The updated 2030 City growth projection shown in Table 5-1 reflects an increase in residential households from the 2005 UWMP forecast but an overall decrease in non-residential (employment) population. As shown in Table 5-2, the residential growth at the Projects commences in 2015 with 6,850 new dwelling units and continues to grow to 27,400 in 2030, essentially growing by 6,850 over each five-year period. In addition, this Study also assumes that the incremental growth throughout San Francisco would occur in the same manner. As shown in Table 5-2, the incremental growth commences in 2015 with 597 new dwelling units and continues to grow to 2,387 in 2030, essentially growing by 597 over each five-year period.

**Table 5-2: Projects and Incremental Growth within San Francisco**

| Residential Units | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| Residential Units [1] | 344,306 | 351,608 | 358,910 | 366,211 | 373,513 |
| Residential Units for Projects[2] | 0 | 6,850 | 13,700 | 20,550 | 27,400 |
| Residential Units for Incremental Growth[3] | 0 | 597 | 1,194 | 1,790 | 2,387 |
| ***Subtotal (Projects and Incremental Growth)*** | | ***7,447*** | ***14,894*** | ***22,340*** | ***29,787*** |
| **Total New Residential Units** | **344,306** | **359,055** | **373,803** | **388,552** | **403,300** |

(1) 2005 UWMP residential unit projections shown in Table 5-1. Source: 2005 SFPUC UWMP Table 2, page 7
(2) Residential Units of Projects (CP-HPS II 10,500 units); (TI-YBI 8,000 units); (Parkmerced 8,900 total units)
(3) Incremental Growth accounts for 2,387 new units.

### *5.1.2 2009 Employment Projections*

The updated 2030 City growth projection shown in Table 5-1 reflects an increase in residential households from the 2005 UWMP forecast but an overall decrease in non-residential (employment) population. These changes mirror the changes in the Association of Bay Area Governments (ABAG) projections. ABAG projections are used for various planning purposes by many of the cities in the nine-county area covered by ABAG. ABAG publishes regional projections and employment and growth every two years. Projections developed after 2002 incorporate a fundamental shift in ABAG's projection methodology. Rather than taking existing local land use policy as a given (as had previously been the case), in the projections following the 2002 projections, ABAG assumes that local policy will be amended in the future to adopt "smart growth" principles. Specifically, the projections assume that higher density growth will be focused in urban core areas, and that more housing will be produced in those areas, compared to that previously assumed. The result of these assumptions is to increase the expected population in already developed areas. Another difference reflected in the later projections is a more current and accurate reflection of the internet industry (dot com era), as well as the effect of the current recession on employment projections.

Table 5-3 shows the progression of growth in employment opportunities forecasted in San Francisco based on SF Planning's 2009 Employment Projections (Appendix B). Beginning in 2015 employment is projected to increase to 719,145 jobs, and then by 2025 employment is expected to grow to 734,050 jobs. As projected, and shown in Table 5-3 employment in San Francisco is expected to reach 748,100 jobs.

**Table 5-3: Non-Residential Employment Projections**

| Non-Residential Employment Projections | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| SF Planning Employment Total[1] (jobs) | 712,145 | 719,447 | 726,749 | 734,050 | 748,100 |

(1) Table 5-1 2009 SF Planning Projections based on ABAG 2030 Employment projections

## *5.2 City of San Francisco Retail Water Demand Analysis*

Retail water demands in the 2005 UWMP were based on the findings of the Demand Report. The Demand Report analyzed water demand associated with each Retail customer sector and then forecasted demand over a 25-year planning horizon using data provided by the City, and the SFPUC. The demand projections were developed using a water use model, which initially established a base-year water demand at the end-use level (such as toilets, showerheads, other lavatory hardware and household fixtures), calibrated the model to initial conditions, and forecasted future water demand based on projected demand of existing water service accounts and future population growth.

This Study updates the 2005 UWMP water demand forecasts in 2010 through 2030 to reflect San Francisco's three major development Projects (CP-HPS II, TI-YBI, and Parkmerced) and incremental growth projected to occur throughout the City, and the 2009 San Francisco non-residential planning projections (based on ABAG 2009 Employment Projections) for 2030. Tables 5-4 and 5-5 show the results of the demand forecasts at the Project sites; anticipated incremental growth expected to occur throughout the City and growth in demand generated through employment opportunities (jobs).

### *5.2.1 Water Demand of Projects and Incremental Growth*

The Projects are proposed as mixed-use residential redevelopment projects within San Francisco. Each project sponsor provided land use plans or reports to the City that include residential unit counts, commercial spaces, and public facilities. These same plans and reports estimated potable water demand along with other land use information. Residential water demands for the Projects were provided to the City by the Project developers, and were developed using an end use model on a per-unit or per-employee basis. The Project demands were independently reviewed by PBS&J and the SFPUC as part of this Study, and appear consistent with the SFPUC demand estimates. See Appendix B for the methodology used in the Project demand estimates.

Upon buildout in 2030, these Projects represent the majority of new growth in San Francisco above the 2030 growth projected in the 2005 UWMP. As shown in Table 5-4, overall water demand at each of the Project sites is estimated at 1.99 mgd (CP-HPS II); 1.70 mgd (TI-YBI) and 0.98 mgd at Parkmerced. The CP-HPS II includes a number of different development scenarios, the estimated water demands of the three main CP-HPS II development scenarios are also shown in Table 5-2.

The Demand Report (see Section 1.2) analyzed water demands associated with each Retail customer sector and established per unit-use rates. As such, between 2010 and 2030, SFPUC used a per-unit use rate average of 98.7 gpd per household for multi-family residential demands. As shown in Table 5-4, the 98.7 gpd per household rate was applied to the incremental growth of 2,387 new dwelling units throughout the City resulting in a demand of 0.24 mgd in 2030.

**Table 5-4: 2030 Water Demand of the Projects and Incremental Growth within SF City and County (mgd)**

| Projects and Incremental Growth[1] | Water Demand (mgd) | | | | | |
|---|---|---|---|---|---|---|
| | Stadium | | R&D Variant | | Housing Variant | |
| | Project Water Demand | Non-Residential Adjustment (1.18)[7] | Project Water Demand | Non-Residential Adjustment (1.40)[7] | Project Water Demand | Non-Residential Adjustment (1.15)[7] |
| CP-HPS II[2] | 1.67 | 1.04 | 1.99 | 1.05 | 1.66 | 1.04 |
| TI – YBI[3] | 1.70 | 1.17 | 1.70 | 1.17 | 1.70 | 1.17 |
| Parkmerced[4] | 0.98 | 0.94 | 0.98 | 0.94 | 0.98 | 0.94 |
| **Projects Subtotal** | **4.38** | **3.16** | **4.67** | **3.16** | **4.34** | **3.16** |
| Existing Demand at Project Sites[5] | -1.51 | -1.51 | -1.51 | -1.51 | -1.51 | -1.51 |
| **Net Development Subtotal** | **2.87** | 1.64 | **3.16** | 1.65 | **2.83** | 1.64 |
| Other Growth in SF (City and County)[6] | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| **Net Change in Water Demand with Non-Residential Adjustment**[7] | | **1.88**[7] | | **1.89**[7] | | **1.88**[7] |

(1) Average annual demands. Residential water demands for the proposed projects were provided to the City by project developer. They were also developed using an end use model on a per unit or per employee basis. The developer demands were independently reviewed by PBS&J and the SFPUC as part of this Study, and appear consistent with the SFPUC demand estimates. (Appendix B)
(2) CP-HPS Phase II Arup – Winzler & Kelly Water Demand Memo September 25, 2009 Appendix B
(3) Treasure Island Technical Memo Section 7 August 2009. Appendix B
(4) Parkmerced Water Demand Spreadsheet from August 2009 Appendix B
(5) Existing demand provided by SFPUC from current billing records
(6) Derived by SFPUC staff based on approximately 2,387 dwelling units at 98.7 gpd. August 2009 Appendix X
(7) To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections.

For conservative water supply planning purposes, this Study uses the highest total water demand adjusted for non-residential uses[5] of 1.89 mgd associated with the R&D Variant at CP-HPS II. The net change in demand accounts for existing uses at the project site and a non-residential demand adjustment.

### *5.2.2 Water Demand of Non-Residential Employment Projections*

As shown above in Table 5-1, the SF Planning and ABAG projected new job growth in the San Francisco based on the employment changes in the San Francisco Bay Area as described in Section 5.1.1 above.

Demand projections for overall City growth were based on 2010-2030 average per-unit use factors of the Demand Report. The Demand Report analyzed water demands associated with each Retail customer sector and established per unit-use rates. As such, between 2010 and 2030, SFPUC used an average of 42.42 gallons per day (gpd) per employee for non-residential water demands. In an effort to represent the employment opportunities over the 20-year planning horizon this Study assumes that the non-residential employment sector would grow at a linear rate over the same planning period without accounting for market force influences and changes in local economics. As shown in Table 5-5, the 42.42 gpd per employee water demand rate was applied to the growth in jobs over the 20-year planning horizon. In 2015, demand is expected to be 30.52 mgd and by 2030, water demand generated through employment is expected to reach 31.73 mgd.

**Table 5-5: Water Demand for Non-Residential Employment Projections**

| Employment Projections and Non-Residential Demand | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| SF Planning Employment Total(1) (jobs) | 712,145 | 719,447 | 726,749 | 734,050 | 748,100 |
| Non-Residential - Business/Industrial Demand(2) (mgd) | 30.21 | 30.52 | 30.83 | 31.14 | 31.73 |

(1) Table 5-1 2009 SF Planning Projections
(2) Average of 42.42 gallons per day (gpd) per employee for non-residential water demands.

### *5.2.3 SFPUC Total Retail System Demand*

The SFPUC incorporated the 2009 SF Planning projections for residential and non-residential growth in San Francisco into this Study to assess the results of the SF Planning projections and its effects on the City's water demand. The previous tables (5-3 and 5-4) along with demand data from the 2005 UWMP is incorporated in the City's total Retail demand. The results of these 2009 demand forecasts are shown in Table 5-6. The table represents the anticipated growth in demand commencing in 2010 and extending over the 20-year planning horizon to 2030.

5 To avoid double-counting the water demand associated with the 2009 Non-Residential Planning Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 Non-Residential SF Planning Projections. Table 5-2 shows the net change in water demand at the Project sites and the adjusted change in water demand without non-residential demand.

As shown in Table 5-6, incremental residential growth demand and demand at the Project sites commences in 2015 at 0.47 mgd and progresses to 1.89 mgd in 2030. In 2015, demand drops slightly due to a reduction in total residential demand. The non-residential demand commences in 2010 at 30.21 mgd, increases to 30.83 mgd and culminates at 31.73 in 2030.

Table 5-6 shows total Retail demands for SFPUC beginning in 2010 at 91.81, and then drops slightly in 2015 because of a drop in residential demand and then increases to 91.87 mgd in 2020. By 2030, Retail demand will be approximately 93.42 mgd.

**Table 5-6: SFPUC Retail Demand (mgd)**

| Users, Facilities and Entities | Projected Water Demand (mgd) | | | | |
|---|---|---|---|---|---|
| | **2010** | **2015** | **2020** | **2025** | **2030** |
| Residential Demand (Single & Multiple Family)(1) | 44.70 | 43.80 | 43.20 | 42.90 | 42.90 |
| New Residential Demand generated by Projects and Incremental Growth(2)(4) | - | 0.47 | 0.95 | 1.42 | 1.89 |
| **Subtotal** | 44.70 | 44.27 | 44.15 | 44.32 | 44.79 |
| Non-Residential - Business/Industrial Demands(3,4) | 30.21 | 30.52 | 30.83 | 31.14 | 31.73 |
| **Subtotal** | **74.91** | **74.79** | **74.97** | **75.46** | **76.52** |
| Unaccounted-for System Losses | 7.30 | 7.30 | 7.30 | 7.30 | 7.30 |
| **Subtotal** | **82.21** | **82.09** | **82.27** | **82.76** | **83.82** |
| Other Retail Demands(5) | 4.90 | 4.90 | 4.90 | 4.90 | 4.90 |
| Lawrence Livermore Laboratory; Groveland CSD(6) | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 |
| City Irrigation Demand(7) | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Castlewood Community Demand(8) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **Total Retail Demand** | **91.81** | **91.69** | **91.87** | **92.36** | **93.42** |

(1) Residential Demands (Source: 2005 SFPUC UWMP Table 8B, page 43)

(2) See Table 5-4. Multiple Family – [In 2030 Incremental Growth of 0.24 mgd + (CP-HPS II 10,500 DU) 1.04 mgd + (TI-YBI 8,000 DU) 1.17 mgd + (Parkmerced 8,900 total DU) 0.94 mgd = 3.40 mgd] Existing Demand is 1.51 mgd at all sites. [3.40 mgd – 1.51 = 1.89 mgd] as shown in Table 4-2 (Sources: ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Updated August 2009)

(3) See Table 5-5. Agriculture, Mining, Construction, Manufacturing, Transportation, Wholesale & Retail Trade, F.I.R.E., Services, Gov't including Builders – Contractors and Docks – Shipping. (Source: Adapted from 2009 ABAG Employment Projections in conjunction with SF Planning, July 2009) As developed in the Demand Study, SFPUC derived the employment water demands by taking the ABAG employment projections and multiplying by 42.42 gallons per employee per day and is consistent with SFPUC's demand projection methodology.

(4) See Table 5-5. Non-residential (jobs/employment) demands at major project sites were assumed to be contained in the 2009 ABAG Employment projections. Growth in demand is incrementally increased to reflect the growth in jobs over the 20-year planning horizon. To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections. Table 5-4 shows the net change in water demand at the Project sites and the adjusted change in water demand without non-residential demand. Adapted by PBS&J and SFPUC September 2009 from ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Updated August 2009

(5) US Navy, SF International Airport, and other suburban/municipal accounts. (Source: 2005 SFPUC UWMP Table 8B, page 43)

(6) Lawrence Livermore Laboratories (0.8 mgd); Groveland CSD (0.4 mgd) (Source: 2005 SFPUC UWMP Table 8B, page 43)

(7) City Irrigation at Golden Gate Park, Great Highway Median and SF Zoo. (Source: 2005 SFPUC UWMP Table 8B, page 43)

(8) Castlewood Community demand served by wells in the Pleasanton well field. (Source: 2005 SFPUC UWMP Table 8B, page 43)

### *5.2.4 Potential Recycle Water Demand of the Projects*

In addition to providing estimated potable water demands, each of the Projects also provided the City with estimated recycled water demands. Each of the Projects anticipates developing new recycled water projects to help offset potable demand. As shown in Table 5-7, the Projects may produce up to 1.49 or 1.5 mgd of recycled water.

**Table 5-7: Potential Recycled Water Demand of the Projects (mgd)**

| Development | Recycled Water Demand[1] (mgd) |
|---|---|
| CP-HPS II | 0.89 |
| TI-YBI | 0.38 |
| Parkmerced | 0.22 |
| **Total** | **1.49** |

Notes: Average annual recycled water demand.
(1) Sources: ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Updated August 2009. Appendix B

The recycled water potential shown in Table 5-7 is considered additional recycled water sources and have not been included as part of SFPUC's local WSIP supplies. In the event that recycled water is produced at the Project sites, recycled water could offset as much as 1.5 mgd in total City potable demand. This Study provides a conservative analysis of SFPUC's Retail supplies and demands and, as such, evaluates the City's demands to include the proposed projects without recycled water.

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# 6.0 SUPPLY AND DEMAND COMPARISON

This section compares the SFPUC's Retail water supplies and demands through year 2030.

## *6.1 Supply and Demand Comparison*

Table 6-1 compares SFPUC Retail supplies and demand during normal, single dry year, and multiple dry year periods. Section 2.3.6 discusses SFPUC's total water supplies now and over the 20-year planning period. In 2010, prior to the development of the 10 mgd of local supplies, SFPUC can access an annual average 84.50 mgd from all water supply sources. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.5 mgd. These supplies are assumed to be available in the quantities listed in Table 6-1. SFPUC intends to use these supplies to meet its Retail customer demands.

The demand estimates in this Study show that the 2009 SF Planning projections result in an increase in City Retail demand. As stated previously, by 2030 Retail demand is estimated at 93.42 mgd. This increase, however, does not change the findings in the 2005 UWMP, which estimated demand at 93.4 mgd in 2030.[6] As shown in Table 6-1, the SFPUC can meet the current and future demands of its Retail customers in normal years, single dry-years and nearly all multiple dry-year events with the exception of years 2 and 3 in 2030.

As modeled in Table 6-1, the deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd as per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. It is expected that 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (Fiscal Year 2007-2008 use was 83.9 mgd). If Retail demand exceeds the available RWS supply of 81.0 mgd between 2010 and 2015, and total RWS deliveries exceed 265 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water with the payment of an Environmental Surcharge. Notably, total RWS deliveries in Fiscal Year 2007-2008 were 256.7 mgd, which is 8.3 mgd below the 265 mgd watershed delivery goal.

As shown in Table 6-1, during a multiple dry-year event[7] commencing in 2030, it is possible that the SFPUC will not be able to meet 100 percent of Retail demand in 2030. As modeled, a supply shortfall of 0.42 mgd is anticipated to occur in the second and third year of a multiple dry-year event. To overcome the potential 0.42 mgd supply deficit during multiple dry-years in 2030, the SFPUC will implement their adopted drought planning sequence and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in SFPUC reservoirs. If the SFPUC determines the projected total water storage to be less than an identified level sufficient to provide sustained deliveries during drought, the SFPUC may impose delivery reductions or rationing. The WSAP and RWSAP allow the SFPUC to reduce water deliveries to customers during periods of water shortage to

6 SFPUC 2005 Urban Water Management Plan Table 8B, page 43.

7 Multiple dry-year events are defined as a three-year event per UWMP requirements. SFPUC determined that a multiple dry-year event is years 2-4 of SFPUC's 8.5 year design drought. SFPUC can meet 100 percent of deliveries in the first year of such an event.

achieve a positive balance of supplies and demands. Under WSAP, the RWS supply curtailment in multiple dry years of 1.5 mgd to 79.5 mgd, results in a 1.9 percent reduction as shown in Table 4-2. The SFPUC, as part of the WSIP, adopted a water reliability objective of no greater than 20 percent rationing in any one year of a drought.

**Table 6-1: Projected Supply and Demand Comparison - Normal, Dry, and Multiple Dry Years (mgd)**

| | | | | Multiple Dry Year Event | | |
|---|---|---|---|---|---|---|
| | **Retail Supply and Demand** | **Normal Year** | **Single Dry Year** | **Year 1** | **Year 2** | **Year 3** |
| **2010** | RWS Supply[1] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater Supply[2] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | Total Retail Supply[3] | 84.50 | 84.50 | 84.50 | 83.00 | 83.00 |
| | Total Retail Demand[4] | 91.81 | 91.81 | 91.81 | 91.81 | 91.81 |
| | Surplus/(Deficit)[5] | -7.31 | -7.31 | -7.31 | -8.81 | -8.81 |
| **2015** | RWS Supply[1] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater[6] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | WSIP Supply Sources[7] | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | Total City Supply[3] | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| | Total Retail Demand[4] | 91.69 | 91.69 | 91.69 | 91.69 | 91.69 |
| | Surplus/(Deficit) | 2.81 | 2.81 | 2.81 | 1.31 | 1.31 |
| **2020** | RWS Supply[1] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater[6] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | WSIP Supply Sources[7] | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | Total City Supply[3] | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| | Total Retail Demand[4] | 91.87 | 91.87 | 91.87 | 91.87 | 91.87 |
| | Surplus/(Deficit) | 2.63 | 2.63 | 2.63 | 1.13 | 1.13 |
| **2025** | RWS Supply[1] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater[6] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | WSIP Supply Sources[7] | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | Total City Supply[3] | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| | Total Retail Demand[4] | 92.36 | 92.36 | 92.36 | 92.36 | 92.36 |
| | Surplus/(Deficit) | 2.14 | 2.14 | 2.14 | 0.64 | 0.64 |
| **2030** | RWS Supply[1] | 81.00 | 81.00 | 81.00 | 79.50 | 79.50 |
| | Groundwater[6] | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | WSIP Supply Sources[7] | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | Total City Supply[3] | 94.50 | 94.50 | 94.50 | 93.00 | 93.00 |
| | Total Retail Demand[4] | 93.42 | 93.42 | 93.42 | 93.42 | 93.42 |
| | Surplus/(Deficit) | 1.08 | 1.08 | 1.08 | -0.42[8] | -0.42[8] |

(1) RWS Supply (SFPUC Water Supplies Table 2-2)
(2) Groundwater Uses for In-City Irrigation and Castlewood (SFPUC Water Supplies - Table 2-2)
(3) Total Retail Supply (SFPUC Water Supplies Table 2-2)
(4) SFPUC Retail Demand (SFPUC Retail Demand Table 5-6)
(5) The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).
(6) Groundwater Supplies at Castlewood and In-City Irrigation (SFPUC Water Supplies Table 2-2)
(7) WSIP Supply Sources (Recycled Water (4.0 mgd; Groundwater (2.0 mgd Existing and 2.0 from NWGWP, and WSIP Water Efficiency and Conservation (4.0 mgd) (see SFPUC Water Supplies Table 2-2)
(8) Deficit occurs in year 2 and 3 of multiple dry year event, SFPUC implements its Drought Year Water Shortage Contingency Plans - RWSAP and WSAP to balance supply and demand under this projected shortfall as described in Section 4.0

## 6.2 Conclusion and Findings

The updated 2009 SF Planning projections results in a Retail demand in 2030 of 93.42 mgd, which is only slightly greater than the 2030 demand projections estimated in the 2005 UWMP. This increase, however, does not change the results of the 2005 UWMP. In years with normal or above-normal precipitation, the City has sufficient supplies to serve their Retail customers.[8] The ability to meet the demands of the Retail customers is in large part due to the development of 10 mgd of local WSIP supplies in the Retail service area. These new sources of groundwater, recycled water, and water conservation are essential to provide the City with adequate supply in dry year periods, as well as improving supply reliability during years with normal precipitation. Although the 2005 UWMP considered the 10 mgd of new WSIP sources in terms of system-wide drought-planning, the WSIP supplies were not assigned to either the Retail or Wholesale Customers directly as it was not known how the resources would be used. As presented in this Study, with the adoption of the Phased WSIP Variant, the WSIP supplies can now be applied to meet Retail demands. In addition, due to the nature and development of the local supplies, these WSIP supply sources are not subject to reduction under the WSAP.

During a multiple dry-year event, however, it is possible that the SFPUC will not be able to meet 100 percent of demand from its Retail customers in 2030, and will therefore have to impose reductions on its Retail supplies. Under the WSAP, SFPUC Retail customers would experience no reduction in deliveries at a 10 percent RWS shortage. However, during a 20 percent system-wide shortage, the Retail customers would experience a 1.9 percent reduction in Retail deliveries. Table 6-1 compared SFPUC Retail supplies during normal, single dry year, and multiple dry year periods. The main difference between 2010 and subsequent planning years (2015–2030) is due to the development of the additional 10 mgd of local WSIP supplies in the Retail service area. These WSIP local supplies are not subject to a reduction under the WSAP, as the WSAP only allocates water from the RWS, which is subject to reductions.

The Projects anticipate developing new recycled water projects to help offset potable demand. These new projects may produce up to 1.5 mgd of recycled water. By reducing their potable water demands through the use of recycled water, these projects have the ability to eliminate the City's overall water shortage during multiple dry year periods.

8 The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).

Regarding the availability of water supplies to serve the City, beginning in 2015 the SFPUC finds as follows:

- In years of average and above-average precipitation and including development of SFPUC's local WSIP water supply sources the SFPUC has adequate supplies to serve 100 percent of normal, single dry and multiple dry year demand up to 2030.[9]
- In multiple-dry-year events after 2030, when the SFPUC imposes reductions in its supply, the SFPUC has in place the WSAP and RWSAP to balance supply and demand.
- If recycled water is implemented as proposed at each of the major development project sites, then it is assumed that potable water demands for the City can decrease by up to 1.5 mgd; thereby, eliminating potential multiple dry-year deficit after 2030.
- With the WSAP and RWSAP in place, and the addition of local WSIP supplies, the SFPUC finds it has sufficient water supplies available to serve its existing Retail customers and planned future uses.

9 The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).

# 7.0 REFERENCES

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# APPENDICES

A Growth Projections Letter from San Francisco Planning Department
B Major Projects Water Demand Estimates from Project Sponsors

# APPENDIX A

## Growth Projections Letter from San Francisco Planning Department

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

Reception:
**415.558.6378**

Fax:
**415.558.6409**

Planning
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**415.558.6377**

July 9, 2009

Michael P. Carlin
Deputy General Manager, SFPUC
1155 Market St, 11th Floor
San Francisco, CA 94103

**Subject: Projections of growth by 2030**

Dear Michael:

Thank you for your letter dated March 11, 2009 requesting the Planning Department's projections of growth by 2030 in order to satisfy your mandates in connection with assessing water supply and demand in the years to come, and more specifically for preparing water supply assessments for individual projects moving forward.

The Planning Department routinely prepares projections for the purposes of analyzing impacts of plans and projects undergoing the environmental review process. While the assumptions of these sets may vary depending on the circumstances surrounding a specific project, the Department recently completed a citywide projection capturing citywide growth expectations by 2030 designed to closely match the recently adopted ABAG Projections 2009 target, but taking into account local knowledge of projects currently in various stages of the entitlement process, commonly referred to as the development pipeline. Table 1 shows the projections for 2030.

**Table 1 Development Projections**

| | 2000 | 2005 | 2030 | Growth 2000-2030 | Growth 2005-2030 |
|---|---|---|---|---|---|
| Households | 329,700 | 341,478 | 403,292 | 73,592 | 61,814 |
| HH Population | 756,976 | 783,441 | 916,800 | 159,824 | 133,359 |
| Jobs | 642,500 | 553,090 | 748,100 | 105,600 | 195,010 |

Source: ABAG, San Francisco Planning Department

As the question may arise whether particular projects were included, the Planning Department for the purposes of these numbers assumed full buildout over the course of the forecast period of three large development programs currently undergoing environmental review, namely Treasure Island, Bayview Waterfront, and Park Merced projects.

More generally, we included entitled pipeline projects, and projects larger than 500 units, or large commercial projects per criteria set forth in California Water Code §10912(a) as these are the projects for which individual water supply assessments would otherwise need to be made in the near future.

We are looking forward to continuing the larger regional growth dialogue with PUC and other regional stakeholders.

Sincerely,

John Rahaim
Director of Planning

CC: Aksel Olsen
Teresa Ojeda
File

# APPENDIX B

## Major Projects Water Demand Estimates from Project Sponsors

## [Candlestick Point/Hunter's Point Shipyard; Parkmerced; Treasure Island-Yerba Buena Island]

| | | | |
|---|---|---|---|
| To | Lennar - | Reference number<br>131878/RRJ | |
| cc | | File reference | |
| From | Rowan Roderick-Jones/Manish Dalia x 27222 (San Francisco) | Date<br>October 15, 2009 | |
| Subject | **Candlestick Point / Hunters Point Shipyard Phase II<br>Water Demand Memorandum<br>Revision # 16** | | |

# 1 Purpose

This Water Demand Memorandum (Memo) presents a summary approach, references, assumptions, and results of calculations undertaken by Arup to estimate a range of potential water demands and sanitary sewer flows for the Candlestick Point/Hunters Point Shipyard (CP/HPS) Development including the Proposed Project as well as the R&D and Housing Variants.

The Memo establishes a historical baseline condition and makes adjustments to account for current California building code requirements as well as the San Francisco Green Building Ordinance. The basis for these analyses and the results are presented herein.

Arup worked in conjunction with Winzler & Kelly to develop water demand and sanitary sewer flow values appropriate for use in engineering design.

# 2 Approach

To develop reasonable water demand estimates for the CP/HPS development the following steps were taken.

1) The Proposed Project was divided into land uses as identified in Table 1. Two project variants exclude the stadium. The R&D Variant also includes an additional 2,500,000 square feet of research and development space, as shown in Table 2. The Housing Variant does not include any additional program but shifts 1,350 housing units from Candlestick Point to Hunters Point, as shown in Table 4. The methodology for developing water demands was the same for the Proposed Project and Project Variants.
2) A **Historical Benchmark** demand was estimated for each land use based on a series of assumptions and references. Key references used were:
    a. The Urban Water Management Plan for the City of San Francisco
    b. The SFPUC Wholesale Customer Demand Projections Technical Report (URS, 2004)
    c. The City of Los Angeles CEQA Threshold Guide, 2006
    d. The EPA, Onsite Wastewater Treatment Systems Manual, 2002

A number of other references were also used and these are provided at the end of this memorandum. Arup collected information from a number of sources and selected a method of estimating demands that we believed to be appropriate and reasonable for the area. Assumptions and references are provided in Section 4.

3) The demands were then distributed between indoor and outdoor end uses which were estimated based on published data in the SFPUC Wholesale Customer Demand Projections Report (URS 2004). End use distributions for the stadium and performance venues were assumed rather than taken directly from the SFPUC's projections. The distribution ratios are provided in Table 23 and Table 25.

4) Next, the Historical Benchmark was adjusted to an **Adjusted to California Codes** scenario using new fixture flow rates from California and Federal Buildings standards as well as the International Plumbing Code.

5) The Adjusted to California Codes demand estimate does not include the requirements of the **San Francisco Green Building Ordinance (SFGBO)**. The SFGBO is based on LEED for New Construction (LEED NC) and requires a 50% reduction in landscape irrigation demands. The SFGBO does not specify what code is to be used as the baseline for irrigation demands. Therefore the current code was assumed to be equivalent to the irrigation amount allowed under the California Water Efficient Landscape Ordinance. This rule was assumed to be applicable to both private and public landscape irrigation. In addition, the SFGBO requires a 30% reduction in potable water demand. The SFGBO does not provide specific language as to which portions of demand are to be included in the 30% reduction. However, the intention of the similar LEED NC credit (Water Efficiency Credit 3) is to reduce building water demand by 30%. The total 30% reduction in building water efficiency may be achieved by any number of means including improved fixture efficiency, mechanical building efficiency, or by providing an alternative water supply. The demand estimates, when adjusted for the SFGBO represent the final demands for the Proposed Project and Project Variants.

   The SFGBO demand was developed by using the California code as a baseline and using a trajectory or possible means of water saving strategies and/or alternative water supplies to achieve the SFGBO. The assumptions and references used to make these adjustments are provided in Table 27.

6) Potential reclaimed water demands as well as sewage generation were determined based on end use distributions.

The results of the study are presented at the beginning of this report. References and Assumptions used for making the demand estimations are provided after the results in Section 3.

**Table 1: CP/HPS Land Use Program (Proposed Project)**

| | | Hunters Point Shipyard | Candlestick Point | Project Total |
|---|---|---|---|---|
| **Land Use** | | | | |
| **Residential** | | | | |
| | Density, 15-75 units per acre (units) | 680 | 750 | 1,430 |
| | Density, 50-125 units per acre (units) | 1,415 | 3,215 | 4,630 |
| | Density, 100-175 units per acre (units) | 265 | 2,445 | 2,710 |
| | Density, 175-285 units per acre (units) | 290 | 1,440 | 1,730 |
| | **Total Project (units)** | **2,650** | **7,850** | **10,500** |
| | | | | |
| **Retail** | | | | |
| | Regional Retail (sqft)) | 0 | 635,000 | 635,000 |
| | Neighborhood Retail (sqft) | 125,000 | 125,000 | 250,000 |
| | **Total (sqft)** | **125,000** | **760,000** | **885,000** |
| | | | | |
| **Office (sqft)** | | 0 | 150,000 | 150,000 |
| | | | | |
| **Community Uses (sqft)** | | 50,000 | 50,000 | 100,000 |
| | | | | |
| **Research & Development (sqft)** | | 2,500,000 | 0 | 2,500,000 |
| | | | | |
| **Hotel (sqft)** | | 0 | 150,000 | 150,000 |
| | | | | |
| **Artist's Studios** | | | | |
| | 1:1 Studio Renovation & Replacement (sqft) | 225,000 | 0 | 225,000 |
| | New Artist Center (sqft) | 30,000 | 0 | 30,000 |
| | **Total (sqft)** | **255,000** | **0** | **255,000** |
| | | | | |
| **Parks & Open Space** | | | | |
| | New City Parks (acres) | 140 | 8.1 | 148.1 |
| | New Sports Fields & Active Recreation (acres) | 91.6 | 0 | 91.6 |
| | New Open Space and Restored State Parkland (acres) | 0 | 96.7 | 96.7 |
| | **Total (acres)** | **231.6** | **104.8** | **336.4** |
| | | | | |
| **Football Stadium** (seats) | | 69,000 | 0 | 69,000 |
| | | | | |
| **Performance Venue** (seats) | | 0 | 10,000 | 10,000 |
| Source: Lennar, 2009 | | | | |

**Table 2: CP/HPS Land Use Program (R&D Variant)**

| | | Hunters Point Shipyard | Candlestick Point | Project Total |
|---|---|---|---|---|
| **Land Use** | | | | |
| **Residential** | | | | |
| | Density, 15-75 units per acre (units) | 680 | 750 | 1,430 |
| | Density, 50-125 units per acre (units) | 1,415 | 3,215 | 4,630 |
| | Density, 100-175 units per acre (units) | 265 | 2,445 | 2,710 |
| | Density, 175-285 units per acre (units) | 290 | 1,440 | 1,730 |
| | **Total Project (units)** | **2,650** | **7,850** | **10,500** |
| | | | | |
| **Retail** | | | | |
| | Regional Retail (sqft)) | 0 | 635,000 | 635,000 |
| | Neighborhood Retail (sqft) | 125,000 | 125,000 | 250,000 |
| | **Total (sqft)** | **125,000** | **760,000** | **885,000** |
| | | | | |
| **Office (sqft)** | | 0 | 150,000 | 150,000 |
| | | | | |
| **Community Uses (sqft)** | | 50,000 | 50,000 | 100,000 |
| | | | | |
| **Research & Development (sqft)** | | 5,000,000 | 0 | 5,000,000 |
| | | | | |
| **Hotel (sqft)** | | 0 | 150,000 | 150,000 |
| | | | | |
| **Artist's Studios** | | | | |
| | 1:1 Studio Renovation & Replacement (sqft) | 225,000 | 0 | 225,000 |
| | New Artist Center (sqft) | 30,000 | 0 | 30,000 |
| | **Total (sqft)** | **255,000** | **0** | **255,000** |
| | | | | |
| **Parks & Open Space** | | | | |
| | New City Parks (acres) | 152.4 | 8.1 | 160.5 |
| | New Sports Fields & Active Recreation (acres) | 69.8 | 0 | 69.8 |
| | New Open Space and Restored State Parkland (acres) | 0 | 96.7 | 96.7 |
| | **Total (acres)** | **222.2** | **104.8** | **327** |
| | | | | |
| **Football Stadium** (seats) | | 0 | 0 | 0 |
| | | | | |
| **Performance Venue** (seats) | | 0 | 10,000 | 10,000 |
| Source: Lennar, 2009 | | | | |

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**Table 4: CP/HPS Land Use Program (Housing Variant)**

| | | Hunters Point Shipyard | Candlestick Point | Project Total |
|---|---|---|---|---|
| **Land Use** | | | | |
| **Residential** | | | | |
| | Density, 15-75 units per acre (units) | 1,540 | 970 | 2,510 |
| | Density, 50-125 units per acre (units) | 1,905 | 3,670 | 5,575 |
| | Density, 100-175 units per acre (units) | 265 | 1,220 | 1,485 |
| | Density, 175-285 units per acre (units) | 290 | 640 | 930 |
| | **Total Project (units)** | **4,000** | **6,500** | **10,500** |
| | | | | |
| **Retail** | | | | |
| | Regional Retail (sqft)) | 0 | 635,000 | 635,000 |
| | Neighborhood Retail (sqft) | 125,000 | 125,000 | 250,000 |
| | **Total (sqft)** | **125,000** | **760,000** | **885,000** |
| | | | | |
| **Office (sqft)** | | 0 | 150,000 | 150,000 |
| | | | | |
| **Community Uses (sqft)** | | 50,000 | 50,000 | 100,000 |
| | | | | |
| **Research & Development (sqft)** | | 2,500,000 | 0 | 2,500,000 |
| | | | | |
| **Hotel (sqft)** | | 0 | 150,000 | 150,000 |
| | | | | |
| **Artist's Studios** | | | | |
| | 1:1 Studio Renovation & Replacement (sqft) | 225,000 | 0 | 225,000 |
| | New Artist Center (sqft) | 30,000 | 0 | 30,000 |
| | **Total (sqft)** | **255,000** | **0** | **255,000** |
| | | | | |
| **Parks & Open Space** | | | | |
| | New City Parks (acres) | 149.9 | 8.1 | 158 |
| | New Sports Fields & Active Recreation (acres) | 94.7 | 0 | 94.7 |
| | New Open Space and Restored State Parkland (acres) | 0 | 96.7 | 96.7 |
| | **Total (acres)** | **244.6** | **104.8** | **349.4** |
| | | | | |
| **Football Stadium** (seats) | | 69,000 | 0 | 69,000 |
| | | | | |
| **Performance Venue** (seats) | | 0 | 10,000 | 10,000 |
| Source: Lennar, 2009 | | | | |

# 3 Results

This section provides the results of the water demand assessment. The results are provided by land use as well as by end use (fixture type). The overall results for the proposed project are summarized by Figure 1. Similar summaries for the two project variants are provided in Figure 3and Figure 5.

**Table 4: Potable water demands for Proposed Project and Project Variants.**

| | Proposed Project Demand (MGD) | R&D Variant Demand (MGD) | Housing Variant Demand (MGD) |
|---|---|---|---|
| Historical Baseline | 2.95 | 3.47 | 2.92 |
| Adjusted to California Codes | 2.46 | 2.92 | 2.44 |
| Adjusted to San Francisco Green Building Ordinance | 1.67 | 1.99 | 1.66 |

The above table indicates that the R&D Variant will have the highest potable water demands under the requirements of the SFGBO of 1.99 MGD.

Figures 1 through 3 provide the Proposed Project and Project Variant demands for the Historical Benchmark, the Adjusted to California Codes and the San Francisco Green Building Ordinance cases. They also illustrate the Sustainable Case trajectory defined by the step down line. The first five steps in the "sustainable Case" step-down graph are demand reduction strategies while the later five steps are achieved by utilizing alternative water supplies. Additional demand breakdowns by land use and end use are provided in Table 5 through Table 14 for the Proposed Project and Project Variants. Reclaimed water demands and sanitary flows by end use for the Proposed Project are provided in Table 16 through Table 22.

Please note that in all reported annual water demand and sanitary flow data in Table 5 through Table 22 are in million gallons per day (MGD) and are rounded to the nearest 0.01 millionth gallon. When reporting the calculations within the tables slight rounding errors on the order of 0.01 MGD may occur.

**Figure 1: Water demand results summary step down graph- Proposed Project**

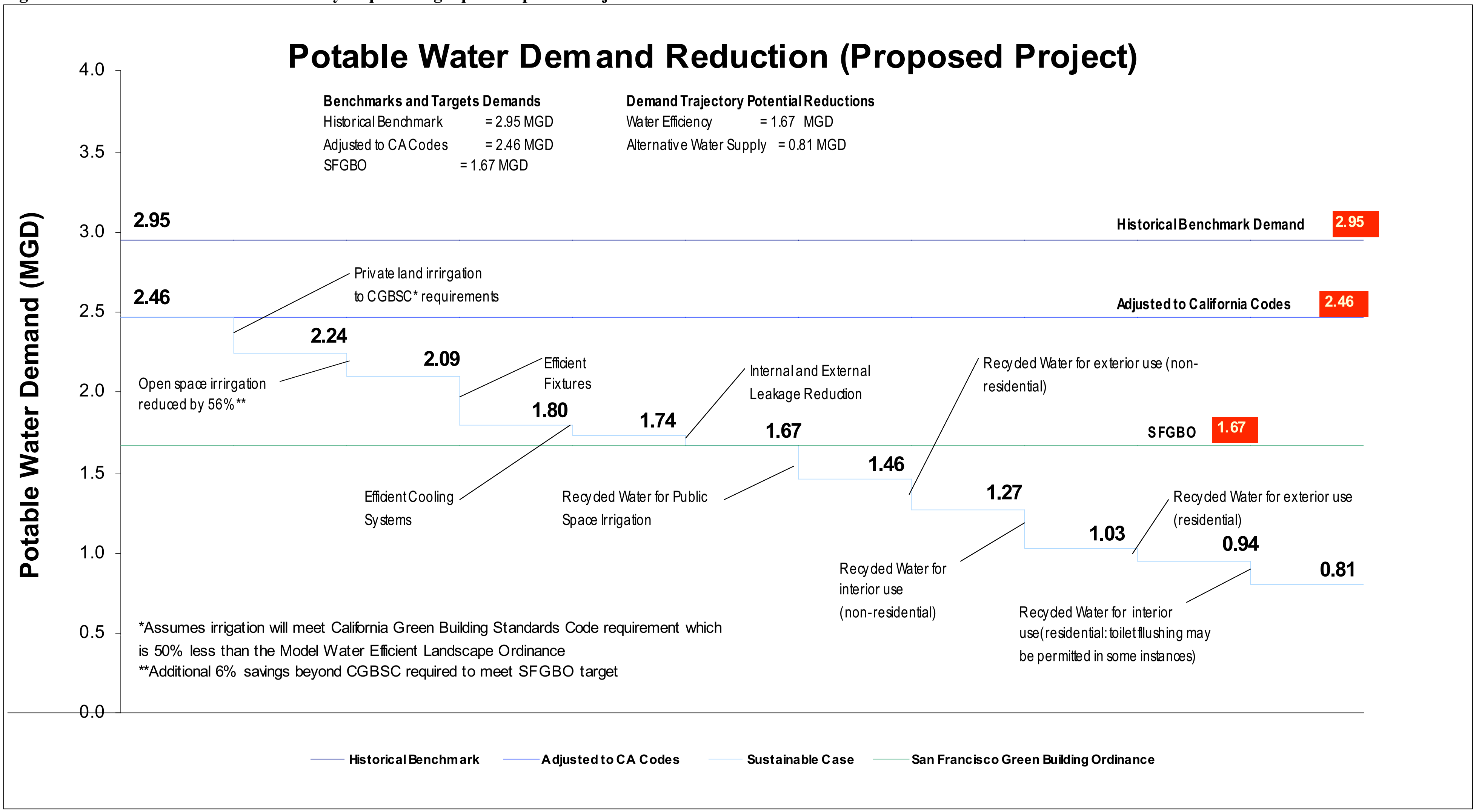

**Figure 3: Water demand results summary (R&D Variant)**

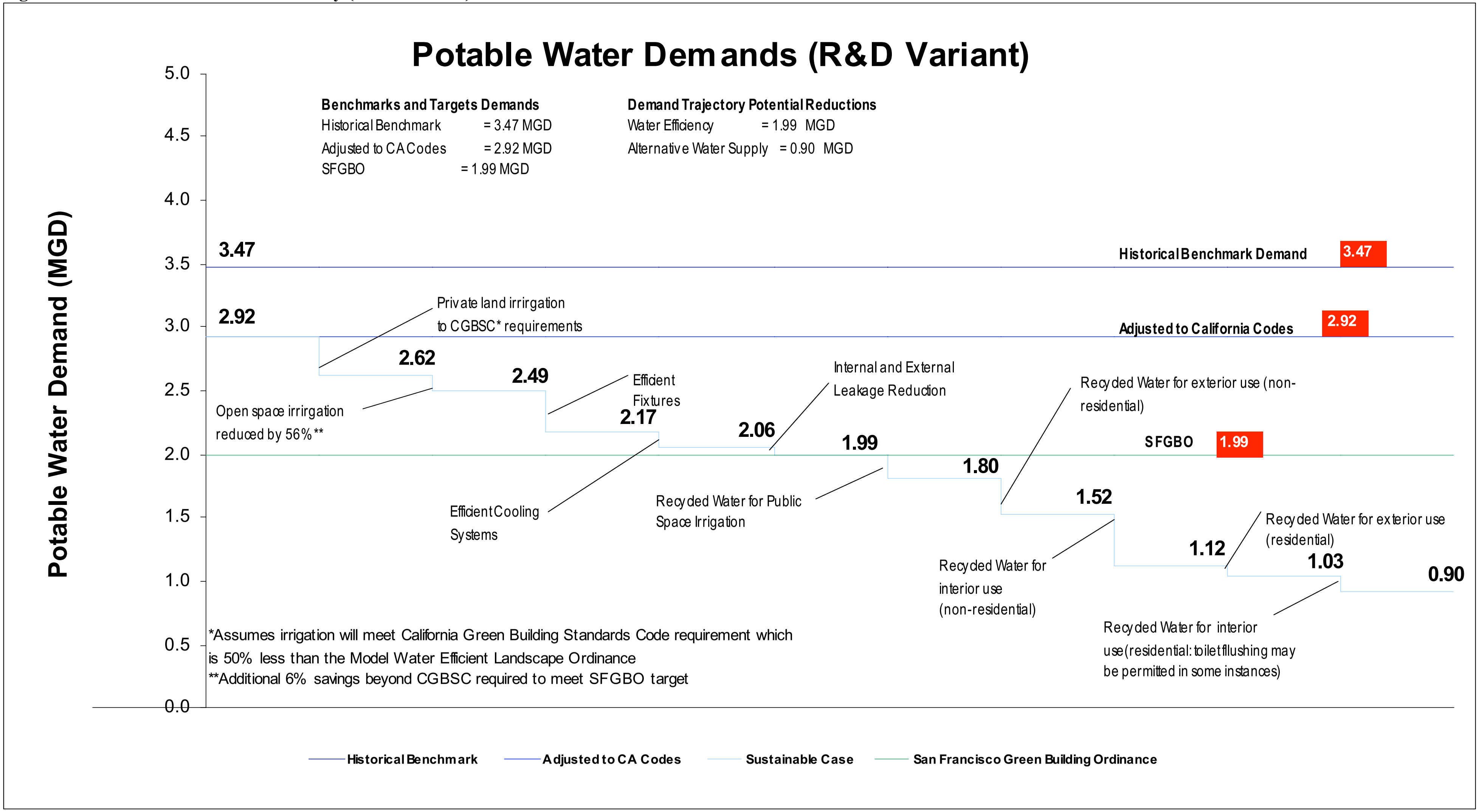

**Figure 5: Water demand results summary (Housing Variant)**

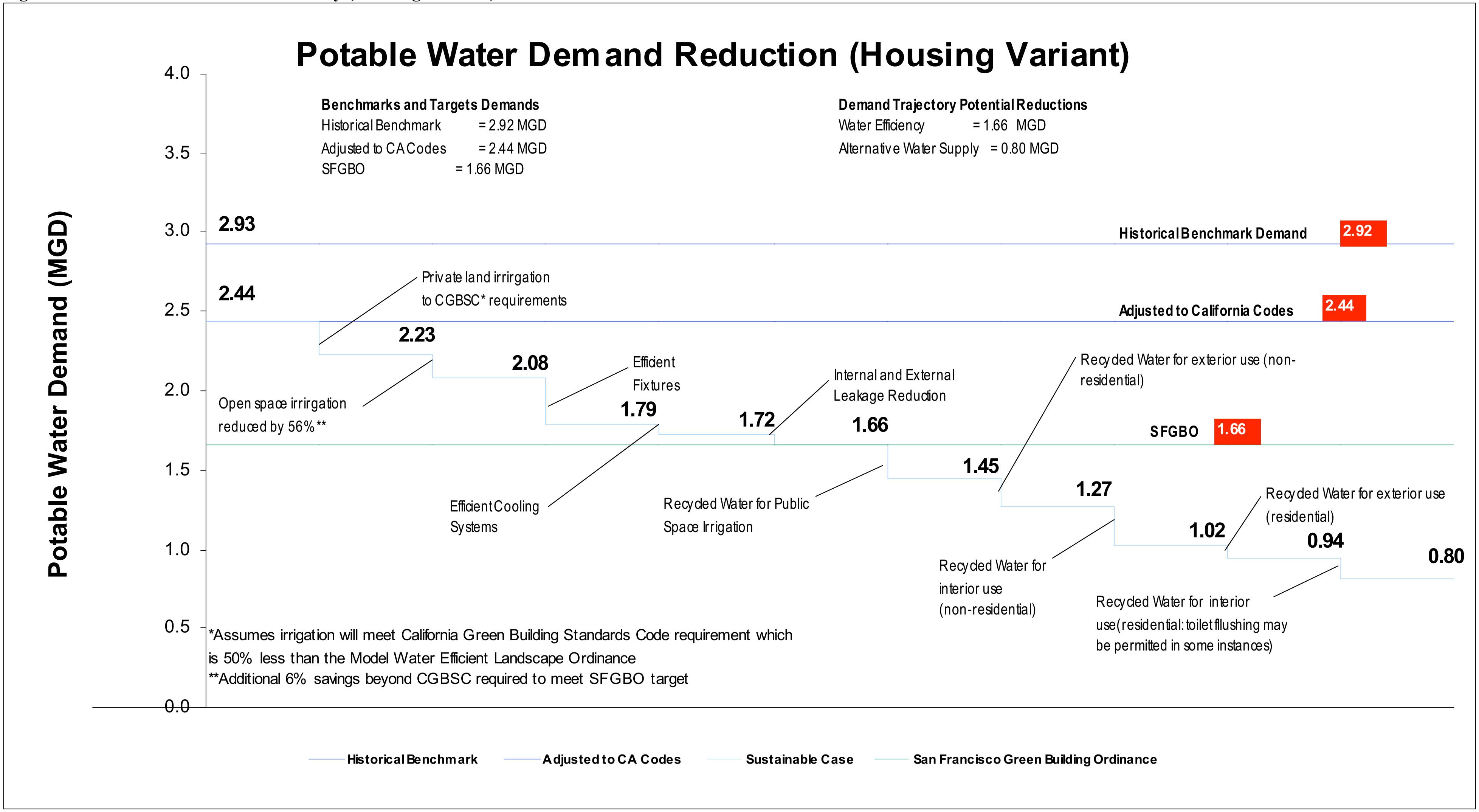

**Table 5: Historical Benchmark demand by land use and end use – Proposed Project**

| Land Use | Historical Benchmark Demand (MGD) | | |
|---|---|---|---|
| | Candlestick Point | Hunters Point | Total Development |
| Residential | 1.13 | 0.38 | 1.52 |
| Hotel | 0.08 | 0.00 | 0.08 |
| Office | 0.07 | 0.01 | 0.08 |
| Artist Studios | 0.00 | 0.03 | 0.03 |
| Research and Development | 0.00 | 0.61 | 0.61 |
| Neighborhood Retail | 0.03 | 0.03 | 0.06 |
| Regional Retail | 0.13 | 0.00 | 0.13 |
| Community Uses | 0.02 | 0.02 | 0.03 |
| Football Stadium | 0.00 | 0.05 | 0.05 |
| Performance Venue | 0.03 | 0.00 | 0.03 |
| **Total demand excluding Parks and Open Space** | **1.49** | **1.11** | **2.60** |
| Parks and Open Space | 0.10 | 0.25 | 0.35 |
| **Total Demand** | **1.59** | **1.36** | **2.95** |
| | | | |
| **End Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| **Indoor Uses** | | | |
| Toilets (low density residential) | 0.03 | 0.01 | 0.04 |
| Toilets (med-high density Residential) | 0.25 | 0.08 | 0.32 |
| Toilets (all other uses) | 0.05 | 0.10 | 0.15 |
| Urinals | 0.01 | 0.02 | 0.02 |
| Laundry (low density residential) | 0.02 | 0.01 | 0.03 |
| Laundry (medium and high density residential) | 0.20 | 0.06 | 0.26 |
| Laundry (all other uses) | 0.02 | 0.03 | 0.04 |
| Shower | 0.19 | 0.08 | 0.27 |
| Bath | 0.02 | 0.01 | 0.02 |
| Faucets | 0.19 | 0.10 | 0.29 |
| Process Water | 0.05 | 0.13 | 0.18 |
| Dishwashers | 0.03 | 0.03 | 0.06 |
| Internal Leakage | 0.16 | 0.09 | 0.25 |
| Other domestic | 0.03 | 0.01 | 0.04 |
| **Subtotal** | **1.24** | **0.76** | **2.00** |
| **Outdoor Uses** | | | |
| Irrigation and landscaping | 0.18 | 0.27 | 0.45 |
| Pools and Fountains | 0.01 | 0.01 | 0.02 |
| Wash down of houses and facilities | 0.01 | 0.01 | 0.02 |
| Car Washing | 0.01 | 0.00 | 0.01 |
| Cooling | 0.02 | 0.05 | 0.07 |
| External Leakage | 0.01 | 0.02 | 0.03 |
| **Subtotal** | **0.24** | **0.36** | **0.60** |
| **Total excluding Parks and Open Space** | **1.49** | **1.11** | **2.60** |
| | | | |
| Parks and Open Space | 0.10 | 0.25 | 0.35 |
| **Total Demand** | **1.59** | **1.36** | **2.95** |

*Note: Rounding errors may occur.

**Table 6: Adjusted to CA Codes demand by land use and end use- Proposed Project**

| | Adjusted to CA Codes Demand (MGD) | | |
|---|---|---|---|
| **Land Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| Residential | 0.87 | 0.29 | 1.16 |
| Hotel | 0.07 | 0.00 | 0.07 |
| Office | 0.06 | 0.01 | 0.07 |
| Artist Studios | 0.00 | 0.02 | 0.02 |
| Research and Development | 0.00 | 0.54 | 0.54 |
| Neighborhood Retail | 0.02 | 0.02 | 0.05 |
| Regional Retail | 0.12 | 0.00 | 0.12 |
| Community Uses | 0.01 | 0.01 | 0.03 |
| Football Stadium | 0.00 | 0.04 | 0.04 |
| Performance Venue | 0.02 | 0.00 | 0.02 |
| **Total demand excluding Parks and Open Space** | **1.18** | **0.94** | **2.11** |
| Parks and Open Space | 0.10 | 0.25 | 0.35 |
| **Total Demand** | **1.28** | **1.19** | **2.46** |
| | | | |
| **End Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| **Indoor Uses** | | | |
| Toilets (low density residential) | 0.01 | 0.01 | 0.02 |
| Toilets (med-high density Residential) | 0.11 | 0.04 | 0.15 |
| Toilets (all other uses) | 0.02 | 0.05 | 0.07 |
| Urinals | 0.00 | 0.01 | 0.01 |
| Laundry (low density residential) | 0.02 | 0.01 | 0.02 |
| Laundry (medium and high density residential) | 0.14 | 0.05 | 0.19 |
| Laundry (all other uses) | 0.01 | 0.02 | 0.03 |
| Shower | 0.15 | 0.06 | 0.21 |
| Bath | 0.02 | 0.01 | 0.02 |
| Faucets | 0.16 | 0.09 | 0.25 |
| Process Water | 0.05 | 0.13 | 0.18 |
| Dishwashers | 0.03 | 0.03 | 0.06 |
| Internal Leakage | 0.16 | 0.09 | 0.25 |
| Other domestic | 0.03 | 0.01 | 0.04 |
| **Subtotal** | **0.93** | **0.58** | **1.51** |
| **Outdoor Uses** | | | |
| Irrigation and landscaping | 0.18 | 0.27 | 0.45 |
| Pools and Fountains | 0.01 | 0.01 | 0.02 |
| Wash down of houses and facilities | 0.01 | 0.01 | 0.02 |
| Car Washing | 0.01 | 0.00 | 0.01 |
| Cooling | 0.02 | 0.05 | 0.07 |
| External Leakage | 0.01 | 0.02 | 0.03 |
| **Subtotal** | **0.24** | **0.36** | **0.60** |
| **Total excluding Parks and Open Space** | **1.18** | **0.94** | **2.11** |
| | | | |
| Parks and Open Space | 0.10 | 0.25 | 0.35 |
| **Total Demand** | **1.28** | **1.19** | **2.46** |

*Note: Rounding errors may occur.

**Table 7: SFGBO demands by land use and end use – Proposed Project**

| Land Use | SFGBO Demand (MGD) Candlestick Point | Hunters Point | Total Development |
|---|---|---|---|
| Residential | 0.61 | 0.22 | 0.83 |
| Hotel | 0.05 | 0.00 | 0.05 |
| Office | 0.04 | 0.00 | 0.04 |
| Artist Studios | 0.00 | 0.01 | 0.01 |
| Research and Development | 0.00 | 0.36 | 0.36 |
| Neighborhood Retail | 0.02 | 0.02 | 0.03 |
| Regional Retail | 0.08 | 0.00 | 0.08 |
| Community Uses | 0.01 | 0.01 | 0.02 |
| Football Stadium | 0.00 | 0.02 | 0.02 |
| Performance Venue | 0.01 | 0.00 | 0.01 |
| **Total demand excluding Parks and Open Space** | **0.82** | **0.64** | **1.47** |
| Parks and Open Space | 0.06 | 0.15 | 0.21 |
| **Total Demand** | **0.88** | **0.79** | **1.67** |
| | | | |
| **End Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| **Indoor Uses** | | | |
| Toilets (low density residential) | 0.01 | 0.01 | 0.02 |
| Toilets (med-high density Residential) | 0.09 | 0.03 | 0.12 |
| Toilets (all other uses) | 0.02 | 0.04 | 0.06 |
| Urinals | 0.00 | 0.00 | 0.00 |
| Laundry (low density residential) | 0.01 | 0.01 | 0.02 |
| Laundry (medium and high density residential) | 0.10 | 0.03 | 0.13 |
| Laundry (all other uses) | 0.01 | 0.01 | 0.02 |
| Shower | 0.10 | 0.04 | 0.15 |
| Bath | 0.02 | 0.01 | 0.02 |
| Faucets | 0.11 | 0.06 | 0.18 |
| Process Water | 0.04 | 0.10 | 0.14 |
| Dishwashers | 0.02 | 0.02 | 0.04 |
| Internal Leakage | 0.12 | 0.07 | 0.19 |
| Other domestic | 0.02 | 0.01 | 0.03 |
| **Subtotal** | **0.68** | **0.42** | **1.11** |
| **Outdoor Uses** | | | |
| Irrigation and landscaping | 0.09 | 0.14 | 0.24 |
| Pools and Fountains | 0.01 | 0.01 | 0.02 |
| Wash down of houses and facilities | 0.01 | 0.01 | 0.02 |
| Car Washing | 0.01 | 0.00 | 0.01 |
| Cooling | 0.01 | 0.04 | 0.05 |
| External Leakage | 0.01 | 0.01 | 0.02 |
| **Subtotal** | **0.14** | **0.22** | **0.36** |
| **Total excluding Parks and Open Space** | **0.82** | **0.64** | **1.47** |
| | | | |
| Parks and Open Space | 0.06 | 0.15 | 0.21 |
| **Total Demand** | **0.88** | **0.79** | **1.67** |

*Note: Rounding errors may occur.

**Table 8: Historical Benchmark demand by land use and end use – R&D Variant**

| Land Use | Historical Benchmark Demand (MGD) | | |
|---|---|---|---|
| | Candlestick Point | Hunters Point | Total Development |
| Residential | 1.13 | 0.38 | 1.52 |
| Hotel | 0.08 | 0.00 | 0.08 |
| Office | 0.07 | 0.01 | 0.08 |
| Artist Studios | 0.00 | 0.03 | 0.03 |
| Research and Development | 0.00 | 1.21 | 1.21 |
| Neighborhood Retail | 0.03 | 0.03 | 0.06 |
| Regional Retail | 0.13 | 0.00 | 0.13 |
| Community Uses | 0.02 | 0.02 | 0.03 |
| Football Stadium | 0.00 | 0.00 | 0.00 |
| Performance Venue | 0.04 | 0.00 | 0.04 |
| **Total demand excluding Parks and Open Space** | **1.49** | **1.67** | **3.16** |
| Parks and Open Space | 0.09 | 0.22 | 0.31 |
| **Total Demand** | **1.58** | **1.89** | **3.47** |
| | | | |
| **End Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| **Indoor Uses** | | | |
| Toilets (low density residential) | 0.03 | 0.01 | 0.04 |
| Toilets (med-high density Residential) | 0.25 | 0.08 | 0.32 |
| Toilets (all other uses) | 0.05 | 0.18 | 0.23 |
| Urinals | 0.01 | 0.02 | 0.03 |
| Laundry (low density residential) | 0.02 | 0.01 | 0.03 |
| Laundry (medium and high density residential) | 0.20 | 0.06 | 0.26 |
| Laundry (all other uses) | 0.02 | 0.05 | 0.07 |
| Shower | 0.19 | 0.09 | 0.28 |
| Bath | 0.02 | 0.01 | 0.02 |
| Faucets | 0.19 | 0.14 | 0.33 |
| Process Water | 0.05 | 0.24 | 0.29 |
| Dishwashers | 0.03 | 0.06 | 0.09 |
| Internal Leakage | 0.16 | 0.12 | 0.28 |
| Other domestic | 0.03 | 0.01 | 0.04 |
| **Subtotal** | **1.25** | **1.08** | **2.33** |
| **Outdoor Uses** | | | |
| Irrigation and landscaping | 0.18 | 0.43 | 0.61 |
| Pools and Fountains | 0.01 | 0.02 | 0.03 |
| Wash down of houses and facilities | 0.01 | 0.01 | 0.02 |
| Car Washing | 0.01 | 0.00 | 0.01 |
| Cooling | 0.02 | 0.10 | 0.12 |
| External Leakage | 0.01 | 0.03 | 0.04 |
| **Subtotal** | **0.24** | **0.59** | **0.83** |
| **Total excluding Parks and Open Space** | **1.49** | **1.67** | **3.16** |
| | | | |
| Parks and Open Space | 0.09 | 0.22 | 0.31 |
| **Total Demand** | **1.58** | **1.89** | **3.47** |

*Note: Rounding errors may occur.

**Table 9: Adjusted to CA Codes demand by land use and end use- R&D Variant**

| | Adjusted to Codes BAU Demand (MGD) | | |
|---|---|---|---|
| **Land Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| Residential | 0.87 | 0.29 | 1.16 |
| Hotel | 0.07 | 0.00 | 0.07 |
| Office | 0.06 | 0.01 | 0.07 |
| Artist Studios | 0.00 | 0.02 | 0.02 |
| Research and Development | 0.00 | 1.08 | 1.08 |
| Neighborhood Retail | 0.02 | 0.02 | 0.05 |
| Regional Retail | 0.12 | 0.00 | 0.12 |
| Community Uses | 0.01 | 0.01 | 0.03 |
| Football Stadium | 0.00 | 0.00 | 0.00 |
| Performance Venue | 0.02 | 0.00 | 0.02 |
| **Total demand excluding Parks and Open Space** | **1.18** | **1.43** | **2.61** |
| Parks and Open Space | 0.09 | 0.22 | 0.31 |
| **Total Demand** | **1.27** | **1.66** | **2.92** |
| | | | |
| **End Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| **Indoor Uses** | | | |
| Toilets (low density residential) | 0.01 | 0.01 | 0.02 |
| Toilets (med-high density Residential) | 0.11 | 0.04 | 0.15 |
| Toilets (all other uses) | 0.02 | 0.08 | 0.11 |
| Urinals | 0.01 | 0.01 | 0.01 |
| Laundry (low density residential) | 0.02 | 0.01 | 0.02 |
| Laundry (medium and high density residential) | 0.14 | 0.05 | 0.19 |
| Laundry (all other uses) | 0.01 | 0.04 | 0.05 |
| Shower | 0.15 | 0.08 | 0.23 |
| Bath | 0.02 | 0.01 | 0.02 |
| Faucets | 0.17 | 0.12 | 0.29 |
| Process Water | 0.05 | 0.24 | 0.29 |
| Dishwashers | 0.03 | 0.05 | 0.08 |
| Internal Leakage | 0.16 | 0.12 | 0.28 |
| Other domestic | 0.03 | 0.01 | 0.04 |
| **Subtotal** | **0.93** | **0.84** | **1.78** |
| **Outdoor Uses** | | | |
| Irrigation and landscaping | 0.18 | 0.43 | 0.61 |
| Pools and Fountains | 0.01 | 0.02 | 0.03 |
| Wash down of houses and facilities | 0.01 | 0.01 | 0.02 |
| Car Washing | 0.01 | 0.00 | 0.01 |
| Cooling | 0.02 | 0.10 | 0.12 |
| External Leakage | 0.01 | 0.03 | 0.04 |
| **Subtotal** | **0.24** | **0.59** | **0.83** |
| **Total excluding Parks and Open Space** | **1.18** | **1.43** | **2.61** |
| | | | |
| Parks and Open Space | 0.09 | 0.22 | 0.31 |
| **Total Demand** | **1.27** | **1.66** | **2.92** |

*Note: Rounding errors may occur.

**Table 10: SFGBO demands by land use and end use – R&D Variant**

| Land Use | SFGBO (MGD) | | |
|---|---|---|---|
| | Candlestick Point | Hunters Point | Total Development |
| Residential | 0.62 | 0.21 | 0.83 |
| Hotel | 0.05 | 0.00 | 0.05 |
| Office | 0.04 | 0.00 | 0.04 |
| Artist Studios | 0.00 | 0.01 | 0.01 |
| Research and Development | 0.00 | 0.71 | 0.71 |
| Neighborhood Retail | 0.02 | 0.02 | 0.03 |
| Regional Retail | 0.08 | 0.00 | 0.08 |
| Community Uses | 0.01 | 0.01 | 0.02 |
| Football Stadium | 0.00 | 0.00 | 0.00 |
| Performance Venue | 0.01 | 0.00 | 0.01 |
| **Total demand excluding Parks and Open Space** | **0.83** | **0.96** | **1.80** |
| Parks and Open Space | 0.05 | 0.14 | 0.19 |
| **Total Demand** | **0.89** | **1.11** | **1.99** |
| | | | |
| **End Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| **Indoor Uses** | | | |
| Toilets (low density residential) | 0.01 | 0.01 | 0.02 |
| Toilets (med-high density Residential) | 0.09 | 0.03 | 0.12 |
| Toilets (all other uses) | 0.02 | 0.07 | 0.09 |
| Urinals | 0.00 | 0.00 | 0.00 |
| Laundry (low density residential) | 0.01 | 0.01 | 0.02 |
| Laundry (medium and high density residential) | 0.10 | 0.03 | 0.13 |
| Laundry (all other uses) | 0.01 | 0.03 | 0.03 |
| Shower | 0.10 | 0.05 | 0.16 |
| Bath | 0.02 | 0.01 | 0.02 |
| Faucets | 0.11 | 0.08 | 0.20 |
| Process Water | 0.04 | 0.18 | 0.22 |
| Dishwashers | 0.02 | 0.03 | 0.05 |
| Internal Leakage | 0.12 | 0.09 | 0.21 |
| Other domestic | 0.02 | 0.01 | 0.03 |
| **Subtotal** | **0.68** | **0.62** | **1.31** |
| **Outdoor Uses** | | | |
| Irrigation and landscaping | 0.09 | 0.22 | 0.32 |
| Pools and Fountains | 0.01 | 0.02 | 0.03 |
| Wash down of houses and facilities | 0.01 | 0.01 | 0.02 |
| Car Washing | 0.01 | 0.00 | 0.01 |
| Cooling | 0.01 | 0.08 | 0.09 |
| External Leakage | 0.01 | 0.02 | 0.03 |
| **Subtotal** | **0.14** | **0.36** | **0.50** |
| **Total excluding Parks and Open Space** | **0.83** | **0.96** | **1.80** |
| | | | |
| Parks and Open Space | 0.05 | 0.14 | 0.19 |
| **Total Demand** | **0.89** | **1.11** | **1.99** |

*Note: Rounding errors may occur.

**Table 11: Historical Benchmark demand by land use and end use – Housing Variant**

| Land Use | Historical Benchmark Demand (MGD) Candlestick Point | Hunters Point | Total Development |
|---|---|---|---|
| Residential | 0.94 | 0.58 | 1.52 |
| Hotel | 0.08 | 0.00 | 0.08 |
| Office | 0.07 | 0.01 | 0.08 |
| Artist Studios | 0.00 | 0.03 | 0.03 |
| Research and Development | 0.00 | 0.61 | 0.61 |
| Neighborhood Retail | 0.03 | 0.03 | 0.06 |
| Regional Retail | 0.13 | 0.00 | 0.13 |
| Community Uses | 0.02 | 0.02 | 0.03 |
| Football Stadium | 0.00 | 0.00 | 0.00 |
| Performance Venue | 0.04 | 0.00 | 0.04 |
| **Total demand excluding Parks and Open Space** | **1.29** | **1.26** | **2.56** |
| Parks and Open Space | 0.11 | 0.25 | 0.36 |
| **Total Demand** | **1.40** | **1.51** | **2.92** |
| | | | |
| **End Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| **Indoor Uses** | | | |
| Toilets (low density residential) | 0.05 | 0.05 | 0.10 |
| Toilets (med-high density Residential) | 0.18 | 0.09 | 0.26 |
| Toilets (all other uses) | 0.05 | 0.10 | 0.15 |
| Urinals | 0.01 | 0.01 | 0.02 |
| Laundry (low density residential) | 0.04 | 0.04 | 0.08 |
| Laundry (medium and high density residential) | 0.14 | 0.07 | 0.21 |
| Laundry (all other uses) | 0.02 | 0.03 | 0.04 |
| Shower | 0.16 | 0.11 | 0.26 |
| Bath | 0.01 | 0.01 | 0.02 |
| Faucets | 0.16 | 0.13 | 0.29 |
| Process Water | 0.05 | 0.13 | 0.18 |
| Dishwashers | 0.03 | 0.03 | 0.06 |
| Internal Leakage | 0.14 | 0.11 | 0.25 |
| Other domestic | 0.03 | 0.01 | 0.04 |
| **Subtotal** | **1.07** | **0.91** | **1.98** |
| **Outdoor Uses** | | | |
| Irrigation and landscaping | 0.17 | 0.26 | 0.43 |
| Pools and Fountains | 0.01 | 0.01 | 0.02 |
| Wash down of houses and facilities | 0.01 | 0.01 | 0.02 |
| Car Washing | 0.00 | 0.00 | 0.01 |
| Cooling | 0.02 | 0.05 | 0.07 |
| External Leakage | 0.01 | 0.02 | 0.03 |
| **Subtotal** | **0.22** | **0.35** | **0.57** |
| **Total excluding Parks and Open Space** | **1.29** | **1.26** | **2.56** |
| | | | |
| Parks and Open Space | 0.11 | 0.25 | 0.36 |
| **Total Demand** | **1.40** | **1.51** | **2.92** |

*Note: Rounding errors may occur.

**Table 12: Adjusted to CA Codes demand by land use and end use- Housing Variant**

| | Adjusted to Codes BAU Demand (MGD) | | |
|---|---|---|---|
| **Land Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| Residential | 0.72 | 0.44 | 1.16 |
| Hotel | 0.07 | 0.00 | 0.07 |
| Office | 0.06 | 0.01 | 0.07 |
| Artist Studios | 0.00 | 0.02 | 0.02 |
| Research and Development | 0.00 | 0.54 | 0.54 |
| Neighborhood Retail | 0.02 | 0.02 | 0.05 |
| Regional Retail | 0.12 | 0.00 | 0.12 |
| Community Uses | 0.01 | 0.01 | 0.03 |
| Football Stadium | 0.00 | 0.00 | 0.00 |
| Performance Venue | 0.02 | 0.00 | 0.02 |
| **Total demand excluding Parks and Open Space** | **1.03** | **1.05** | **2.08** |
| Parks and Open Space | 0.11 | 0.25 | 0.36 |
| **Total Demand** | **1.14** | **1.30** | **2.44** |
| | | | |
| **End Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| **Indoor Uses** | | | |
| Toilets (low density residential) | 0.02 | 0.02 | 0.05 |
| Toilets (med-high density Residential) | 0.08 | 0.04 | 0.12 |
| Toilets (all other uses) | 0.02 | 0.04 | 0.07 |
| Urinals | 0.01 | 0.00 | 0.01 |
| Laundry (low density residential) | 0.03 | 0.03 | 0.06 |
| Laundry (medium and high density residential) | 0.10 | 0.05 | 0.15 |
| Laundry (all other uses) | 0.01 | 0.02 | 0.03 |
| Shower | 0.13 | 0.09 | 0.21 |
| Bath | 0.01 | 0.01 | 0.02 |
| Faucets | 0.14 | 0.11 | 0.25 |
| Process Water | 0.05 | 0.13 | 0.18 |
| Dishwashers | 0.03 | 0.03 | 0.06 |
| Internal Leakage | 0.14 | 0.11 | 0.25 |
| Other domestic | 0.03 | 0.01 | 0.04 |
| **Subtotal** | **0.80** | **0.70** | **1.50** |
| **Outdoor Uses** | | | |
| Irrigation and landscaping | 0.17 | 0.26 | 0.43 |
| Pools and Fountains | 0.01 | 0.01 | 0.02 |
| Wash down of houses and facilities | 0.01 | 0.01 | 0.02 |
| Car Washing | 0.00 | 0.00 | 0.01 |
| Cooling | 0.02 | 0.05 | 0.07 |
| External Leakage | 0.01 | 0.02 | 0.03 |
| **Subtotal** | **0.22** | **0.35** | **0.57** |
| **Total excluding Parks and Open Space** | **1.03** | **1.05** | **2.08** |
| | | | |
| Parks and Open Space | 0.11 | 0.25 | 0.36 |
| **Total Demand** | **1.14** | **1.31** | **2.44** |

*Note: Rounding errors may occur.

**Table 14: SFGBO demands by land use and end use – Housing Variant**

| Land Use | SFGBO (MGD) | | |
|---|---|---|---|
| | Candlestick Point | Hunters Point | Total Development |
| Residential | 0.51 | 0.33 | 0.83 |
| Hotel | 0.05 | 0.00 | 0.05 |
| Office | 0.04 | 0.00 | 0.04 |
| Artist Studios | 0.00 | 0.01 | 0.01 |
| Research and Development | 0.00 | 0.36 | 0.36 |
| Neighborhood Retail | 0.02 | 0.02 | 0.03 |
| Regional Retail | 0.08 | 0.00 | 0.08 |
| Community Uses | 0.01 | 0.01 | 0.02 |
| Football Stadium | 0.00 | 0.00 | 0.00 |
| Performance Venue | 0.01 | 0.00 | 0.01 |
| **Total demand excluding Parks and Open Space** | **0.72** | **0.73** | **1.45** |
| Parks and Open Space | 0.06 | 0.15 | 0.22 |
| **Total Demand** | **0.78** | **0.88** | **1.66** |
| | | | |
| **End Use** | **Candlestick Point** | **Hunters Point** | **Total Development** |
| **Indoor Uses** | | | |
| Toilets (low density residential) | 0.02 | 0.02 | 0.04 |
| Toilets (med-high density Residential) | 0.06 | 0.03 | 0.10 |
| Toilets (all other uses) | 0.02 | 0.03 | 0.05 |
| Urinals | 0.00 | 0.00 | 0.00 |
| Laundry (low density residential) | 0.02 | 0.02 | 0.04 |
| Laundry (medium and high density residential) | 0.07 | 0.03 | 0.11 |
| Laundry (all other uses) | 0.01 | 0.01 | 0.02 |
| Shower | 0.09 | 0.06 | 0.15 |
| Bath | 0.01 | 0.01 | 0.02 |
| Faucets | 0.10 | 0.08 | 0.18 |
| Process Water | 0.04 | 0.10 | 0.14 |
| Dishwashers | 0.02 | 0.02 | 0.04 |
| Internal Leakage | 0.10 | 0.08 | 0.19 |
| Other domestic | 0.02 | 0.01 | 0.03 |
| **Subtotal** | **0.58** | **0.51** | **1.10** |
| **Outdoor Uses** | | | |
| Irrigation and landscaping | 0.08 | 0.14 | 0.22 |
| Pools and Fountains | 0.01 | 0.01 | 0.02 |
| Wash down of houses and facilities | 0.01 | 0.01 | 0.02 |
| Car Washing | 0.00 | 0.00 | 0.01 |
| Cooling | 0.01 | 0.04 | 0.05 |
| External Leakage | 0.01 | 0.01 | 0.02 |
| **Subtotal** | **0.13** | **0.22** | **0.34** |
| **Total excluding Parks and Open Space** | **0.72** | **0.73** | **1.45** |
| | | | |
| Parks and Open Space | 0.06 | 0.15 | 0.22 |
| **Total Demand** | **0.78** | **0.88** | **1.66** |

*Note: Rounding errors may occur.

Potential reclaimed water demands and sanitary flows by end use were estimated for the Proposed Project and Project Variants. These are provided below in Table 16 through Table 22.

**Table 16: Reclaimed water demands by end use – Proposed Project**

| End Use | Reclaimed Water Demands by End Use (MGD) | | |
|---|---|---|---|
| | Historical Benchmark | Adjusted to CA Codes | SFGBO |
| Toilets (residential) | 0.36 | 0.17 | 0.14 |
| Toilets (non-residential)) | 0.15 | 0.07 | 0.06 |
| Urinals | 0.02 | 0.01 | 0.00 |
| Process Water (non-residential) | 0.18 | 0.18 | 0.14 |
| Irrigation and landscaping (residential) | 0.12 | 0.12 | 0.06 |
| Irrigation and Landscaping (non-residential) | 0.33 | 0.33 | 0.16 |
| Pools and Fountains (residential) | 0.01 | 0.01 | 0.01 |
| Pools and Fountains (non-residential) | 0.01 | 0.01 | 0.01 |
| Wash down (residential) | 0.01 | 0.01 | 0.01 |
| Wash down (non-residential) | 0.01 | 0.01 | 0.01 |
| Car Washing (residential) | 0.01 | 0.01 | 0.01 |
| Car Washing (non-residential) | 0.00 | 0.00 | 0.00 |
| Cooling (non-residential) | 0.07 | 0.07 | 0.05 |
| **Total flow excluding Parks and Open Space** | **1.30** | **1.00** | **0.66** |
| Parks and Open Space | 0.35 | 0.35 | 0.21 |
| **Total Demand** | **1.65** | **1.35** | **0.87** |

*Note: Rounding errors may occur.

**Table 15: Sanitary flows by end use – Proposed Project**

| End Use | Sanitary Flows by End Use (MGD) | | |
|---|---|---|---|
| | Historical Benchmark | Adjusted to CA Codes | SFGBO |
| Toilets | 0.52 | 0.24 | 0.19 |
| Urinals | 0.02 | 0.01 | 0.00 |
| Laundry | 0.34 | 0.24 | 0.17 |
| Shower | 0.27 | 0.21 | 0.15 |
| Bath | 0.02 | 0.02 | 0.02 |
| Faucets | 0.29 | 0.25 | 0.18 |
| Process Water | 0.18 | 0.18 | 0.14 |
| Dishwashers | 0.06 | 0.06 | 0.04 |
| Other domestic | 0.04 | 0.04 | 0.03 |
| Cooling | 0.07 | 0.07 | 0.05 |
| **Total** | **1.82** | **1.33** | **0.98** |

*Note: Rounding errors may occur.

**Table 16: Reclaimed water demands by end use – R&D Variant**

| End Use | Reclaimed Water Demands by End Use (MGD) | | |
|---|---|---|---|
| | Historical Benchmark | Adjusted to Codes BAU | SFGBO |
| Toilets (residential) | 0.36 | 0.17 | 0.14 |
| Toilets (non-residential)) | 0.23 | 0.11 | 0.09 |
| Urinals | 0.03 | 0.01 | 0.00 |
| Process Water (non-residential) | 0.29 | 0.29 | 0.22 |
| Irrigation and landscaping (residential) | 0.12 | 0.12 | 0.06 |
| Irrigation and Landscaping (non-residential) | 0.49 | 0.49 | 0.25 |
| Pools and Fountains (residential) | 0.01 | 0.01 | 0.01 |
| Pools and Fountains (non-residential) | 0.02 | 0.02 | 0.02 |
| Wash down (residential) | 0.01 | 0.01 | 0.01 |
| Wash down (non-residential) | 0.02 | 0.02 | 0.02 |
| Car Washing (residential) | 0.01 | 0.01 | 0.01 |
| Car Washing (non-residential) | 0.00 | 0.00 | 0.00 |
| Cooling (non-residential) | 0.12 | 0.12 | 0.09 |
| **Total flow excluding Parks and Open Space** | **1.71** | **1.37** | **0.90** |
| Parks and Open Space | 0.31 | 0.31 | 0.19 |
| **Total Demand** | **2.02** | **1.69** | **1.09** |

*Note: Rounding errors may occur.

**Table 17: Sanitary flows by end use – R&D Variant**

| End Use | Sanitary Flows by End Use (MGD) | | |
|---|---|---|---|
| | Historical Benchmark | Adjusted to CA Codes | SFGBO |
| Toilets | 0.60 | 0.27 | 0.22 |
| Urinals | 0.03 | 0.01 | 0.00 |
| Laundry | 0.36 | 0.26 | 0.18 |
| Shower | 0.28 | 0.23 | 0.16 |
| Bath | 0.02 | 0.02 | 0.02 |
| Faucets | 0.33 | 0.29 | 0.20 |
| Process Water | 0.29 | 0.29 | 0.22 |
| Dishwashers | 0.09 | 0.08 | 0.05 |
| Other domestic | 0.04 | 0.04 | 0.03 |
| Cooling | 0.12 | 0.12 | 0.09 |
| **Total** | **2.16** | **1.61** | **1.18** |

*Note: Rounding errors may occur.

**Table 18: Reclaimed water demands by end use – Housing Variant**

| End Use | Reclaimed Water Demands by End Use (MGD) | | |
|---|---|---|---|
| | Historical Benchmark | Adjusted to Codes BAU | SFGBO |
| Toilets (residential) | 0.36 | 0.17 | 0.14 |
| Toilets (non-residential)) | 0.15 | 0.07 | 0.05 |
| Urinals | 0.02 | 0.01 | 0.00 |
| Process Water (non-residential) | 0.18 | 0.18 | 0.14 |
| Irrigation and landscaping (residential) | 0.12 | 0.12 | 0.06 |
| Irrigation and Landscaping (non-residential) | 0.30 | 0.30 | 0.15 |
| Pools and Fountains (residential) | 0.01 | 0.01 | 0.01 |
| Pools and Fountains (non-residential) | 0.01 | 0.01 | 0.01 |
| Wash down (residential) | 0.01 | 0.01 | 0.01 |
| Wash down (non-residential) | 0.01 | 0.01 | 0.01 |
| Car Washing (residential) | 0.01 | 0.01 | 0.01 |
| Car Washing (non-residential) | 0.00 | 0.00 | 0.00 |
| Cooling (non-residential) | 0.07 | 0.07 | 0.05 |
| **Total flow excluding Parks and Open Space** | **1.26** | **0.97** | **0.64** |
| Parks and Open Space | 0.37 | 0.37 | 0.22 |
| **Total Demand** | **1.63** | **1.34** | **0.86** |

*Note: Rounding errors may occur.

**Table 22: Sanitary flows by end use – Housing Variant**

| End Use | Sanitary Flows by End Use (MGD) | | |
|---|---|---|---|
| | Historical Benchmark | Adjusted to CA Codes | SFGBO |
| Toilets | 0.51 | 0.23 | 0.19 |
| Urinals | 0.02 | 0.01 | 0.00 |
| Laundry | 0.34 | 0.24 | 0.17 |
| Shower | 0.26 | 0.21 | 0.15 |
| Bath | 0.02 | 0.02 | 0.02 |
| Faucets | 0.29 | 0.25 | 0.18 |
| Process Water | 0.18 | 0.18 | 0.14 |
| Dishwashers | 0.06 | 0.06 | 0.04 |
| Other domestic | 0.04 | 0.04 | 0.03 |
| Cooling (50% flow to sewer) | 0.07 | 0.07 | 0.05 |
| **Total** | **1.80** | **1.32** | **0.97** |

*Note: Rounding errors may occur.

# 4 Assumptions and References

This section describes assumptions used to:

1) Estimate historical baseline demands;
2) Distribute the historical baseline demands to specific end uses such as toilets, showers, irrigation etc…;
3) Adjust the historical baseline demands to current California code; and
4) Adjust the to-code demands to a sustainable case wherein efficiency measures such as efficient fixturesare applied. The efficiency measures applied in the Sustainable Case have been tailored to meet the demand reduction requirements of the SFGBO.

**Table 20: Assumptions for estimating water demands by land use for the Historical Benchmark case .**

| Assumptions Summary for Historical Benchmark Demand Estimation | | | | | | |
|---|---|---|---|---|---|---|
| **Land use** | **ID#** | **Description** | **Value** | **Unit** | **Reference or Assumption** | **Notes** |
| **Residential** | | | | | | |
| | 1 | No. of residents per unit - low density | 2.33 | residents | Mundie & Associates, 2009 | |
| | 2 | No. of residents per unit - medium density | 2.33 | residents | Mundie & Associates, 2009 | |
| | 3 | No. of residents per unit - high density | 2.33 | residents | Mundie & Associates, 2009 | |
| | 4 | Average consumption per capita | 62 | gallons per day (gp) | SFPUC, 2005 | |
| | 5 | Average outdoor water use for single family residences | 10 | % | SFPUC, 2005 | Note reference states that average demand is less than 10% |
| **Regional Retail** | | | | | | |
| | 1 | Regional Retail jobs creation | 350 | Square feet (sqft)/job | Economic and Planning Systems, 2009. | |
| | 2 | Area of retail space per customer | 22 | sqft/customer | British Standards Institution. 2006 | |
| | 3 | Sewage generation per employee | 10 | gpd | EPA, 2002 | Sewage generation is only a fraction of overall consumption |
| | 4 | Sewage generation per visitor | 2 | gpd | EPA, 2002 | EPA sites 2 gpd / parking spot. Sewage generation is only a fraction of overall consumption |
| | 5 | Average outdoor water use for non-residential customers | 43 | percent | URS, 2004. | |
| | 6 | Ratio of sewage generation to total water consumed on site | 57 | percent | Assumed based on URS 2004. | Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Neighborhood Retail** | | | | | | |
| | 1 | Neighborhood retail jobs creation | 270 | sqft/job | Economic and Planning Systems, 2009. | |
| | 2 | Area of retail space per customer | 22 | sqft/customer | British Standards Institution. 2006 | |
| | 3 | Sewage generation per employee | 10 | gpd | EPA, 2002 | Sewage generation is only a fraction of overall consumption |
| | 4 | Water  generation per visitor | 2 | gpd | EPA, 2002 | EPA sites 2 gpd / parking spot. Sewage generation is only a fraction of overall consumption |
| | 5 | Average outdoor water use for non-residential customers | 43 | percent | URS, 2004. | Sewage generation is only a fraction of overall consumption |
| | 6 | Ratio of sewage generation to total water consumed on site | 57 | percent | Assumed based on URS 2004. | Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer |
| **Office** | | | | | | |
| | 1 | Office job creation | 276 | sqft/job | Economic and Planning Systems, 2009. | |
| | 2 | Residential jobs creation | 25 | Units/job | Economic and Planning Systems, 2009. | |
| | 3 | Water consumption per employee | 85 | gpd | URS, 2004. | |
| | 4 | Average outdoor water use for non-residential customers | 43 | percent | URS, 2004. | |
| | 5 | Ratio of sewage generation to total water consumed on site | 57 | percent | Assumed based on URS 2004. | Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer |
| **Community Uses** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | Community use job creation | 276 | sqft/job | Assumed similar to office | Actual Community uses are not finalized therefore community use water demands have been estimated in a similar manner as office land use. |
| | 2 | Water consumption per employee | 85 | gpd | Assumed similar to office | |
| | 3 | Average outdoor water use for non-residential customers | 43 | percent | Assumed similar to office | |
| | 4 | Ratio of sewage generation to total water consumed on site | 57 | percent | Assumed similar to office | Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer |
| **Research and Development** | | | | | | |
| | 1 | R&D jobs creation (office) | 267 | sqft/job | Economic and Planning Systems, 2009. | |
| | 2 | Sewage generation per employee for office R&D space | 85 | gpd | URS, 2004. | Sewage generation is only a fraction of overall consumption |
| | 3 | Average outdoor water use for non-residential customers for all R&D | 43 | percent | URS, 2004. | Sewage generation is only a fraction of overall consumption |
| | 4 | Ratio of sewage generation to total water consumed on site | 57 | percent | Assumed based on URS 2004. | Assumption is conservative in that some water consumed indoors would not go to sanitary sewer |
| | 5 | Type of R&D Spaces | 1/3,1/3, and 1/3 | Fraction | Email from Lennar | From email correspondence with Lennar it has been assumed that 1/3 of the R&D space will be office, 1/3 will be wet laboratory, and the remaining 1/3 will be light production which is similar to industrial. |
| | 6 | Water Usage for Wet Laboratory R&D Space | 0.547 | gpsfd | 2020 UC Berkeley LRDP Draft EIR (http://www.cp.berkeley.edu/LRDP_2020 draft.htm) - Table 4.13-1 | Source provided by Winzler & Kelly. The report states that 0.32 is for sustainable lab case with efficient fixtures built in, and calculations were worked backwards to calculate the BAU. |
| | 7 | Water usage profile for | Varies | % | URS, 2004 | The water usage profile for wet lab |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Wet Lab Space | | | | space has been assumed to be the average of the commercial and industrial usage profile. |
| | 8 | Water Usage for Light Projection R&D Space | 0.1 | gpsfd | City of Los Angeles, L.A. CEQA Threshold Guide, 2006, Exhibit M.2. - 12 Sewage Generation Factors | |
| **Hotel** | | | | | | |
| | 1 | Hotel job creation | 700 | sqft/job | Economic and Planning Systems, 2009 | |
| | 2 | Average guest room size | 600 | sqft | Assumed | This includes the space for reception, kitchens and conference facilities |
| | 3 | Average guests / room | 1.9 | guests | Assumed | |
| | 4 | Sewage generation per guest | 50 | gpd | EPA, 2002 | Sewage generation is only a fraction of overall consumption |
| | 5 | Sewage generation per employee | 10 | gpd | EPA, 2002 | Sewage generation is only a fraction of overall consumption |
| | 6 | Average outdoor water use for non-residential customers | 43 | percent | URS, 2004. | Sewage generation is only a fraction of overall consumption |
| | 7 | Ratio of sewage generation to total water consumed on site | 57 | percent | Assumed based on URS 2004. | Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer |
| **Artist Studios** | | | | | | |
| | 1 | # of artists | 252 | people | Lennar, 2009 | |
| | 2 | Consumption per artist | 85 | gpd | URS, 2004. | |
| **Parks and Open Space** | | | | | | |
| | 1 | Total irrigation demand from landscape architect | 350,180 | gpd | Per landscape irrigation prepared by RHAA 7/31/08 | |
| **Football Stadium** | | | | | | |
| | 1 | Football games / year | 10 | Home games | Economic and Planning Systems, 2009. | |
| | 2 | Attendance at football games | 69000 | people | Economic and Planning Systems, 2009. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3 | Other venues per year | 20 | Other venues | Economic and Planning Systems, 2009. | |
| | 4 | Attendance at other venues | 37500 | people | Lennar, 2009 | |
| | 5 | Employees (football day) | 3625 | people | Stadium Staffing Numbers from SF 49ers, (Lennar, 2009) | Includes 2900 employees and 725 media personnel |
| | 6 | Employees (event day) | 1,922 | people | Pro-rated using football day attendance and employees on football days | |
| | 7 | Employee (nonevent days) | 48 | people | Stadium Staffing Numbers from SF 49ers, (Lennar, 2009) | |
| | 8 | No. of players/performers (event day) | 200 | people | Assumed | 100 people per team for players and staff. Assumed same number for other event days |
| | 9 | Stadium average daily irrigation | 23979 | gpd | Marty Laporte, 2009 | |
| | 10 | Sewage generation per seat and employee on game days | 4 | gpd | EPA, 2002. | EPA value is for "auditorium" Sewage generation is only a fraction of overall consumption |
| | 11 | Ratio of sewage generation to indoor water consumption | 95 | percent | Assumed based on URS 2004. | Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer |
| | 12 | Water consumption per permanent employee per day | 85 | gpd | URS, 2004. | |
| **Performance Venue** | | | | | | |
| | 1 | Performance venue job creation | 40 | seats/job | Economic and Planning Systems, 2009. | |
| | 2 | Performance events per year | 250 | events | Economic and Planning Systems, 2009. | |
| | 3 | Employees - typical day | 7 | people | Assumed | Prorated to be similar to stadium |
| | 4 | Visitors per performance | 10,000 | people | Per CP/HPS development program, 2009 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 6 | Water consumption per permanent employee per day | 85 | gpd | URS, 2004. | |
| | 7 | Sewage generation per seat and employee on event days | 4 | gpd | EPA, 2002. | EPA value is for "auditorium". Sewage generation is only a fraction of overall consumption |
| | 12 | Ratio of sewage generation to indoor water consumption | 95 | percent | Assumed based on URS 2004. | Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer |
| **Sanitary Sewer** | | | | | | |
| | 1 | Percent of indoor consumption to sanitary sewer | 100% | Percent | Assumed per URS 2004 and conversations with W&K | |
| | 2 | Cooling demands assumed to contribute to sanitary sewer. (Non Res) | | | Assumed per conversations with W&K | Though some losses may occur, 100% of cooling demand is assumed to go to sanitary sewer |

**Table 23: End use demand distributions by land use (URS 2004)**

Table 3-3
End-Use Data - Initial Percentage Assumptions

| End Use | Initial Percentages by Customer-Billing Category | | | | |
|---|---|---|---|---|---|
| | Single-Family Residential | Multi-Family Residential | Commercial | Industrial | Institutional |
| **Indoor Usage** | | | | | |
| Toilets (indoor) | 26.7% | 26.7% | 25% | 23% | 20% |
| Urinals (indoor) | NA | NA | 0% | 7% | 0% |
| Laundry (indoor) | 21.7% | 21.7% | 8% | 5% | 10% |
| Showers (indoor) | 16.8% | 16.8% | 5% | 5% | 16% |
| Bath (indoor) | 1.7% | 1.7% | NA | NA | NA |
| Faucets (indoor) | 15.7% | 15.7% | 10% | 15% | 19% |
| Process (indoor) | NA | NA | 34% | 30% | 5% |
| Dishwashers (indoor) | 1.4% | 1.4% | 8% | 5% | 15% |
| Internal Leakage (indoor) | 13.7% | 13.7% | 10% | 10% | 15% |
| Other Domestic (indoor) | 2.2% | 2.2% | NA | NA | NA |
| **Outdoor Usage** | | | | | |
| Irrigation and Landscaping (outdoor) | 80% | 80% | 75% | 65% | 70% |
| Pools and Fountains (outdoor) | 5% | 5% | 2% | 5% | 5% |
| Wash-down of house/facilities (outdoor) | 5% | 5% | 3% | 0% | 5% |
| Car Washing (outdoor) | 5% | 5% | 0% | 0% | 0% |
| Cooling (outdoor) | 0% | 0% | 15% | 25% | 15% |
| External Leakage (outdoor) | 5% | 5% | 5% | 5% | 5% |

NA – Not Applicable

*Sources: AWWARF, Konen (1986), Behling et al. (1992)*

**Table 25: Assumed end use distributions for the stadium and performance venue**

| | | |
|---|---|---|
| Indoor Usage | % | 95% |
| Outdoor Usage | % | 5% |
| | | |
| **Indoor Uses** | | |
| Toilets | % | 30% |
| Urinals | % | 30% |
| Laundry | % | 0% |
| Shower | % | 5% |
| Bath | % | 0% |
| Faucets | % | 15% |
| Process Water | % | 10% |
| Dishwashers | % | 0% |
| Internal Leakage | % | 10% |
| Other domestic | % | 0% |
| **Outdoor Uses** | | |
| Irrigation and landscaping | % | 20% |
| Pools and Fountains | % | 0% |
| Wash down of houses and facilities | % | 20% |
| Car Washing | % | 0% |
| Cooling | % | 50% |
| External Leakage | % | 10% |

**Table 27: Assumptions used to adjust between water demand scenarios**

| | Historical Benchmark | | Adjusted to CA Code | | SFGBO | | |
|---|---|---|---|---|---|---|---|
| | Max Flow or Quantity | Note / Reference | Max Flow or Quantity | Note / Reference | Max Flow or Quantity | Note/Reference | Unit |
| ***Plumbing Fixture*** | | | | | | | |
| Lavatory faucet, private | 2.5 | | 2.2 | 2007 California Plumbing Code | 1.5 | EPA WaterSense | gpm at 60 psi |
| Lavatory faucet, public, (metering) | 0.25 | | 0.25 | 2006 International Plumbing Code | 0.2 | CA Green Building Standard 2008 | gallon per metering cycle |
| (not metering) | 0.6 | | 0.5 | IPC | 0.5 | n.a. | gpm at 60 psi |
| Shower head | 3.125 | URS 2004* | 2.5 | 2007 California Plumbing Code | 1.75 | EPA WaterSense | gpm at 80 psi |
| Sink faucet | 2.5 | | 2.2 | Plumbing Code | 1.5 | EPA WaterSense | gpm at 60 psi |
| Urinal | 2 | URS 2004* | 1 | 2007 California Plumbing Code | 0.125 | EPA Water Sense | gallon per flushing cycle |
| Water closet | 3.5 | URS 2004* | 1.6 | 2007 California Plumbing Code | 1.28 | EPA Water Sense and CA Green Building Standard 2008 | gallon per flushing cycle |
| ***Other Appliances*** | | | | | | | |
| Dishwasher (Residential) | 7 | | 6 | US Department of Energy 2007 | 4 | Energy Star | gallons/cy capacity |
| Dishwasher (Commercial) | 1.75 | | 1.46 | Energy Star | 0.92 | Energy Star | gallons per rack |
| Laundry | 36.4 | URS 2004 | 26 | (US Federal Standard by 2011) | 18 | n.a. (calc) | gal/load |
| Laundry | 13.2 | | 8.5 | CA Green Building Standard 2008 | 6 | EPA Water Sense | gal/load-cf (Water Factor) |
| ***Irrigation*** | | | | | | | |
| Private Lands | | Based on water demand distribution | | California Water Efficient Landscape Ordinance (CWELO) | 50% | CA Green Building Standard 2008 | Fractional reduction compared to CWELO |
| Public Open Space | | Per Landscape Architect Estimates | | Per Landscape Architect Estimates - Note that this is less than CWELO | 50% | CA Green Building Standard 2008 | Fractional reduction compared to CWELO |

**Table 24: Other assumptions used to adjust the CA code demand to the SFGBO**

| | | |
|---|---|---|
| **Improved Cooling Efficiency** | | |
| Total fraction demand reductiont due to building envelope improvement measures and improved cooling technologies | 0.25 | |
| | | |
| **Reduced Losses** | | |
| Fractional demand reduction due to new piping and metering | 0.25 | |

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**FUTURE DEMANDS**

**Residential (Indoor) New Unit**

| | | | Annual Demand (MG/yr) | Annual Demand (mgd) | Peak Month Demand (mgd) |
|---|---|---|---|---|---|
| | # of persons per new unit | 2.3 | | | |
| | # of new units | 7248 | | | |
| | leaks | 5% | | | |
| | gal/person/day | gal/unit/day | | | |
| Toilet Flushing | 6.46 | 14.87 | 39.3 | 0.108 | 0.108 |
| Laundry | 6.29 | 14.47 | 38.3 | 0.105 | 0.105 |
| Shower | 10.13 | 23.29 | 61.6 | 0.169 | 0.169 |
| Bathtub | 4.0 | 9.20 | 24.3 | 0.067 | 0.067 |
| Dishwashing | 0.96 | 2.21 | 5.8 | 0.016 | 0.016 |
| Bath Faucet | 1.95 | 4.49 | 11.9 | 0.033 | 0.033 |
| Kitchen Faucet | 9.90 | 22.77 | 60.2 | 0.165 | 0.165 |
| Leaks | | 4.56 | 12.1 | 0.033 | 0.033 |
| **Subtotal Residential New Tower** | 39.7 | 95.85 | 254 | 0.69 | 0.69 |

**Residential (Indoor) Existing Tower Unit**

| | | | | | |
|---|---|---|---|---|---|
| | # of persons per ex tower unit | 2.3 | | | |
| | # of ex tower units | 1638 | | | |
| | leaks | 10% | | | |
| | gal/person/day | gal/unit/day | | | |
| Toilet Flushing | 8.08 | 18.58 | 11.1 | 0.030 | 0.030 |
| Laundry | 5.85 | 13.46 | 8.0 | 0.022 | 0.022 |
| Shower | 8.00 | 18.39 | 11.0 | 0.030 | 0.030 |
| Bathtub | 4.0 | 9.20 | 5.5 | 0.015 | 0.015 |
| Bath Faucet | 1.95 | 4.49 | 2.7 | 0.007 | 0.007 |
| Kitchen Faucet | 11.30 | 25.98 | 15.5 | 0.043 | 0.043 |
| Leaks | | 9.01 | 5.4 | 0.015 | 0.015 |
| **Subtotal Residential Ex. Tower** | 39.2 | 99.10 | 59 | 0.16 | 0.16 |

**Non-Residential**

| | square feet | g/sf/yr | | | |
|---|---|---|---|---|---|
| Retail | 203,900 | 15 | 3.059 | 0.008 | 0.008 |
| Office | 120,100 | 8 | 0.961 | 0.003 | 0.003 |
| Educational | 21,600 | 10 | 0.216 | 0.001 | 0.001 |
| Maintenance | 15,000 | 20 | 0.300 | 0.001 | 0.001 |
| Fitness Club | 54,700 | 130 | 7.111 | 0.019 | 0.019 |
| Structured Parking | 2,917,400 | 0.1 | 0.292 | 0.001 | 0.001 |
| | | **Subtotal Non-Residential** | 11.9 | 0.03 | 0.033 |

**Irrigation**

| | acres | | | |
|---|---|---|---|---|
| Public Open Space | 49 | 22.72 | 0.06 | 0.16 |
| Courtyards | 12.3 | 5.70 | 0.02 | 0.04 |
| Farm | 3 | 1.71 | 0.005 | 0.011 |
| Playing Fields | 1.8 | 1.13 | 0.003 | 0.008 |
| Pond | 0.8 | 0.12 | 0.0003 | 0.004 |
| | **Subtotal Irrigation** | 31.4 | 0.09 | 0.22 |
| | **TOTAL** | 297 | 0.98 | 1.11 |

**Parkmerced Water Demands September 2009**

## EXISTING UNITS

**Base Case (existing code)**

| | Shower | Bath Faucet | WC | Bathtub | Kitchen | Dishwasher | Laundry | Total Per Person |
|---|---|---|---|---|---|---|---|---|
| gpm/gpf/gpl | 2.5 | 1.5 | 3.5 | 40 | 2.2 | | 40.9 | |
| uses/person/day | 0.65 | 1.5 | 5.05 | 0.1 | 1.0 | | 0.37 | |
| minutes | 8.2 | | | | 7.5 | | | |
| gallons/day | 13.33 | 2.25 | 17.68 | 4.0 | 16.57 | | 15.13 | 68.95 |

**Efficient Fixtures**

| | Shower | Bath Faucet | WC | Bathtub | Kitchen | Dishwasher | Laundry | Total Per Person |
|---|---|---|---|---|---|---|---|---|
| gpm/gpf/gpl | 1.5 | 1.3 | 1.6 | 40 | 1.5 | | 15 | |
| uses/person/day | 0.65 | 1.5 | 5.05 | 0.1 | 1.0 | | 0.39 | |
| minutes | 8.2 | | | | 7.5 | | | |
| gallons/day | 8.0 | 2.0 | 8.08 | 4.0 | 11.30 | | 5.9 | 39.17 |

**Super Efficient Fixtures**

| | Shower | Bath Faucet | WC | Bathtub | Kitchen | Dishwasher | Laundry | Total Per Person |
|---|---|---|---|---|---|---|---|---|
| gpm/gpf/gpl | 1.5 | 1.0 | 1.1 | 40 | 1.34 | | 15 | |
| uses/person/day | 0.65 | 1.5 | 5.05 | 0.1 | 1.0 | | 0.39 | |
| minutes | 8.2 | | | | 7.5 | | | |
| gallons/day | 8.00 | 1.50 | 5.56 | 4.00 | 10.09 | | 5.9 | 34.99 |

## NEW UNITS

**Base Case (existing code)**

| | Shower | Bath Faucet | WC | Bathtub | Kitchen | Dishwasher | Laundry | Total Per Person |
|---|---|---|---|---|---|---|---|---|
| gpm/gpf/gpl | 1.9 | 1.5 | 1.6 | 40 | 2.2 | 12.5 | 26 | |
| uses/person/day | 0.65 | 1.5 | 5.05 | 0.1 | 1.0 | 0.10 | 0.37 | |
| minutes | 8.2 | | | | 6.6 | | | |
| gallons/day | 10.13 | 2.25 | 8.08 | 4.00 | 14.52 | 1.25 | 9.62 | 49.85 |

**Efficient Fixtures**

| | Shower | Bath Faucet | WC | Bathtub | Kitchen | Dishwasher | Laundry | Total Per Person |
|---|---|---|---|---|---|---|---|---|
| gpm/gpf/gpl | 1.9 | 1.3 | 1.28 | 40 | 1.5 | 9.6 | 17 | |
| uses/person/day | 0.65 | 1.5 | 5.05 | 0.1 | 1.0 | 0.10 | 0.37 | |
| minutes | 8.2 | | | | 6.6 | | | |
| gallons/day | 10.1 | 1.95 | 6.46 | 4.0 | 9.9 | 1.0 | 6.29 | 39.69 |

**Super Efficient Fixtures**

| | Shower | Bath Faucet | WC | Bathtub | Kitchen | Dishwasher | Laundry | Total Per Person |
|---|---|---|---|---|---|---|---|---|
| gpm/gpf/gpl | 1.5 | 0.5 | 1.1 | 40 | 1.3 | 4 | 9.9 | |
| uses/person/day | 0.65 | 1.5 | 5.05 | 0.1 | 1.0 | 0.13 | 0.39 | |
| minutes | 8.2 | | | | 6.6 | | | |
| gallons/day | 8.00 | 0.75 | 5.56 | 4.00 | 8.6 | 0.52 | 3.9 | 31.26 |

current retrofit

find cut sheet or reference

model numbers for cut sheets:

| | | |
|---|---|---|
| bath faucet | 2.2 gpm | |
| | 1.5 gpm | EPA WaterSense |
| | 1.3 gpm | SFPUC Conservation Model |
| | 1.0 gpm | *Niagara_* ***faucet*** *_aerator_N3210-SAW* |
| | 0.5 gpm | Kohler K-15597-P-CP |
| toilets | 1.6 gpf | |
| | 1.28 gpf | Green Building Standard (2008) |
| | 1.1 gpf | Kohler K-3519 |
| kitchen faucet | 2.2 gpm | |
| | 1.5 gpm | 1.5 *GPM* Niagara Dual-Spray *Kitchen* Aerator |
| | 1.3 gpm | SFPUC Conservation Model |
| laundry (commercial) | | |
| | 40.9 gpl | SFPUC Conservation Model |
| | 15 gpl | Maytag MAH21PD |

| | | |
|---|---|---|
| laundry (private) | | |
| | 26 gpl | US Federal Standard (2011) |
| | 17 gpl | SFPUC Conservation Model |
| | 9.9 gpl | Asko |
| dishwasher | | |
| | 12.5 gpl | SFPUC Conservation Model |
| | 9.6 gpl | |
| | 4 gpl | |
| shower | 2.5 gpm | CA Plumbing Code (2007) |
| | 1.9 gpm | SFPUC Conservation Model |
| | 1.75 gpm | EPA WaterSense |
| | 1.5 gpm | |

## TOTALS BY UNIT

**Existing Units to Remain**

| # of units | persons per unit | leaks |
|---|---|---|
| 1638 | 2.3 | 10% |

| | gpcd | gal/unit/day | total (mgd) | total (MG/yr) |
|---|---|---|---|---|
| code | 75.8 | 174.4 | 0.286 | 104.3 |
| efficient | 43.09 | 99.1 | 0.162 | 59.2 |
| super efficient | 38.49 | 88.5 | 0.145 | 52.9 |

**New Units**

| # of units | persons per unit | leaks |
|---|---|---|
| 7248 | 2.3 | 5% |

| | gpcd | gal/unit/day | total (mgd) | total (MG/yr) |
|---|---|---|---|---|
| code | 52.3 | 120.4 | 0.873 | 318.5 |
| efficient | 41.68 | 95.9 | 0.695 | 253.6 |
| super efficient | 32.82 | 75.5 | 0.547 | 199.7 |

**Weighted Average**

| | gpcd | gal/unit/day | total (mgd) | total (MG/yr) |
|---|---|---|---|---|
| code | 56.7 | 130.3 | 0.945 | 344.8 |
| efficient | 41.9 | 96.5 | 0.699 | 255.2 |
| super efficient | 33.9 | 77.9 | 0.565 | 206.1 |

## TOTALS BY SITE

**TOTAL RESIDENTIAL**

| | MGD | MG/YR |
|---|---|---|
| code | 1.158 | 422.8 |
| efficient | 0.857 | 312.8 |
| super efficient | 0.692 | 252.7 |

**NON-POTABLE RESIDENTIAL** — toilet flushing new units, plus all laundry

| | MGD | MG/YR |
|---|---|---|
| code | 0.352 | 128.5 |
| efficient | 0.235 | 85.6 |
| super efficient | 0.179 | 65.3 |

**POTABLE RESIDENTIAL**

| | MGD | MG/YR |
|---|---|---|
| code | 0.806 | 294.3 |
| efficient | 0.622 | 227.2 |
| super efficient | 0.513 | 187.3 |

Parkmerced Existing Demand Backup documentation – June 25, 2009
Beth Goldstein, P.E. Hydroconsult Engineers, Inc.

**EXISTING:**

| | POTABLE | | NON-POTABLE | | TOTAL | |
|---|---|---|---|---|---|---|
| | MG/yr | mgd | MG/yr | mgd | MG/yr | mgd |
| **Residential (Indoor)** | 202 | 0.55 | - | - | 202 | 0.55 |
| **Non-Residential** | - | - | - | - | - | - |
| **Irrigation** | 58 | 0.16 | - | - | 0 | 0.16 |
| | 260 | 0.71 | - | - | 202 | 0.71 |

**FULL BUILD-OUT: (previously reported)**

| | POTABLE | | NON-POTABLE | | TOTAL | |
|---|---|---|---|---|---|---|
| | MG/yr | mgd | MG/yr | mgd | MG/yr | mgd |
| **Residential (Indoor)** | 272 | 0.74 | 50.1 | 0.14 | 322 | 0.88 |
| **Non-Residential** | 12 | 0.03 | - | - | 12 | 0.03 |
| **Irrigation** | - | - | 31 | 0.09 | 31 | 0.09 |
| | 284 | 0.78 | 82 | 0.22 | 365 | 1.00 |

**FULL BUILD-OUT: (w/efficient fixtures)**

| | POTABLE | | NON-POTABLE | | TOTAL | |
|---|---|---|---|---|---|---|
| | MG/yr | mgd | MG/yr | mgd | MG/yr | mgd |
| **Residential (Indoor)** | 227 | 0.62 | 85.6 | 0.23 | 313 | 0.86 |
| **Non-Residential** | 8 | 0.02 | 3.6 | 0.01 | 12 | 0.03 |
| **Irrigation** | - | - | 31 | 0.09 | 31 | 0.09 |
| | 236 | 0.65 | 121 | 0.33 | 356 | 0.98 |

Notes: Existing demands calculated from residential billing records 2006-7 and irrigation billing records 2005-2006.

Future non-potable demand includes toilet flushing in new units, all laundry, and all irrigation.

# 7. WATER SYSTEM

## 7.1 Existing System

### 7.1.1 Existing Water Supply

There are two existing sources of water supply serving Treasure Island. The primary supply is provided by the San Francisco Public Utilities Commission (SFPUC) through an existing 10-inch diameter steel pipe attached to the western span of the Bay Bridge. Water is pumped across the bridge by a pumping station located at 475 Spear Street in San Francisco. The station contains four pumps each rated at 900 gpm. The station can run a maximum of two pumps at a time for a maximum station output of 1,800 gpm.

The existing back up supply of water is provided by the East Bay Municipal Utility District (EBMUD) through a 12-inch diameter ductile iron main connected to an EBMUD water meter at Beach Street in Emeryville. From this location, water is delivered to a pump station located at Pier E23 of the existing Bay Bridge in Oakland. Water is then pumped through a 12-inch diameter steel pipe attached to the eastern span of the Bay Bridge. This water supply charges the fire hydrants on the Bridge and is connected to the existing water tanks on YBI for an emergency backup water supply. The maximum flow rate for this system is reported to be 1,500 gpm. There is currently an agreement in place between EBMUD and the Navy that limits the average annual flow 61 gallons per minute to maintain water quality in the line on the bridge. Actual average annual flows are well below that limit, at approximately 35 gpm.

### 7.1.2 Existing Water Storage

There are currently four existing concrete reservoirs on Yerba Buena Island that service both Yerba Buena Island and Treasure Island. Combined they have a total design capacity of approximately 6.5 million gallons to serve as both the potable and fire protection water supplies for Treasure Island and Yerba Buena Island. However, all of the tanks are in varying states of disrepair and cannot operate to their full design capacity. The actual operating storage capacity is approximately 1.9 million gallons with another 0.5 million gallons dedicated for fire protection. The design capacities, operating capacities, and operating elevations of the existing reservoirs are shown in Table 7.1.

**Table 7.1 – Existing Reservoir Data**

| Reservoir Number | Design Capacity (million gallons) | Current Operating Capacity (million gallons) | Operating Elevation Range (NAVD88) | Primary Service |
|---|---|---|---|---|
| 227 | 3.0 | 0.0 | 252.5 to 255.5 | TI |
| 162 | 2.0 | 1.3 | 322.0 to 327.0 | YBI |
| 168 | 0.5 | 0.5 | 356.0 to 359.0 | Fire Reserve |
| 242 | 1.0 | 0.6 | 247.0 to 251.0 | TI/YBI |

The elevations of the existing reservoirs provide an operating pressure of approximately 100-115 psi on TI and 80 psi on YBI (pressures at the higher areas of YBI are achieved with booster pumps).

The existing water storage tanks range in age from 60 to 85 years, and studies indicate that they are all in poor condition and will require either major rehabilitation or replacement.

### 7.1.3 Existing Water Distribution System

The original piping systems for a separate potable water and fire protection system for the Islands was constructed in 1939 out of copper, galvanized steel, and asbestos cement pipe. In 1990, the two systems were combined and the pipe material replaced with PVC pipe. Many of the individual building services and irrigation services originally constructed out of galvanized steel, however, have not been replaced. The relatively new PVC pipe system will be utilized on an interim basis during the initial phases of construction, but will eventually be replaced at the full build out of the project.

## 7.2 Proposed Domestic Water System

### 7.2.1 Proposed Water Demand

The estimated water demand for the proposed Land Use Plan is presented on Table 7.2. This estimate includes demand for the new development as well as the existing demand for the Department of Labor and the Coast Guard. The demand factors for the various facilities are indicated in the notes at the bottom of the table. The project will include the use of recycled water for irrigation and appropriate plumbing in the commercial use buildings. The potable demand factors included in Table 7.2 account for the use of water conserving fixtures in all buildings, the use of recycled water for toilet flushing and other non potable water uses in commercial buildings, and the use of recycled water for irrigation uses where appropriate. Recycled water demands are shown in Table 9.1 and 9.2A of Section 9, Recycled Water System.

As shown on Table 7.2, the average daily demand is estimated to be 1.08 millions gallons per day, or 753 gallons per minute (gpm). Because of the size of the proposed development, the relatively homogeneous use, and the use of recycled water for the irrigation needs, the project will use a maximum day demand factor of 1.2 times the average daily demand. Therefore, the maximum daily demand is 1.3 million gallons per day or 904 gpm.

The project will be designed to provide fire flow of 3,500 gallons per minute. This will be adequate to accommodate new construction. The existing Buildings 2 and 3 are designated to remain and will be retrofitted with appropriate supplemental fire protection systems when they are remodeled for commercial use. The fire protection systems designs for these structures will need to consider the building construction, use, and available fire flow.

### 7.2.2 Proposed Water Supply

#### 7.2.2.1 Primary Water Supply

The existing SFPUC pump station in San Francisco and 10-inch line on the western span of the Bay Bridge is adequate to provide the required water supply to the project at full buildout and will continue to be the primary supply of water to Treasure Island. As with other water systems in the City, the SFPUC will need to monitor the condition of the pump station and supply line and perform routine maintenance and repairs to ensure reliable service to the islands.

#### 7.2.2.2 Secondary Water Supply Source

The proposed secondary water supply to Treasure Island will continue to be from the EBMUD service in Oakland. Caltrans' construction of the new eastern span of the Bay Bridge, the Eastern Span Seismic Safety Project (ESSSP), is requiring modifications to the EBMUD service near the bridge abutment in Oakland and across the bridge. The new improvements will include:

- Relocation of the water main to the new Bay Bridge abutment.
- New pump station near the new bridge abutment in Oakland.
- New stub and shut off valve on YBI near column line XXX of the new bridge structure.

All of these items will be constructed as part of the ESSSP in cooperation with the SFPUC, and are not considered part of this project.

In addition to the secondary water source improvements associated with the new Bay Bridge project, the alignment of the secondary water source on YBI will be revised to as shown on Figure 7.1. The new alignment will follow North Gate Drive and Macalla Road to the new water tank locations.

The EBMUD back-up system will be capable of delivering approximately 1,800 gpm during emergency conditions. The system will continue to operate within the existing limit of 61 gallons per minute in average annual flow. This modest routine use is needed to maintain the water quality in the line across the Bay Bridge.

**8,000 Residential Units + 100,000 Office**

**Table 7.2 - Treasure Island Redevelopment Project Water Demand**

| DESCRIPTION OF USE | | | | | | POTABLE DEMAND | | |
|---|---|---|---|---|---|---|---|---|
| Notes | Land Use | Units | Rooms | Area | Unit | Average Daily Demand (gpd) | Average Daily Demand (gpm) | Maximum Daily Demand (gpm) (Note 12) |
| 1 | **Residential** | 8,000 | | | ea | 912,000 | 633 | 760 |
| 2 | **Hotel** | | 500 | | ea | 132,500 | 92 | 110 |
| 3 | **Retail/Commercial** | | | 370,000 | sf | 25,900 | 18 | 22 |
| 4 | **Miscellaneous Structures** | | | 75,000 | sf | 7,500 | 5 | 6 |
| 5 | **Adaptive Reuse** | | | 325,000 | sf | 55,957 | 39 | 47 |
| 6 | **Police/Fire** | | | 30,000 | sf | 4,000 | 3 | 3 |
| 7 | **Treasure Island School** | | | 105,000 | sf | 21,000 | 15 | 18 |
| 8 | **Department of Labor (DOL)** | | 900 | | | 111,542 | 77 | 93 |
| 9 | **Coast Guard Facility** | | | | | 17,000 | 12 | 14 |
| 10 | **Open Space** | | | 300 | ac | 30,000 | 21 | 25 |
| 11 | **Urban Farm** | | | 20 | ac | 2,000 | 1 | 2 |
| | **Totals** | | | | | **1,319,399** | **916** | **1,099** |

Notes:

1 50 gallons per capita per day (gpcd), based on water conserving projections for 2030, based on 6000 units at 2.28 residents per dwelling unit. Population per dwelling unit based on City average from Demands Report

2 Potable use based on 265 gpd/room; this includes all uses within the hotel. Recycled use based on 7 gallons recycled water per room per day (toilet flushing). Assumes no grounds for irrigation. Water demand based on AWWA standards.

3 Potable use based on 0.07 gpd/sf of retail/commercial space

4 YBI Historic: Potable use based on 1 person per 200 SF, 20 gpcd total water use, minus 5 gpcd recycled water for toilets

5 Potable use based on 50 persons per acre at 150 gpcd, recycled use based on 20 gpcd.

6 Potable use based on 400 persons per day at 15 gpcd total water use, minus recycled water use (toilets) at 5 gpcd

7 1 Student per 100 SF, 20 gpd per students

8 Value based on 2007 monthly demand provided by S. Larano, SFPUC.

9 Value provided by S. Larano, SFPUC.

10 100 gpd/acre

11 100 gpd/acre

12 Maximum daily demand 120% of average daily demand

#### 7.2.3 Proposed Water Storage

The existing water tanks that serve YBI and TI are in poor condition and need major repair or replacement in order to serve the proposed project. To meet current SFPUC requirements, the Project will replace the existing water storage tanks in phases. The new water storage tanks will be sized to serve both the proposed new uses, as well as the existing uses that will remain.

The SFPUC water storage requirements for Treasure Island will be 2 days of maximum daily demand plus 4 hours of fire flow, or approximately 3.4 million gallons of storage.

The redundant water source from EBMUD provides an equal, compatible, and reliable back up water source to Treasure Island. If either SFPUC or EBMUD system is taken off line for maintenance, power interruptions, or damage due to earthquake, the other source will continue to supply 1,800 gpm, sufficient to meet the peak daily demands for the development. In the extremely unlikely event that both water supplies are taken down at the same time, then 2 days of maximum daily demand plus four 4 hours of fire storage should be sufficient to bridge the time for repairs or evacuation of the Island. It should also be noted that in such an event of extreme emergency, the consumption of potable water would likely be much lower than the calculated average demand shown in Table 7.2. Assuming reasonable reductions in retail, hotel, public and cultural uses that would naturally result following events of dire emergency the potable emergency demand would be significantly less than the average demand under normal conditions.

In addition to the normal operational storage requirements described above, the storage design will also need the ability to accommodate the maintenance of storage tanks. During maintenance, one tank, or portions of a tank, will need to taken out of service. During these regularly scheduled maintenance periods the SFPUC requires that the Treasure Island project maintain a minimum storage of 1 day maximum daily demand plus 4 hours of fire storage, or approximately 2.1 million gallons, at all times.

In order to meet the emergency and maintenance storage requirements, the water storage will be provided in two tanks. The existing 1.0 million gallon, circular, steel water storage tank adjacent to Macalla Road will be replaced with a new 1.0 million gallon, above grade, circular, steel water storage tank in the existing location. The remainder of the storage will be in a 2.4 million gallon water storage tank located at a higher elevation on YBI. Two locations are being considered for this tank as shown on Figure 7.2. The final location of this tank will be determined during the Master Planning phase of the project. The 2.4 million gallon tank will be divided into two 1.2 million gallon cells to accommodate maintenance and provide a minimum of 2.2 million gallons of storage at all times during maintenance. Together, the two tanks will provide 3.4 million gallons of storage. The final sizes, configuration and locations of the water storage tanks are described in more detail in the "Treasure Island and Yerba Buena Island Water Service Area Master Plan and Tank Siting Study" (Appendix E)

The upper storage tank (2.4 million gallons) will be supplied by water pumped directly from the 10-inch supply line from San Francisco, and the back up supply from EBMUD during emergencies. Supply to the lower, 1.0 million gallon tank will flow from the 2.4 million gallon tank by gravity. Because of the elevation of the 1.0 million gallon tank, it is likely that there will need to be a pressure reducing valve between the tank and the Treasure Island service area. The 2.4 million gallon tank is not high enough to provide service with adequate pressure to the upper portions of YBI. Fire flow and domestic demands to these YBI areas will be provided by an adjacent booster pump station with multiple pumps and emergency generator.

#### 7.2.4 Proposed Domestic Water Distribution System

Through phased development of YBI and Treasure Island the existing PVC water distribution system will be replaced with a new ductile iron water system installed to SFPUC standards. Based on preliminary calculation, we anticipate that new water mains will range in size from 8 inches at minimum to a maximum size of 24 inches. A conceptual layout of the proposed domestic water distribution system is shown on Figure 7.1.

The California Code of Regulations, Title 22, requires that the water distribution system be capable of delivering the maximum daily demand coincident with the required fire flow. Based on the preliminary demand calculations described above, the proposed water system will be designed to deliver the maximum daily demand of 882 gpm along with the design fire flow of 3,500 gpm with a minimum residual pressure of 20 pounds per square inch to the fire hydrants on the Island.

### 7.3 Proposed Bay Water Auxiliary Water Supply System (AWSS)

Treasure Island and YBI do not currently have an AWSS system for fire protection. The project proposes to construct a new bay water AWSS system on TI as a backup fire protection system in the unlikely event of an extended total disruption of water supplies to Treasure Island. AWSS is not planned for Yerba Buena Island due to its steep topography, smaller size and development, and proximity to storage tanks and water supply lines on the Bay Bridge. The exact nature of the AWSS system is still being discussed with the San Francisco Fire Department (SFFD). It is expected that TI's AWSS may provide the following:

- A pump station with a salt-water intake pipe
- Two pipe manifolds for connection to fireboats
- Up to twenty-nine fire hydrants
- A main trunk pipe connecting the pump station, manifolds, and fire hydrants
- Three suction hydrants

The proposed bay water AWSS system discussed with TIDA, SFPUC and SFFD is shown on Figure 7.3. A brief description of the main elements of the AWSS system are as follows:

Pump Station and Intake Structure
The AWSS pump station and intake structure will be capable of continually charging the system and delivering 3,500 gpm of bay water at a maximum pressure of 125 psi. The pump station will include a diesel emergency power generator and additional pumps to provide redundancy during emergencies.

The water is drawn through a horizontal, large diameter draft tube (steel or concrete pipe) with a trash rack on the end to prevent uptake of debris. The draft tube connects to the vertical pump pit (precast concrete box or large diameter manhole), in which the pump intake pipe is located. A retractable fish screen may be included at the interface of the draft tube and the pump pit to prevent fish from entering into the pump system. Portions of the pump station will be contained in a pump house, for protection from weather and damage. See Figure 7.3.1.

Distribution Piping
A dedicated underground piping system will distribute the bay water within the developed areas of TI; dedicated bay water AWSS hydrants will be provided along the distribution route.

Fireboat Manifolds
The fireboat manifolds will be located near the ferry quay and near Pier 1. The manifolds will allow the fireboats to connect to the AWSS system and charge the lines in the unlikely event the pump station fails or additional flow/pressure is required in the system. When connected to the pipe manifold, the fireboat will draw salt water via its on-board pumps which may have a minor effect on the natural environment; this is assumed to be inherent to the operation of the fireboat and is beyond the scope of the AWSS.

Suction Hydrants
Three suction hydrants will be located around the perimeter of Treasure Island that will allow fire trucks to draft water directly from the Bay. Suction hydrants, also called Bay Suction connections, allow fire engines to draft water directly from the Bay. The hydrant is similar to typical fire hydrants, however there is no connection to a pressurized, piped water supply – the hydrant is connected to an intake pipe leading into the Bay. To prevent debris from entering the intake pipes, the end of the pipe may be fitted with a screen. See Figure 7.3.1.

**Potential Bay Regulatory Issues**
Construction and operation of the AWSS may potentially affect the Bay environment. Descriptions of the potential temporary and permanent effects on the environment, as well as ways in which those effects could possibly be reduced, are described below:

1. Temporary Construction Effects:
   Construction of the draft tube and suction hydrant pipes will require temporary shoreline excavation in the vicinity of the intakes, construction of temporary shoring,

and backfill/replacement of existing shoreline revetment. See Figure 7.3.2 – 4 for approximate areas of potential effect. Measures to reduce the possible temporary environmental effects of this work could include:

- Limit the amount of disturbed area below the mean high water mark as much as feasible.
- Prohibit the use of materials that may reduce water quality
- Follow erosion control plans to keep sediment from entering the Bay
- Follow site maintenance plans to eliminate construction debris from entering the Bay

2. Permanent Construction Effects
The pump station draft tube and suction hydrant intake pipes will permanently extend through the shoreline revetment into the bay (below low water). This will be similar to other pipe penetrations through the shoreline for storm drain outfalls. Measures to reduce the possible permanent effects on the environmental from this work, could include:
    - Limit the amount of permanent improvements below the mean high water mark as much as feasible.
    - Prohibit the use of materials that may reduce water quality

3. AWSS Operational Effects
The intake structures have the potential to create a vortex at the end of intakes (pump station draft tube and suction hydrant intake pipes) which could constitute a hazard at the water surface if not addressed. To prevent this, the end of the intakes could be enlarged or otherwise designed to prevent vortex formation.

a. There may be potential effects on fish during the regular testing of the AWSS system. The effect will depend largely on the anticipated usage of the AWSS, which will depend on the frequency and duration of scheduled tests of the system. For short-duration tests to verify the operational functionality of the system, measures – such as fish screens – to prevent fish uptake may not be necessary. If fish screens are required, the affect on fish in the Bay will depend on the design of the fish screen in accordance with the following parameters:
    - Size of openings (based on species and size of fish to be protected);
    - Porosity (percent open area of screen face);
    - Approach velocity (perpendicular to screen face);
    - Sweeping velocity (parallel to screen face).

    In the event that the AWSS is operated to suppress actual fires, the system will be used for a longer duration than that used for periodic testing; consequently, the effect on the environment could be greater. However, it is assumed that any effects that occur as a result of an actual emergency will be acceptable as a unique, singular event, and that the emergency needs will govern.

The final designs for the AWSS intake structures will be submitted to the appropriate agencies for review and approval prior to construction. The permitting agencies will include the Bay Conservation and Development Commission (BCDC), Army Corps of Engineers, Regional Water Quality Control Board, California Department of Fish and Game, and United States Fish and Wildlife Service.

### 7.4 Phases for Water System Construction

The new water infrastructure to support development of the project will be installed in phases to match development of the project. The existing land uses on Treasure Island will continue to utilize the existing water distribution system with temporary connections to the new system and temporary water infrastructure where required to maintain the existing uses until they are demolished or permanent connections can be made. Water storage will be brought on-line as required to support the water demands of the project as it develops.

### 7.5 Master Utility System Plans and Master Fire Protection Plan

A Water System Master Plan will be prepared in coordination with the SFPUC and the SFFD during the development of the DDA. The Water System Master Plan will include detailed calculation to size pipes, domestic water system layout, proposed water tank locations and project phasing. The Master Plan is not expected to substantially change the supply, storage and distribution of water described here.

### 7.6 Sustainability Goals

The construction of the secondary water source from EBMUD, combined with the reconstruction of the entire water storage and delivery system on Yerba Buena and Treasure Islands will provide a robust water supply to sustain and protect the island community. This new system combined with water conserving fixtures within the new buildings, and the maximum feasible use of recycled water for the landscape areas and commercial buildings within the core development area (see below) will meet, or exceed, the goals described in the Sustainability Plan.

# 9. RECYCLED WATER SYSTEM

To support the goals of the Sustainability Plan, and to meet the SFPUC requirements for use of recycled water, this Infrastructure Plan includes a program to utilize recycled water for irrigation and for building plumbing.

## 9.1 Existing System

Treasure Island does not currently have a recycled water system.

## 9.2 Proposed System

### 9.2.1 Recycled Water Demand

The use of recycled water is proposed for irrigation of the open space areas, the urban farm, roadside planter areas, landscape water features, and for use in appropriate plumbing fixtures within commercial buildings. Recycled water will not be used for indoor residential use or irrigation in the residential areas.

The Treasure Island open space program includes approximately 300 acres of open space, including a 20-acre urban farm. The development plan calls for 25-acres of the open space area to be planted in turf grass for recreational use. These areas will require permanent, long-term irrigation. The remainder of the open space area will be planted with native and adapted drought tolerant species that require significantly less or no irrigation after being irrigated for the first two years for plant establishment. The largest irrigation demand will take place during the dry months of April through October, with peak irrigation demands expected in July. In addition, the irrigation demands for open space also include a component of flow to maintain the storm water treatment wetlands during the dry weather months. Recycled water demand for irrigation will increase with phased construction of the open space, peaking with the completion of the large natural park area on the north end of the island in the last phase of construction. Demand will then be reduced as the natural areas are established and removed from the irrigation system. Changes to the open space program will subsequently modify the irrigation demand, therefore the recycled water plant will need to be coordinated and sized as part of the open space and landscape design process.

The recycled water demand within commercial buildings will be consistent and occur throughout the year.

Based on the requirements described above, the required recycled water demand is estimated to be as follows:

**Table 9.1 -Recycled Water Demand –Plant Establishment Period (through completion of open space construction)**

| Description | Average | Peak |
|---|---|---|
| General Open Space Irrigation | 0.13 | 0.19 |
| Urban Farm | 0.04 | 0.06 |
| Recreation Fields | 0.08 | 0.11 |
| Stormwater Wetland | 0.03 | 0.04 |
| Commercial Building Plumbing | 0.15 | 0.15 |
| **Total Recycled Water Demand** | **0.43 mgd** | **0.55 mgd** |

**Table 9.1A -Recycled Water Demand – Long Term**

| Description | Average | Peak |
|---|---|---|
| General Open Space Irrigation | 0.08 | 0.12 |
| Urban Farm | 0.04 | 0.06 |
| Recreation Fields | 0.08 | 0.11 |
| Stormwater Wetland | 0.03 | 0.04 |
| Commercial Building Plumbing | 0.15 | 0.15 |
| **Total Recycled Water Demand** | **0.38 mgd** | **0.48 mgd** |

#### 9.2.2 Proposed Recycled Water Supply

The August 13, 2006 Brown and Caldwell (B&C) report *Evaluation of Wastewater and Recycled Water Treatment Alternatives for the Proposed Treasure Island Development* (Appendix F) evaluated, at a planning level, the recycled water options for Treasure Island. Although the recycled water demands described in the B&C report have been updated based on the more recent irrigation demand numbers described above, and the type of on-island treatment process has been updated (refer to Section 8-Wastewater System), the analysis in that report still holds. The report reviewed general options for on-island and off-island supply of recycled water, and recommended a new on-island Recycled Water Treatment Plant.

Recycled water supply will be provided by an on-island recycled water plant sized to provide the average long-term recycled water demand of 0.38 mgd. The recycled water treatment plant will be constructed adjacent to the WWTF and include a 0.3 million gallon storage tank in order to meet the long-term peak demands of 0.48 mgd. Details of the proposed recycled treatment plant are included in Appendix G.

The on-island recycled water treatment plant will be sized to meet the long-term demand estimates. If the recycled water demand exceeds the recycled water supply during the first phases of development and the plant establishment period, the excess irrigation demand will be met with the potable water system. The proposed potable water storage built at the beginning of the project will be sufficient to supplement the recycled water supply in the early phases of the project when the domestic demand has not reached build-out levels. During the period of development when the potable water supply is needed to supplement the recycled water demand, the potable water system will be temporarily connected to the recycled water system. This temporary connection will include a backflow prevention device approved by the SFPUC. The connection will be removed once the recycled supply is sufficient to meet the demands.

#### 9.2.3 Proposed Recycled Water Distribution

Distribution piping for recycled water will be provided on TI (see Figure 9.1). Recycled water will not be used on YBI due to its distance from the recycled treatment plant and the pumping that would be required to meet the elevation change. The pipe material will be selected to meet the SFPUC requirements. Alternative pipe materials such as High Density Polyethylene (HDPE) or polyvinyl chloride (PVC) will also be explored with the SFPUC and SFDPW. Distribution pressure and flow requirements will be provided by a hydro pneumatic pressure system constructed near the storage at the recycled water plant.

### 9.3 Phases for Recycled Water System Construction

The Recycled Water Treatment Plant will be constructed concurrent with the Wastewater Treatment Facility. The recycled water distribution piping will be constructed in phases along with the other infrastructure systems. As noted above, during the initial phases the landscaping and building plumbing systems will utilize the potable water source until the recycled water treatment plant is complete. Once the treatment facility is complete, and the irrigation demand stabilizes to meet long-term demand projections, the connections to the potable water lines will be removed.

### 9.4 Master Utility Plans

A detailed Master Recycled Water Plan will be prepared in coordination with the SFPUC during the development of the DDA. The plan will provide additional design details for the above-described system, including the recycled water plant design requirements, detailed layouts and hydraulic calculations for the reclaimed water system, and system phasing plans. The Master Plan is not anticipated to substantially change the approach to recycled water provision described here.

### 9.5 Sustainability Goals

The use of recycled water for irrigation and building plumbing is a major component of the Treasure Island Sustainability Plan. The construction of the recycled water plant will provide the necessary irrigation for the open space landscaping included in the Land Use Plan as well as the required plumbing fixtures in the proposed commercial buildings. The supply of recycled water will achieve the goal of reducing the overall consumption of potable water from the municipal supply.

# APPENDIX E TABLE 7.2 TREASURE ISLAND PROJECT WATER DEMAND WITH RECYCLED WATER FOR RESIDENTIAL USES (NOVEMBER 2009)

**APPENDIX E: Table 7.2 - Treasure Island Project Water Demand (8,000 Residential Units + 100,000 sf Office) with Recylced Water for Residential Toilet Flushing**

| DESCRIPTION OF USE | | | POTABLE WATER DEMAND | | | RECYCLED WATER DEMAND (with recycled water residential toilet) | | TOTAL WATER DEMAND | SEWER DEMAND | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | No. | Unit | Average Daily Demand (gpd) | Average Daily Demand (gpm) | Maximum Daily Demand (gpm) (Note 11) | Average Daily Irrigation Demand (gpd) | Average Daily Building Demand (gpd) | Average Daily Demand (gpd) | Average Daily Demand (gpd) | |
| **Residential** **(with toilet recycled water)** | 8,000 | Units | 812,704 | 564 | 677 | 30,000 | 119,296 | 962,000 | 891,365 | 1 |
| **Hotel** | 500 | Rooms | 132,500 | 92 | 110 | | 3,500 | 136,000 | 129,375 | 2 |
| **Office** | 100,000 | sf | 7,000 | 5 | 6 | | 3,500 | 10,500 | 10,150 | 3 |
| **Retail** | 140,000 | sf | 9,800 | 7 | 8 | | 4,900 | 14,700 | 14,210 | 3 |
| **Adaptive Reuse, General** | 244,000 | sf | 17,080 | 12 | 14 | | 8,540 | 25,620 | 24,766 | 3 |
| **Adaptive Reuse, Retail** | 67,000 | sf | 4,690 | 3 | 4 | | 2,345 | 7,035 | 6,801 | 3 |
| **Open Space** | 300 | ac | 30,000 | 21 | 25 | 180,000 | 0 | 210,000 | 28,500 | 9 |
| **Miscellaneous Structures** | 75,000 | sf | 5,625 | 4 | 5 | | 1,875 | 7,500 | 7,219 | 4 |
| **Marina** | 400 | Slips | 20,000 | 14 | 17 | | 0 | 20,000 | 19,000 | 12 |
| **Treasure Island School** | 105,000 | sf | 21,000 | 15 | 18 | | 0 | 21,000 | 19,950 | 6 |
| **Police/Fire** | 30,000 | sf | 4,000 | 3 | 3 | | 2,000 | 6,000 | 5,800 | 5 |
| **Misc. Small Community Facilities** | 13,500 | sf | 945 | 1 | 1 | | 473 | 1,418 | 1,370 | 3 |
| **Pier 1 Community Center** | 35,000 | sf | 2,450 | 2 | 2 | | 1,225 | 3,675 | 3,553 | 3 |
| **TI Sailing Center** | 15,000 | sf | 1,050 | 1 | 1 | | 525 | 1,575 | 1,523 | 3 |
| **Museum** | 75,000 | sf | 5,250 | 4 | 4 | | 2,625 | 7,875 | 7,613 | 3 |
| **Department of Labor (DOL)** | 900 | Rooms | 111,542 | 77 | 93 | | 0 | 111,542 | 105,965 | 7 |
| **Coast Guard Facility** | | | 17,000 | 12 | 14 | | 0 | 17,000 | 16,150 | 8 |
| **Utility Facilities** | 14,000 | sf | 980 | 1 | 1 | | 490 | 1,470 | 1,421 | 3 |
| **Urban Farm** | 20 | ac | 2,000 | 1 | 2 | 60,000 | 0 | 62,000 | 1,900 | 10 |
| **Totals** | | | **1,205,616** | **837** | **1,005** | **270,000** | **151,294** | **1,626,910** | **1,296,629** | |

Notes:

1 Potable water demand based on 50 gallons per capita per day (gpcd) minus 6.4 gpcd recycled water for toilets, based on water conserving projections for 2030, 8,000 homes at 2.33 residents per dwelling unit. Population per dwelling unit based on City average from Demands Report. Includes 30,000 gpd irrigation (CMG 8/7/09 spreadsheet)

2 Potable use based on 265 gpd/room; this includes all uses within the hotel. Recycled use based on 7 gallons recycled water per room per day (toilet flushing). Assumes no grounds for irrigation. Water demand based on AWWA standards.

3 Potable water demand based on 0.07 gpd/sf. Recycled water demand based on 0.375 gpd/sf.

4 Allowance for misc. open space buildings not included elsewhere, including the YBI Historic Buildings, kiosks, warming hut, etc. Estimated potable use is based on 1 person per 200 SF, 20 gpcd total water use, minus 5 gpcd recycled water for toilets.

5 Potable use based on 400 persons per day at 15 gpcd total water use, minus recycled water use (toilets) at 5 gpcd.

6 1 Student per 100 SF, 20 gpd per students.

7 Value based on 2007 monthly demand provided by S. Larano, SFPUC.

8 Value provided by S. Larano, SFPUC.

9 Potable demand at 100 gpd/acre. Irrigation demand at 180,000 gpd for TI (CMG 8/7/09 spreadsheet).

10 Potable demand at 100 gpd/acre. Irrigation demand at 60,000 gpd (CMG 8/7/09 spreadsheet).

11 Maximum daily demand 120% of average daily demand.

12 Based on 400 slips, day use only (no live aboard). 50 gpd per slip.