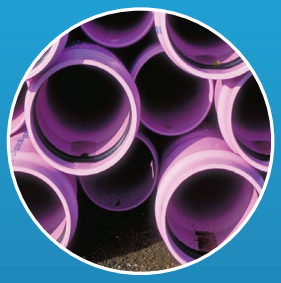
Prepared for: BAWSCA
Bay Area Water Supply & Conservation Agency

California Water Service
Redwood City California Founded 1867
City of San Mateo California
San Francisco Water Power Sewer
SVCW Silicon Valley Clean Water




DRAFT

Potable Reuse Exploratory Plan (PREP) Concept Study

28 May 2019

Kennedy Jenks

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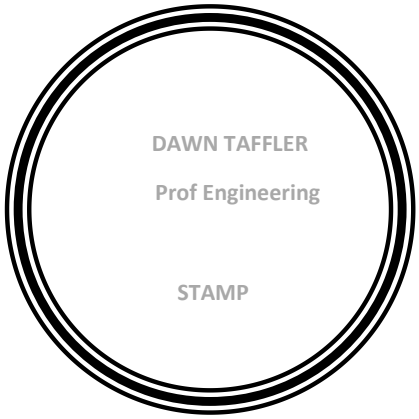

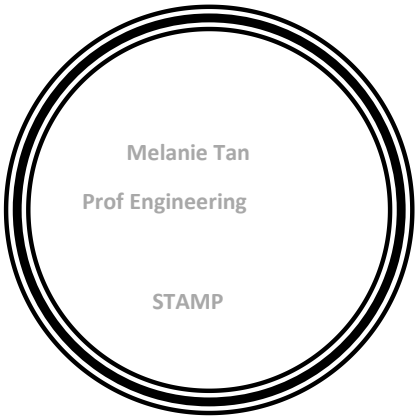

Prepared for the Potable Reuse Exploratory Plan (PREP) Parties

- **Bay Area Water Supply and Conservation Agency**
- **California Water Service Company**
- **City of Redwood City,**
- **City of San Mateo**
- **San Francisco Public Utilities Commission**
- **Silicon Valley Clean Water**

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Acronyms and Abbreviations

AS	Activated Sludge
ADWF	Average Dry Weather Flow
AF	Acre-feet
AFY	Acre-feet per year
AOP	Advanced oxidation process
AWPF	Advanced Water Purification Facility
AWWA	American Water Works Association
BAC	Biologically Activated Carbon
BAWSCA	Bay Area Water Supply and Conservation Agency
BDP	Bay Division Pipeline
BMP	Best Management Practices
BNR	Biological Nutrient Removal
BOD	Biochemical oxygen demand
Cal Water	California Water Service Company
CBOD	Carbonaceous biochemical oxygen demand
CCF	Hundred Cubic Feet
CCR	California Code of Regulations
CCWD	Coastside County Water District
CDPH	California Department of Public Health (now SBDDW)
CEQA	California Environmental Quality Act
CHRIS	California Historical Resources Information System
CSPS	Crystal Springs Pump Station
CSR	Crystal Spring Reservoir
CWA	Clean Water Act
DBP	disinfection byproduct
Dia	Diameter
DPR	Direct potable reuse
DWR	Department of Water Resources
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
FAT	Full Advanced Treatment
FEF	Flow Equalization Facility
Ft	Feet
GIS	Geographic Information System
gpd	Gallons per day
gpm	Gallons per minute
GRR	Groundwater Replenishment Reuse
GRRP	Groundwater Replenishment Reuse Project
GW	Groundwater

HDPE	high density polyethylene
Hp	horsepower
Hwy	Highway
IAP	Independent Advisory Panel
IPAC	Information for Planning and Consultation
IPR	Indirect potable reuse
JPA	Joint Powers Authority
LF	Lineal feet
LRV	Log reduction values
M	million
Max	Maximum
MBR	Membrane bioreactor
MCL	Maximum contaminant limit
Menlo CC	Menlo Country Club
MF	Microfiltration
MG	Million gallons
mg/L	Milligrams per liter
mgd	Million gallons per day
Min	Minimum
MND	Mitigated Negative Declaration
MOU	Memorandum of Understanding
NDN	Nitrification/Denitrification
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPR	Non-Potable Reuse
NTU	Nephelometric Turbidity Units
NWRI	National Water Research Institute
O&M	Operations and maintenance
P3	Public Private Partnership
PREP	Potable Reuse Exploratory Plan
Q	Total flow out of the reservoir
RO	Reverse osmosis
ROW	Right-of-Ways
RW	Recycled water
RWA	Reservoir water augmentation
RWPS	Recycled Water Pump Station
RWQCB	Regional Water Quality Control Board or Regional Board
RWS	SFPUC's Hetch Hetchy Regional Water System
SBDDW	State Board Division of Drinking Water
SF Bay	San Francisco Bay
SFPUC	San Francisco Public Utilities Commission
SHGCC	Sharon Heights Golf and Country Club

SRF	State Revolving Fund
SVCW	Silicon Valley Clean Water
ROW	Right-of-ways
RWA	Reservoir water augmentation
SWRCB	State Water Resources Control Board or State Board
TDH	Total Dynamic Head
TDS	Total dissolved solids
TM	Technical memorandum
TMDL	Total Maximum Daily Load
TOC	Total organic carbon
TSS	Total suspended solids
UF	Ultrafiltration
USFWS	United States Fish and Wildlife Service
UV	Ultraviolet
UWMP	Urban Water Management Plan
Vol	Total volume of the reservoir
V/G/C	Virus, Giardia, and Cryptosporidium
WC	Water Code
WBSD	West Bay Sanitary District
WDR	Waste Discharge Requirements
WRF	Water Reclamation Facility
WRRF	WateReuse Research Foundation
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

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Executive Summary

Development of a Potable Reuse Exploratory Plan (PREP) is an effort initiated by the Bay Area Water Supply and Conservation Agency (BAWSCA), California Water Service Company (Cal Water), City & County of San Francisco acting by and through the Public Utilities Commission (SFPUC), the City of Redwood City, the City of San Mateo, and Silicon Valley Clean Water (SVCW), to study potable reuse opportunities in the Mid-Peninsula region. Together, the PREP parties recognize that regional collaboration offers opportunities to address multiple water supply and wastewater challenges, while realizing the benefits of shared infrastructure, asset recovery, economies of scale, and a more competitive strategy to pursue funding, in addition to enhancing regional self-reliance through integrated water management.

ES.1 A Phased Approach to Exploring Potable Reuse Opportunities

The PREP Parties first came together in Phase 1 of the project, to consider potable reuse alternative concepts on the San Francisco Mid-Peninsula. A preliminary screening of alternatives was performed to provide the PREP Parties sufficient information to determine whether to proceed with continued exploration of, and investment in, potable reuse. The outcome of Phase 1 was a ***PREP Phase 1 Initial Study*** (Kennedy Jenks 2017), which concluded that potable reuse via groundwater augmentation and reservoir water augmentation (RWA) could provide an integrated approach to:

1. Enhance water supply reliability for water purveyors on the San Francisco Peninsula.
2. Reduce discharge to the San Francisco Bay - helping communities proactively address costly and increasingly stringent wastewater discharge requirements, recover water from becoming a lost resource, reduce the likelihood of unavoidable environmental impacts to receiving waters, and avoid costly upgrades to facility treatment.
3. Create a multi-agency project with multiple economic, environmental and social benefits that would increase the potential for acquiring grants and low- interest loans.

Based on the findings from the PREP Phase 1 Initial Study, it appeared possible that a potable reuse project could offer benefits for the Bay Area water and wastewater utilities, the environment, local communities and the regional economy. The PREP Parties agreed to proceed with Phase 2, to further define the RWA Project concept, confirm the ability to meet RWA regulatory requirements in Crystal Springs Reservoir, assess cost beneficial alignments and facility siting options and identify the next steps to further refining the project.

This report, herein referred to as the ***PREP Phase 2 Concept Study***, builds on the ***PREP Phase 1 Initial Study*** to further define the RWA Project concept at Crystal Springs Reservoir (CSR). A parallel study, ***PREP Institutional Considerations*** (Kennedy Jenks 2019), provides a preliminary evaluation of institutional

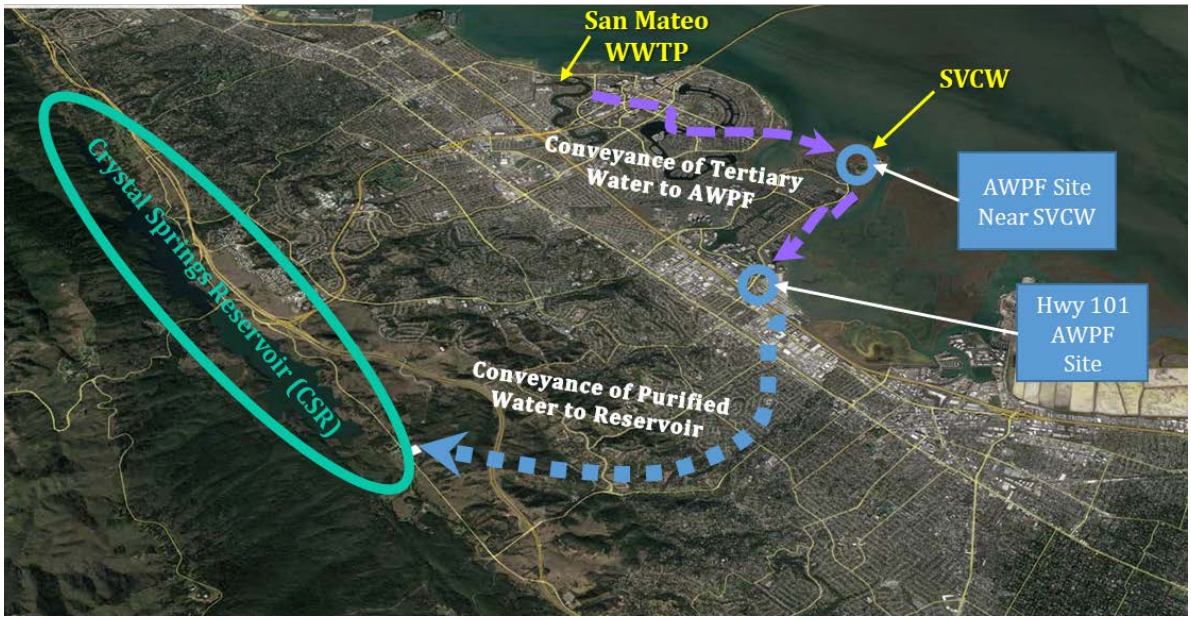
Benefits of Regional Collaboration
Developing a new drought-resistant, local water supply would help address water supply shortfalls during droughts, while maintaining the quality of life within the local community and the vital regional economy.

considerations related to the implementation of a potable reuse project that augments CSR with purified water.

ES.2 Reservoir Water Augmentation (RWA) Concept

The PREP Phase 2 Concept Study defines the potable reuse via RWA at Crystal Spring Reservoir (CSR) concept, as shown in Figure ES-1.

Figure ES-1: Overview of Potential RWA Project Facilities



Two potential sources of supply were evaluated: (1) effluent from the SVCW facility; and (2) effluent from the San Mateo Wastewater Treatment Plant (WWTP). Both supply sources would require additional treatment at an advanced water purification facility (AWPF) located near the SVCW facility, or near the San Carlos Airport (herein referred to as the Hwy 101 Site).

The AWPF train is assumed to consist of low-pressure membrane filtration via microfiltration (MF) or ultrafiltration (UF) as pretreatment prior to reverse osmosis (RO), followed by an ultra-violet light advanced oxidation process (UV-AOP). This combination of treatment processes is assumed to be sufficient for a RWA project, though it is recognized that additional treatment steps may be required based on site specific conditions. Reject water from the RO membrane, herein referred to as RO concentrate, would be discharged via connection to the existing SVCW outfall to the Bay.

Purified water would be conveyed via new pipelines and pump stations to CSR, where it would comingle with raw water at SFPUC's existing Pulgas Facilities that currently dechloraminate and discharge Hetch Hetchy flows into the reservoir. Stored water in CSR is treated at the Harry Tracy Water Treatment Plant (WTP) and conveyed to drinking water users through the existing potable water distribution system.

ES.3 Meeting Regulatory Requirements

RWA Regulations

The final RWA regulations, adopted by the State Water Resource Control Board – Division of Drinking Water (SBDDW) on March 6, 2018, include minimum retention time and dilution requirements:

1. An initial reservoir retention time of 180 days must be demonstrated, with flexibility for an alternative minimum theoretical retention time as low as 60 days on a case-by-case basis with State Board approval. RWA projects with minimum retention times of less than 120 days must provide an additional 1-log treatment.
2. The dilution requirement in the reservoir is 100:1 (one percent by volume), or 10:1 (ten percent by volume) with an additional 1-log microbial pathogen treatment, to demonstrate the percent of recycled water withdrawn from the reservoir, by volume, during any 24-hour period.

Three RWA scenarios were developed to represent summer, winter and emergency storage and outflow scenarios. All scenarios were able to achieve a dilution of 100:1. The summer and winter scenarios achieved a retention time of > 120 days, however the emergency scenario had a calculated retention of 115 days. Based on these outcomes, it is anticipated that the project would need to meet pathogen removal requirements of 9/8/9 for virus, Giardia, and Cryptosporidium (V/G/C), based on a retention time of < 120 days and dilution ratio of 100:1. Upon further evaluation of operational scenario assumptions, it may be possible to increase the retention time from the minimum calculated 115 days to > 120 days, thereby reducing the pathogen removal requirements to 8/7/8.

Demonstrated modeling and tracer studies would need to be conducted as part of the next steps to simulate then validate these assumptions. The proposed MF/RO/UV-AOP treatment train should be able to achieve the 9/8/9 removal requirements, though the ultimate inactivation credit achieved for a given process may be based on site-specific performance and/or a negotiated validation approach with SBDDW on a case-by-case basis (WateReuse 2016).

CSR Augmentation Considerations

Any discharges into CSR would not only need to comply with RWA requirements but would also need to meet local SF Bay Basin Plan requirements and match or be compatible with background water quality concentrations in CSR:

- Ammonia concentrations are controlled by the SF Basin Plan limits, and
- Phosphorus concentrations are controlled by the background concentrations in Upper CSR.

Based on the initial analysis, additional treatment would likely be required to reduce nutrient concentrations prior to release into CSR. For this study, it is assumed nitrifying/denitrifying filters would be installed to remove ammonia and the need for phosphorus removal would be further evaluated in a future study.

Bay Discharge Requirements

RO concentrate disposal via SVCW's outfall would need to meet existing and future regulations at the SVCW outfall to the San Francisco Bay (SF Bay), which is regulated under three Waste Discharge Requirements (WDRs) / National Pollutant Discharge Elimination System (NPDES) permits:

(1) SVCW Individual WDR,
(2) SF Bay Watershed WDR for mercury and PCBs and
(3) SF Bay Watershed WDR for nutrients.

This study looked at anticipated water quality from the average monthly RO concentrate (from a 6 mgd and 12 mgd AWPF) combined with the tertiary effluent discharge remaining in SVCW's outfall for dilution to identify parameters that limit disposal to the SF Bay. The combined discharge would not impact the ability to meet load or mass-based limits, but concentration-based limits may require dilution with tertiary effluent or additional treatment to meet certain targets (e.g., toxicity and ammonia). Given the high-level of analysis performed as part of this study, a more detailed analysis of water quality is warranted in future phases.

ES.4 RWA Alternative Evaluation

Two primary alternatives, with a variety of sub-alternatives related to the potential location of the AWPF and pipeline alignments, were developed to identify infrastructure requirements and develop a conceptual-level engineers' opinion of probable costs. Figure ES-2 illustrates the potential AWPF facility locations and potential pipeline alignment to deliver tertiary effluent to the AWPF and purified water from the AWPF to CSR. Table 5-1 lists the 15 sub-alternatives, which were developed to assess various combinations of treatment capacity, treatment location, pipeline alignments and potential cost savings from repurposing existing infrastructure and repurposing abandoned assets.

Two tertiary alignments from the San Mateo WWTP to AWPF are evaluated based on the outcomes of the San Mateo Recycled Water Facilities Planning Study (HydroScience 2017) and discussions with the Cities of San Mateo and Foster City. Three alignment options from the AWPF to CSR are evaluated to explore options to re-use infrastructure, avoid construction disruption in public right-of-way (ROW) through residential areas of the valley, utilize SFPUC's ROW, avoid the Pulgas Tunnel and minimize pipeline length and total lift. RO concentrate pipelines from the AWPF to the existing SVCW outfall are not shown in Figure ES-2 but are included in the costs estimates.

Figure ES-2: Overview of Potential RWA Project Facilities

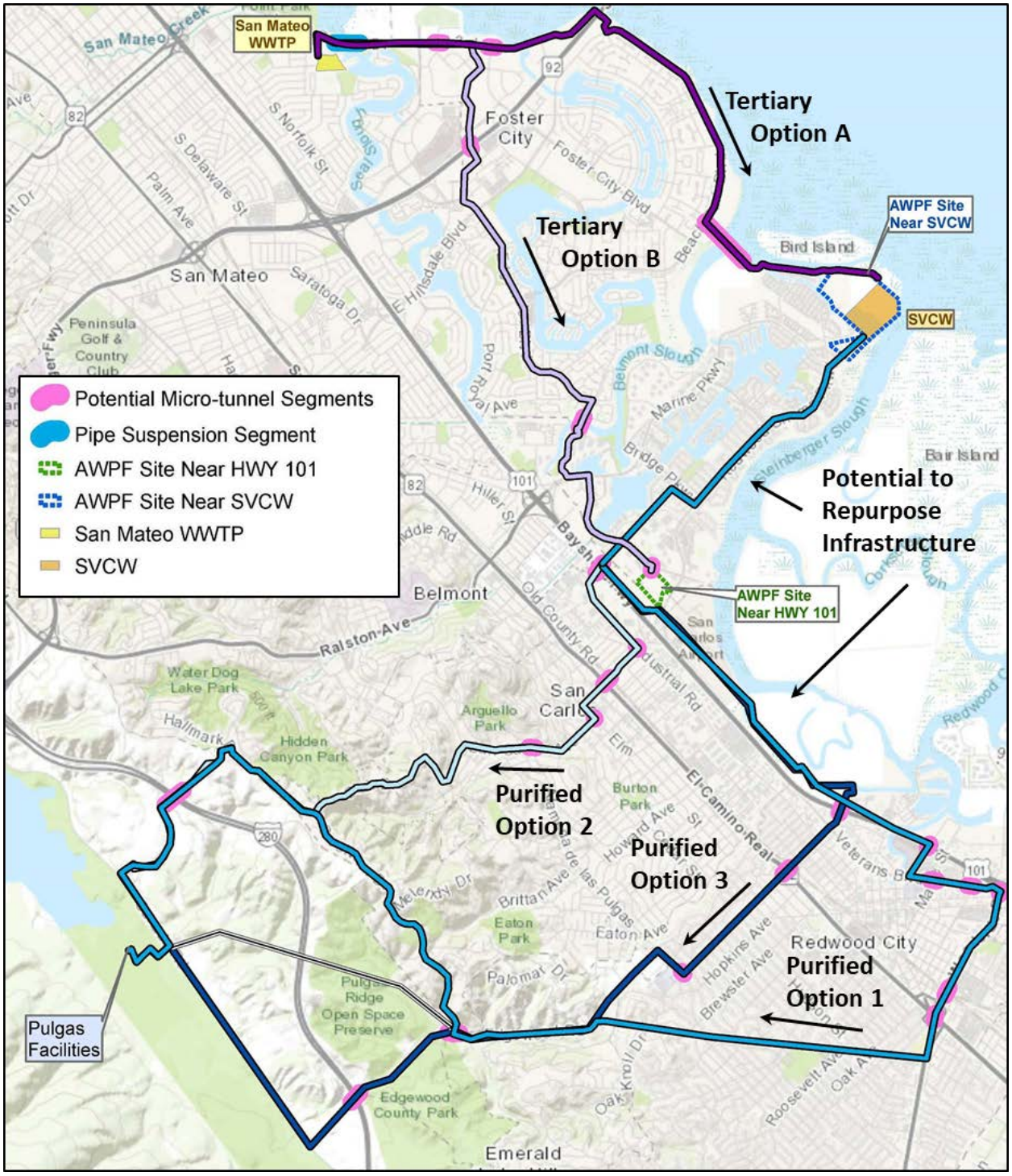


Table ES-1: Overview of Sub-Alternatives

Alternative	Source Water (Tertiary)	AWPF Location [a]	Tertiary Alignment [b]	RO Concentrate Alignment [c]	Purified Alignment [d]	Sub Alternative [e]
Alt 1 6-mgd RWA at CSR	SVCW (~8 mgd)	Near SVCW	Short Alignment	Short Alignment	Option 1	1a.1*
					Option 2	1a.2*
					Option 3	1a.3*
		Hwy 101 Site	Repurpose SVCW Pipeline	Repurpose SVCW Pipeline	Option 1	1b.1*
					Option 2	1b.2
					Option 3	1b.3
Alt 2 12-mgd RWA at CSR	SVCW + San Mateo (~16 mgd)	Near SVCW	Option A + Short Alignment	Short Alignment	Option 1	2a.1*
					Option 2	2a.2
					Option 3	2a.3
			Option B + Redwood Shores Open Trench		Option 1	2b.1*
					Option 2	2b.2
					Option 3	2b.3
		Hwy 101 Site	Option B + Repurpose RWC Pipeline	Repurpose SVCW Pipeline	Option 1	2c.1*
					Option 2	2c.2
					Option 3	2c.3

* Detailed cost are prepared provided for sub-alternatives indicated with a "*"

a. Assume 4 and 5.5 acres for 6 and 12 mgd capacity AWPF's respectively.
Exact footprint location, and land acquisition costs, to be determined in a future study.

b. Short Alignment = connect Redwood City RW Tank to AWPF Inlet.
Repurpose Pipeline = slip-line in abandoned pipeline along Redwood Shores Parkway
Option A = Beach Park Alignment; Option B = Edgewater Blvd Alignment

c. Short Alignment = AWPF to SVCW outfall.
Repurpose Pipeline = slip-line in abandoned pipeline along Redwood Shores Parkway

d. Option 1 = Woodside Road - SFPUC ROW; Option 2 = San Carlos - Club Drive; Option 3 = Edgewood Road

e Detailed costs are provided for highlighted sub-alternatives only, see Appendix D for additional detail.

Construction of new infrastructure may provide more flexibly for design but could cause community disruption during construction, encounter utility conflicts and have a higher cost for design and construction. Repurposing existing infrastructure would reduce community disruption during construction and avoid utility conflicts and may have lower costs for design and construction but would be limited by other planned or unknown new projects and the viability and longevity of use would depend on the condition assessment of the asset. For the purpose of this study, all sub-alternatives include the repurpose of infrastructure, where appropriate, which may include some or all of the following:

- ✓ Utilize RWC storage tanks at SVCW,
- ✓ Repurpose SVCW Pipelines along Redwood Shores Pkwy,
- ✓ Repurpose SVCW Pipelines along Shoreway Rd,
- ✓ Utilize RWC Recycled water pipeline to Hwy 101 AWPF Site,
- ✓ Utilize Puglas Dechloramination Facility, and
- ✓ Utilize Pulgas Discharge Facility.

Future studies are needed to assess the full range of conveyance options including the condition of existing assets, availability of ROWs and land for acquisition, subterranean conditions, existing utilities, hydraulic requirements, environmental impacts, community response and alternative alignments.

Table ES-2 summarizes the conceptual-level estimate of direct costs to implement potable reuse via RWA at CSR. Key assumptions are as follows:

- Construction costs shown represent loaded facility costs for treatment, pipelines, pump stations, storage tanks, and other facilities necessary to develop each project, including taxes, allowances, contingencies and escalation to an estimated midpoint of construction.
- Costs excluded from the estimate, due to the need for additional information, studies and in many cases, negotiated agreements to provide a reasonable or justifiable unit cost estimate, include: land acquisition, reuse of Redwood City facilities, use of SFPUC Pulgas facilities and ROWs, and future studies.
- Annual operations and maintenance (O&M) costs include energy, labor, chemicals, maintenance and repair.
- Unit life cycle costs represent annualized construction costs plus O&M costs divided by the recycled water delivered over the life of the project to obtain a uniformly derived unit cost per volume of water delivered.
- Cost ranges shown represent variations due to the location of the AWPF, pipeline alignments and pumping requirements.

Table ES-2: Summary of Estimated Probable Costs of Alternatives (2019 dollars)

Alternative	Alternative 1 6 mgd RWA	Alternative 2 12 mgd RWA
Purified Water Delivered (AFY)	6,720	13,440
Purified Water Delivered (mgd)	6	12
Loaded Facility Component Cost ($mil)		
Treatment	$226	$400
Pipelines	$59 to $88	$140 to $170
Pump Station	$16 to $23	$38 to $41
Storage	$3.5	$5.4
Connection to Pulgas Facilities	$3.3	$4.3
Total Construction Cost ($)	**$310 to $342**	**$591 to $618**
Annual O&M Cost ($mil/year)	**$10 to $11**	**$13 to $14**
Unit Cost ($/AF)	$4,130 to $4,580	$3,650 to $3,730
Unit Cost ($/CCF)	$10 to $11	$8 to $9
Unit Cost ($/gal)	$0.013 to $0.014	$0.011 to $0.012

Units: AFY = acre-feet per year, mgd = million gallons per day, $/AF = dollars per acre-foot, $/gal = dollars per gallon, $/CCF = dollars per hundred cubic feet (of puriried water delivered).

ES.5 Summary of Findings

Overall, a regional RWA Project could provide an integrated approach to:

1. Enhance water supply reliability for water purveyors on the San Francisco Peninsula,
2. Reduce discharge to the San Francisco Bay - helping communities proactively address costly and increasingly stringent wastewater discharge requirements, recover water from becoming a lost resource, reduce the likelihood of unavoidable environmental impacts to receiving waters, and avoid costly upgrades to facility treatment, and
3. Create a multi-agency project with multiple economic, environmental and social benefits that would increase the potential for acquiring grants and low- interest loans.

Based on the following technical, financial and institutional findings, it appears possible that a RWA project could offer benefits for the Bay Area water and wastewater utilities, the environment, local communities and the regional economy.

Technical Findings: The RWA regulatory criteria for treatment, dilution and retention can be met. The SF Bay Basin Plan requirements for discharge to CSR can be met (may require additional treatment) and the RO concentrate discharge requirements via the SVCW outfall can likely be met (with additional treatment for brine toxicity). Multiple conveyance options, with opportunities to repurpose assets, have been identified as viable, but would need future study to confirm alignments and refine costs. Thus, a RWA project at CSR is technically feasible.

Financial Findings: A RWA project can produce a local, reliable and sustainable supply of water that may be comparable to the costs of other new sources of supply. The outcomes of the cost comparison indicates that (1) a larger regional project would be more cost-effective due to the benefit of economies of scale and (2) repurposing assets between project partners can provide additional cost savings as well as reducing environmental and social impacts. There are many state and federal funding programs that have been created to assist agencies with funding regional reuse projects, and the PREP Parties would offer a compelling story for this project which would be highly competitive in the pursuit of funding.

Institutional Findings: A parallel study, ***PREP Institutional Considerations*** (Kennedy Jenks 2019), provides a preliminary evaluation of institutional considerations related to the implementation of a potable reuse project that augments CSR with purified water. Based on survey questionnaires, interviews and a workshop with the PREP Parties, it appears that, collectively, the PREP Parties have all of the required functional and legal capacity to finance and deliver the project. Therefore, the project is institutionally feasible – it can be done. At present, however, there is no designated project sponsor (lead agency) or committed off-takers (customer) for the purified water produced by the facilities because (1) potential off-takers do not have an immediate need for new water supply, and (2) institutional and physical means of achieving drought-year reliability at CSR (through some form of water banking) do not exist at this time. This lack of current off-taker demands due to the timing for new water supply needs and the institutional and physical infeasibility of banking water diminishes the current interest in project sponsorship. These circumstances could change in the future.

ES.6 Next Steps

There is interest in leveraging the success of the Phase 1 and 2 PREP studies and the commitment of the PREP Parties to maintain momentum for exploring potable reuse opportunities in the Mid-Peninsula region.

If the PREP Parties agree to proceed with a RWA project at CSR, additional studies would be warranted to demonstrate the ability to meet RWA regulations, evaluate pipeline alignments and facility siting, further define treatment process criteria for purification and nutrient removal, develop operational scenarios to accommodate purified water in CSR and initiate outreach to the community to gain social acceptance for reuse.

Other future studies of interest may include:

- Exploration of raw water augmentation or treated drinking water augmentation potable reuse concepts, which would help justify other water supply reliability or wastewater regulatory compliance projects in the future and offer an alternative for future CEQA documents.
- Development of a demonstration project concept, which could serve multiple benefits for the project by providing a vehicle to test the most current treatment technologies directly on source water(s) and provide educational opportunities for the community.

Future studies can compare the relative costs, benefits and limitations of non-traditional, local, sustainable supplies and would provide leadership and staff with current knowledge regarding new technical, regulatory developments over time. Future studies would also allow the parties to more clearly define beneficiaries, functional roles and address other institutional considerations.

Section 1: Introduction

Development of a Potable Reuse Exploratory Plan (PREP) is a regional effort to study potable reuse opportunities in the San Francisco Mid-Peninsula region. The PREP Parties first came together in Phase 1 of the project, to consider potable reuse alternative concepts on the San Francisco Mid-Peninsula region. This summary report documents Phase 2 of the effort to further define the concept for a reservoir water augmentation (RWA) Project. The information herein was developed to provide sufficient information for the PREP Parties to determine whether and how to proceed together with continued exploration of, and investment in a RWA project.

1.1 Background

The PREP Parties include: Bay Area Water Supply and Conservation Agency (BAWSCA), California Water Service Company (Cal Water), City & County of San Francisco acting by and through the Public Utilities Commission (SFPUC), the City of Redwood City, the City of San Mateo and Silicon Valley Clean Water (SVCW). The group will be referred collectively herein as the "Parties" and singularly as a "Party". Together, the PREP parties recognized that regional collaboration offers opportunities to address multiple water supply and wastewater challenges, while realizing the benefits of shared infrastructure, asset recovery, economies of scale, and a more competitive strategy to pursue funding, in addition to enhancing regional self-reliance through integrated water management. A map showing the service areas of the Parties is shown in Figure 1-1.

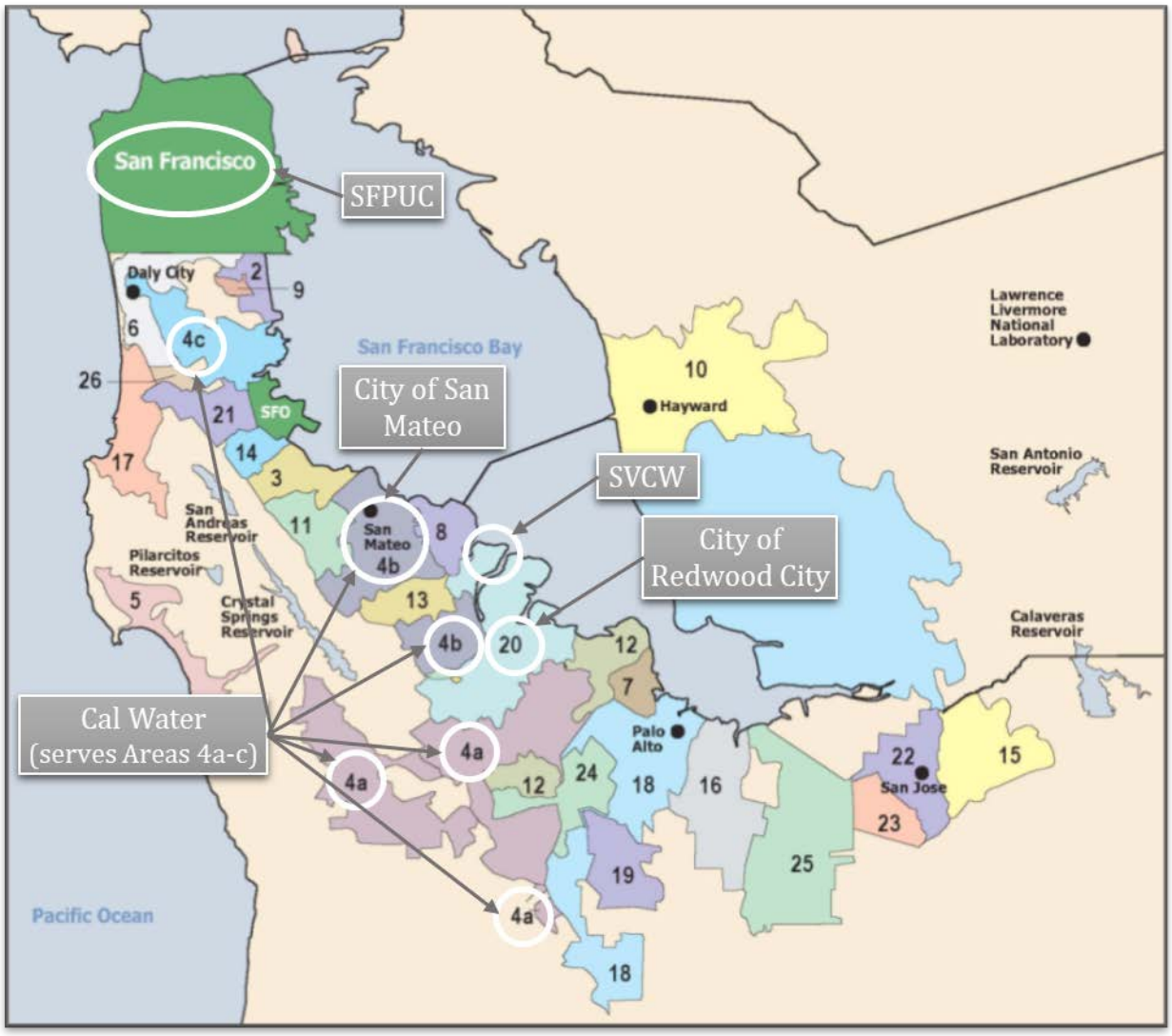
In Phase 1, a subset of this group of stakeholders worked collaboratively together to develop a Draft PREP Initial Study, herein referred to as the ***PREP Phase 1 Initial Study***, which documents the first-step by the PREP Parties to consider potable reuse alternative concepts on the San Francisco Mid-Peninsula. The PREP Phase 1 Initial Study evaluated project alternatives for potable reuse via groundwater augmentation in the San Mateo Plain Basin and reservoir water augmentation (RWA) at Crystal Spring Reservoir (CSR) and Bear Gulch Reservoir. A potable reuse project alternative for raw water augmentation or treated water augmentation was not considered as part of the initial work. Sub-alternatives were developed to assess various combinations of treatment capacity, treatment location, and potential cost savings from repurposing existing infrastructure and reusing abandoned assets.

Securing Local Supplies for the Future
The PREP Phase 2 Concept Study explores the viability of a RWA Project that could provide benefits for the Bay Area water and wastewater utilities, the environment, local communities, and the regional economy.

Overall, the PREP Phase 1 Initial Study found that a regional GRR or RWA Project could provide an integrated approach to:

1. Enhance water supply reliability for water purveyors on the San Francisco Peninsula.
2. Reduce discharge to the San Francisco Bay - helping communities proactively address costly and increasingly stringent wastewater discharge requirements, recover water from becoming a lost resource, reduce the likelihood of unavoidable environmental impacts to receiving waters, and avoid costly upgrades to facility treatment.
3. Create a multi-agency project with multiple economic, environmental and social benefits that would increase the potential for acquiring grants and low- interest loans.

Figure 1-1: Study Area and PREP Parties' Service Areas



Map source: BAWSCA Member Agencies

Based on the findings from the PREP Phase 1 Initial Study, it appeared possible that a potable reuse project via GRR or RWA could offer benefits for the Bay Area water and wastewater utilities, the environment, local communities and the regional economy. The PREP Parties agreed to proceed to Phase 2 to confirm the ability of a RWA at CSR to meet anticipated regulations, to further evaluate cost beneficial pipeline alignments and facility siting options and assess community outreach needs.

This report***,*** herein referred to as the ***PREP Phase 2 Concept Study***, builds on the ***PREP Phase 1 Initial Study*** to further defines the RWA Project concept at CSR. A parallel study, ***PREP Institutional Considerations*** (Kennedy Jenks 2019), provides a preliminary evaluation of institutional considerations related to the implementation of a potable reuse project that augments CSR with purified water. The objective of the study is to provide a starting point from which a more structured framework would be developed. Information from that study is referenced as appropriate.

1.2 Study Objective and Goal

The **objective** of the PREP Phase 2 Concept Study is to define a reservoir augmentation concept, explore various alternatives related to facility locations and conveyance requirements, identify key issues and future studies, and summarize the findings in a report for the PREP Parties.

The **goal** of this effort is to provide sufficient information for the Parties to determine whether and how to proceed together with continued exploration of, and investment in, a RWA Project.

The PREP Phase 2 Concept Study focuses on a RWA project that purifies water from local wastewater facilities and conveys purified water the CSR, where it co-mingles with water from Regional Water System and becomes part of the Bay Area water supply.

Section 2: Wastewater Supply

Two potential sources of treated wastewater are evaluated as part of the PREP Phase 2 Concept Study: (1) effluent from the Silicon Valley Clean Water (SVCW) facility, and (2) effluent from the San Mateo Wastewater Treatment Plant (WWTP). A brief description of these facilities, available flows for reuse, and water quality considerations are included in this section.

2.1 Potential Sources of Supply

The SVCW facility and the San Mateo WWTP are located approximately four miles apart, in the cities of Redwood City and San Mateo, respectively, as depicted in Figure 2-1.

Figure 2-1: Potential Sources of Treated Wastewater

2.1.1 Silicon Valley Clean Water (SVCW)

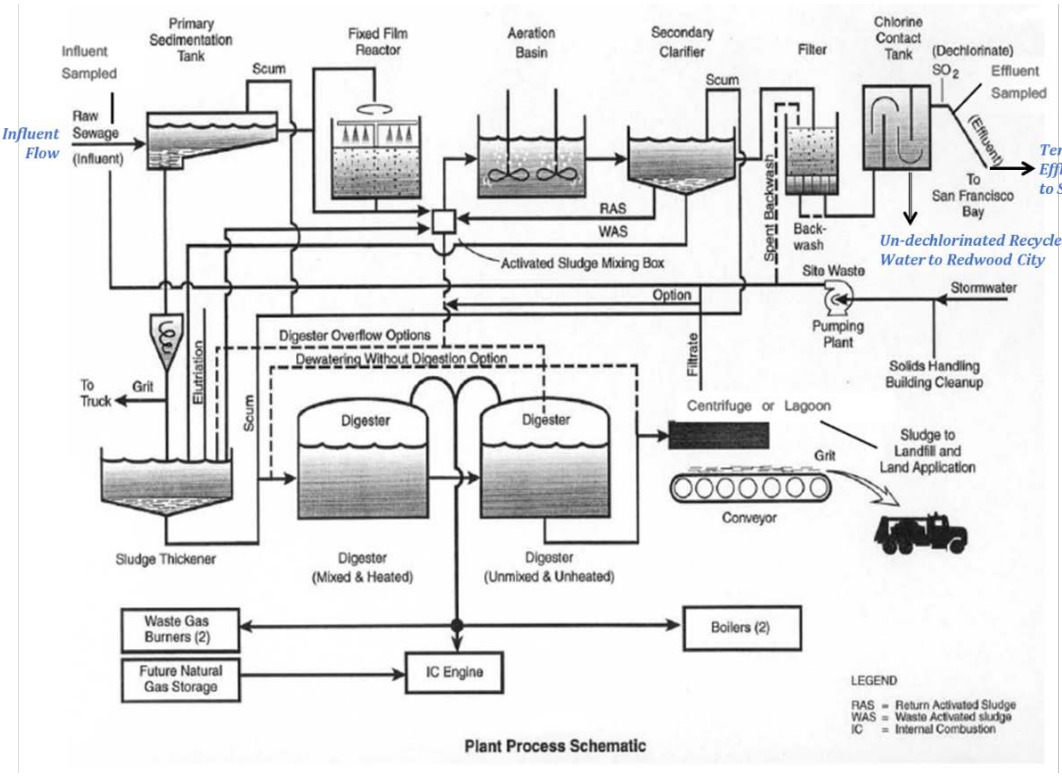
SVCW's Wastewater Conveyance System takes wastewater from each of the Joint Powers Authority (JPA) member agencies' (Belmont, San Carlos, Redwood City, and West Bay Sanitary District) collection systems and pumps the wastewater to its wastewater treatment plant located adjacent to San Francisco Bay at the northeast end of Redwood Shores. The individual members of the JPA own and operate the sanitary sewer collection systems within their respective jurisdictions, and West Bay Sanitary District

(WBSD) also owns the existing Flow Equalization Facility (FEF), which can be used to store their wastewater during wet weather conditions. SVCW owns and operates the wastewater treatment plant (WWTP) as well as the conveyance system force main and pump stations that convey the raw wastewater to the treatment plant.

SVCW is a water resource recovery facility that meets all stringent federal and state regulations. Built in 1980, the SVCW facility enables wastewater to be recycled and the fragile ecosystem of the San Francisco Bay to be protected for current and future generations to enjoy.[1] The SVCW facility uses an advanced, two-stage biological treatment facility where wastewater passes through physical and biological processes, which result in high-quality effluent being discharged to the deep-water channel of the San Francisco Bay. A SVCW treatment process schematic is shown in Figure 2-2.

SVCW is successfully producing recycled water for Redwood City's Phase 1 project that meets Title 22 of the California Code of Regulations (CCR) for unrestricted non-potable uses. The facilities constructed on SVCW's site include tertiary treatment and disinfection, pumping, and storage. Some future filtration and storage improvements are planned for the expansion of Redwood City's recycled water system.

Figure 2-2: Silicon Valley Clean Water Treatment Process Schematic



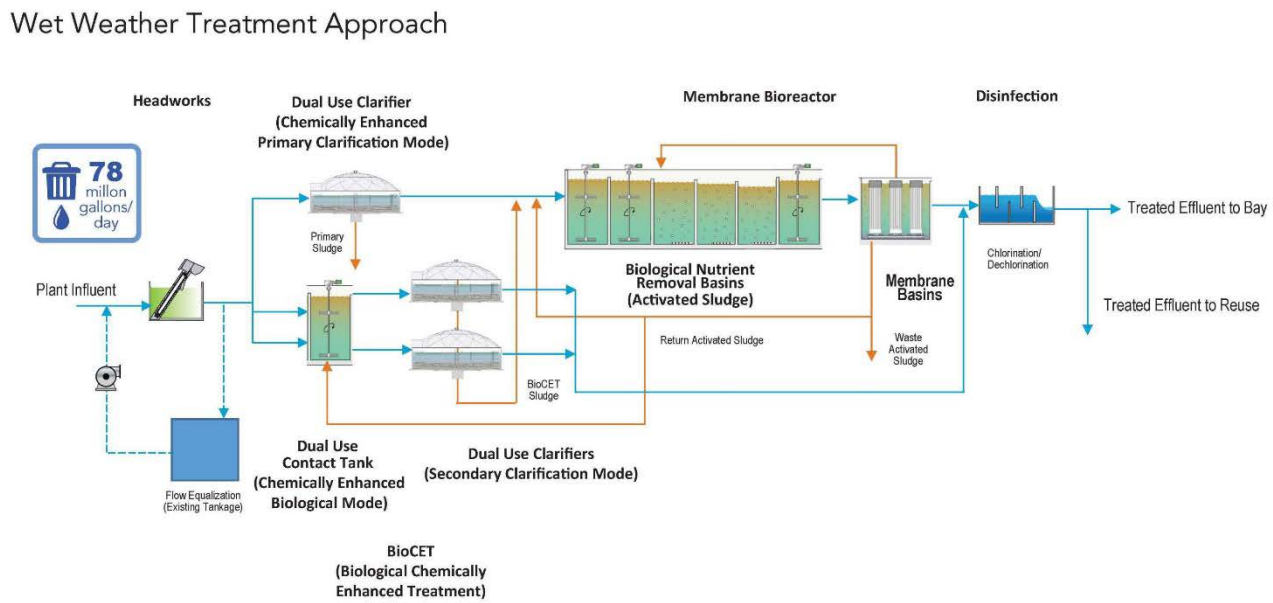
[1] http://www.svcw.org/facilities/sitePages/wastewater%20treatment.aspx

2.1.2 City of San Mateo

The San Mateo WWTP serves more than 130,000 people and businesses in the City of San Mateo's service area. The current treatment plant uses bacteria to remove organic material and toxins from the wastewater it treats. Wastewater arrives at the plant through a series of pipelines and pump stations, which then pass through a series of physical and biological processes. The resulting high-quality effluent is discharged to the deep-water channel of the Bay.

As part of the City of San Mateo's Clean Water Program, the City has embarked on a project to upgrade the existing secondary treatment facilities to replace aging infrastructure, meet current and future regulatory requirements, and ensure wet-weather capacity.[2] This program aligns with the City's sustainability goals to explore water reuse, resource recovery, and incorporation of sustainable materials. The WWTP improvements will include new Biological Nutrient Removal (BNR) Basins, and a new Membrane Bioreactor (MBR) system in addition to other supporting treatment processes. By effectively treating wastewater at an advanced biological treatment facility, the future plant will help keep San Francisco Bay environmentally clean and safe. A schematic of the proposed treatment approach is shown in Figure 2-3.

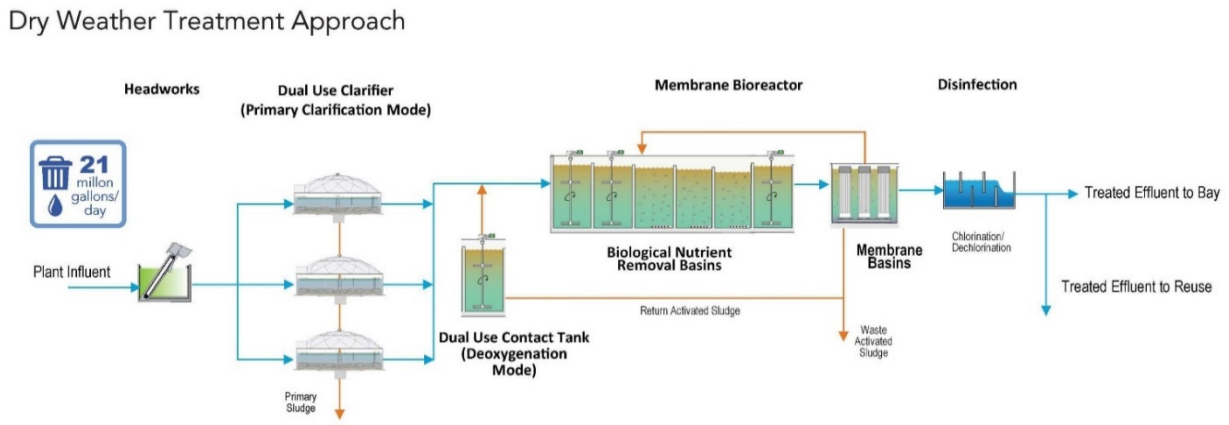
Figure 2-3: San Mateo WWTP Proposed Treatment Process Schematic



Source: CH2M, 2017

[2] http://www.cleanwaterprogramsanmateo.org/

Figure 2-3: San Mateo WWTP Proposed Process Schematic (con't)



Source: CH2M, 2017

2.2 Available Flows

The assumed available flow for a potable reuse project is estimated based on the effluent at each plant during dry weather periods, less existing recycled water commitments.

2.2.1 SVCW Available Flow

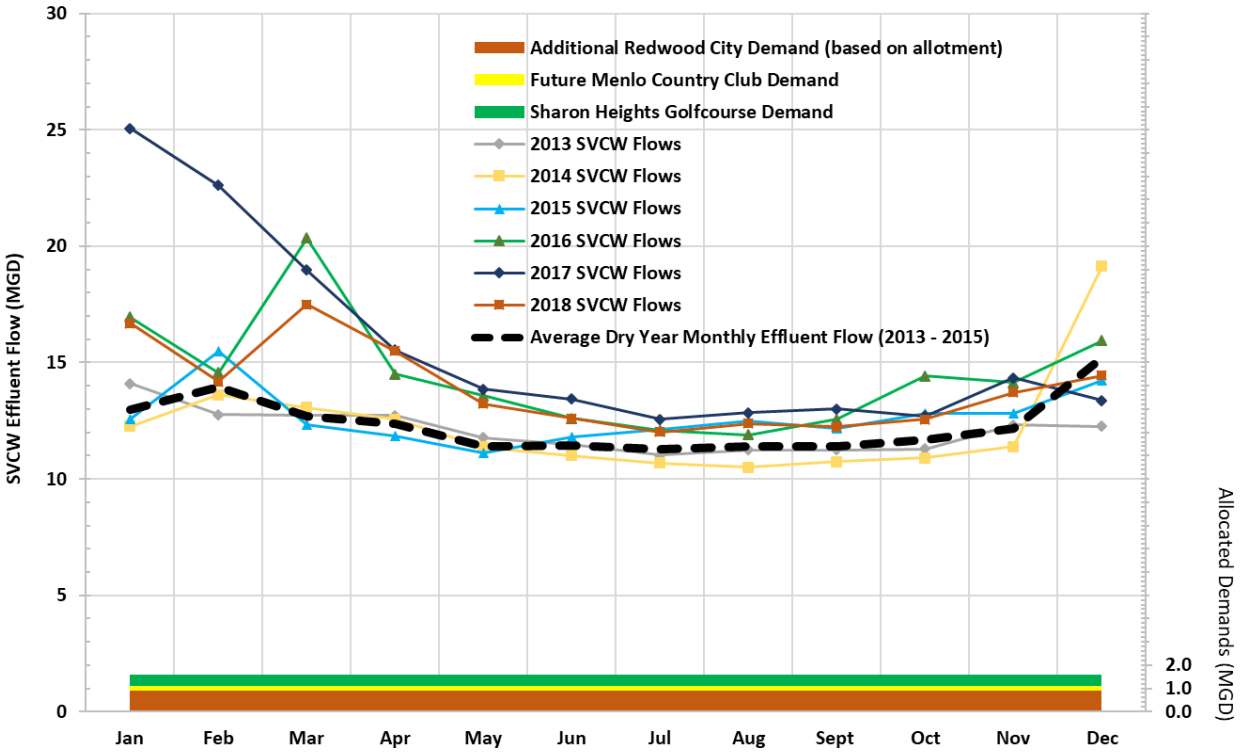
SVCW has a permitted Average Dry Weather Flow (ADWF) capacity of 29 mgd and a Peak Wet Weather Flow capacity of 71 mgd. As shown in Figure 2-2,un-dechlorinated tertiary effluent is supplied to Redwood City to meet recycled water demands, and the remaining tertiary effluent is discharged into San Francisco Bay (SF Bay). From 2013 to 2018, the average monthly effluent flow discharged to SF Bay was approximately 13.5 mgd, with the average monthly effluent flow dropping to 12.3 mgd during the dry years of 2013 to 2015.

During the 2013 to 2015 dry period, the average monthly flow during the three consecutive dry weather months (July – August) was approximately 11.4 MGD. This flow was used was used to provide a conservative estimate the amount of effluent potentially available for reuse.

- Sharon Heights Golf and Country Club (SHGCC) and West Bay Sanitary District (WBSD) are currently constructing a satellite recycled water facility to provide water for irrigation at SHGCC. This project will divert up to 0.5 MGD of influent from SVCW.
- Redwood City has a total allotment of 2.9 mgd of tertiary recycled water. During this same period of record, approximately 2 mgd was used. Hence, Redwood City reserves the right to the remaining 0.9 mgd of effluent, which is assumed to not be available for a potable reuse project.
- Menlo Country Club (Menlo CC) is in SVCW's wastewater service area and currently receives potable water from SFPUC. Menlo CC has expressed interest in switching to recycled water. For this study, it is assumed that Menlo CC's 0.2 mgd of demand would be met by a satellite recycled water facility, hence reducing the amount of influent to SVCW.

This leaves approximately 9.8 mgd of effluent available for source water supply, on daily average. It is recognized that influent flow from the wastewater conveyance system follows a diurnal curve that is typically at its minimum values during the early morning hours. Diurnal storage equalization and/or coordination with future tunnel operations would be required to maintain consistent flows for further purification. The average monthly effluent flows into SF Bay for 2013 to 2018 are shown in Figure 2-4.

Figure 2-4: SVCW Average Monthly Effluent Flows (2013 – 2018)



Note: hourly dry-weather flows were not evaluated as part of this effort and should be further assessed in conjunction with equalization storage to estimate the minimum potential daily supply of available effluent.

For the purpose of the PREP Phase 2 Concept Study it is assumed that 8 mgd would be conveyed to an Advanced Water Purification Facility (AWPF) and the remaining 1.8 mgd would serve to dilute the reject water, or reverse osmosis (RO) concentrate, that is returned to the outfall during the dry weather months. A more detailed discussion of anticipated SF Bay discharge requirements, and the benefits of dilution is provided in Section 3.4.

Assuming a 25% rejection rate, or 2 mgd rejected, from an AWPF that consist of low-pressure membrane filtration, via microfiltration (MF) or ultrafiltration (UF) as pretreatment prior to reverse osmosis (RO), the amount of purified water available for potable reuse would be about approximately 6 mgd. Additional discussion of treatment requirements and AWPF processes are provided in Sections 3 and 4, respectively.

2.2.2 City of San Mateo Available Flow

The San Mateo WWTP has a planned average annual flow of 16 mgd and a planned peak wet weather flow of 78 mgd. Currently, the facility treats an average annual flow of 16 mgd with an average dry weather flow of approximately 9 mgd and a maximum wet weather flow of 21 mgd.

The City does not currently have a recycled water program; however, they are in the process of completing a Recycled Water Master Plan to assess future non-potable reuse opportunities within the City's service area. Since San Mateo has a similar dry weather flow as SVCW, it is assumed that the new MBR facility could provide 8 mgd tertiary effluent, with the potential to contribute an additional 6 mgd of purified water for a regional potable reuse project, after accounting for rejection from membrane treatment processes. It is assumed that no additional effluent from San Mateo would be used to dilute the RO concentrate

2.3 Wastewater Quality

2.3.1 SVCW Wastewater Water Quality

SVCW effluent consistently meets the requirements set forth in their discharge permit (Order No. R2-2018-0005; National Pollutant Discharge Elimination System (NPDES) permit No. CA 0038369) from the Regional Board.[3] SVCW could provide tertiary effluent, or Title 22 effluent depending on the desired water quality to facilitate efficient operation of an AWPF. Table 2-1 lists average water quality for some constituents of interest used to evaluate the potable reuse alternatives, based on available data at the time of this study. Future data collection efforts will be necessary to understand the water quality of the influent to the AWPF and estimate the anticipated water quality of the resulting purified water.

2.3.2 San Mateo WWTP's Water Quality

The City of San Mateo's WWTP's effluent consistently meets the requirements set forth in their discharge permit (Order No. R2-2012-0006; NPDES No. CA 0037541) from the Regional Board.[4] The City's design team is still in the concept design validation and confirmation phase for the updated biological nutrient removal (BNR) and membrane bioreactor (MBR) facilities, thus there are no reported water quality data for the future facility. Table 2-1 lists anticipated water quality for some constituents of interest used to evaluate potable reuse alternatives.

[3] http://www.svcw.org/departments/Maintenance%20and%20Operations/SVCW_Order%20No.%20R2-2018-0005.pdf
[4] http://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2013/R2-2013-0006.pdf

2.4 Summary of Source Water Options

Table 2-1 summarizes the available flows and assumed water quality for SVCW source water, the San Mateo WWTP's source water, and source water from both facilities combined.

Table 2-1: Summary of Source Water Options

Parameter	Units	SVCW Tertiary Effluent[1]	San Mateo Anticipated Tertiary Effluent[2]	SVCW + San Mateo Combined Tertiary Effluent
Tertiary Flow to AWPF	mgd	8	8	16
Est. Purified Flow	mgd	6	6	12
TDS	mg/L	1,000	900	950
TSS[3]	mg/L	3.6	5	4.3
Turbidity[3]	NTU	3	0.25	1.5
CBOD/BOD[4]	mg/L	3.2 (CBOD)	5 (BOD)	N/A
Ammonia (as N)	mg/L	45	1	23
Total Nitrogen[5]	mg/L	48	6	27
Total Phosphorus	mg/L	4.1	1	2.5

[1] SVCW Commonly analyzed parameters from 2012-2015 provided to the Regional Board by City to fulfill NPDES general reporting requirements.
[2] Anticipated water quality data provided by CH2M (Ted Couch, 2017)
[3] TDS and TSS for combined tertiary effluent is shown as an average but is likely to vary based on blending timing and water chemistry.
[4] CBOD = carbonaceous biochemical oxygen demand; BOD = biochemical oxygen demand
[5] Total Nitrogen is a calculated value.

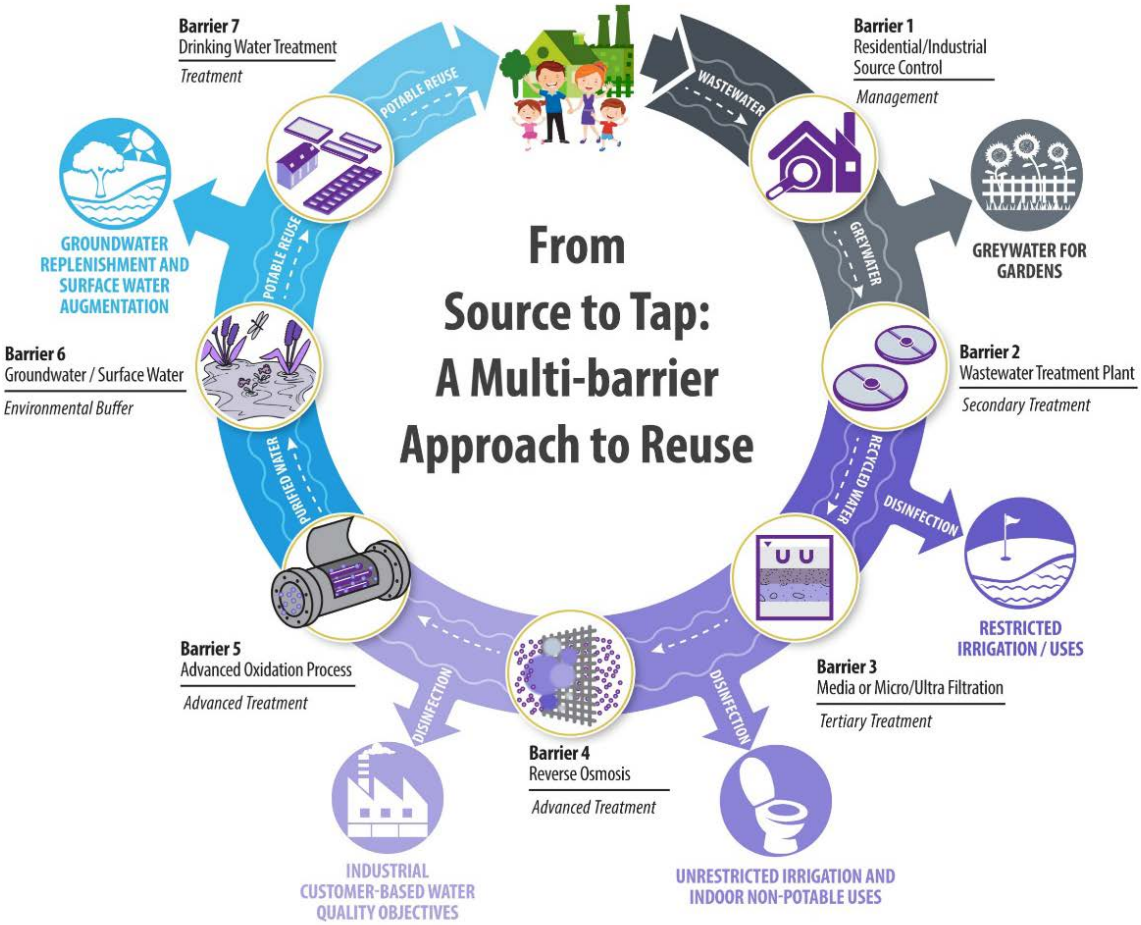
Section 3: Regulatory Overview

This section discusses regulations and treatment requirements for recycled water use to protect public health, including the most recent regulatory expectations for potable reuse.

3.1 Multi-Barrier Approach to Reuse

Recycled water begins as wastewater and undergoes a series of treatment steps, using a multi-barrier approach, to remove organic matter and pollutants. The production and use of recycled water must adhere to strict regulations stipulating the levels of treatment, allowable types of reuse, and water quality requirements. Figure 3-1 illustrates the multi-barrier approach to reuse, highlighting the increasing level of treatment necessary to produce the right quality of water for the right use.

Figure 3-1: Multi-Barrier Approach to Reuse



Non-potable reuse refers to the use of tertiary treated municipal wastewater for a specific purpose other than drinking; such as landscape irrigation, industrial uses, and agriculture, or for environmental benefits. Non-potable reuse usually requires an independent "purple pipe" distribution system for conveying recycled water to customers separate from the potable supply. In California, non-potable reuse has been ongoing throughout the state for the last century and regulations for non-potable reuse have been in place since the 1970s. As previously noted, SVCW has been producing recycled water for Redwood City's recycled water program since 2000 for current non-potable customers.

Potable reuse refers to the intended use of highly treated or purified municipal wastewater to augment a water supply that is used for drinking and all other purposes. Unplanned potable reuse, where one community draws raw water supplies downstream from discharges from wastewater treatment plants, is regulated by federal discharge requirements. Planned potable reuse involves a more formal public process and regulatory consultation program to implement, and the regulations in California for indirect and direct potable reuse are at varying stages of development. AB 292, introduced in January 2019, aims to eliminate the distinctions of "indirect potable reuse" and "direct potable reuse" and define "potable reuse" to include groundwater augmentation, reservoir water augmentation, raw water augmentation, and treated drinking water augmentation. The definitions herein reflect the proposed language in AB 292 and references the terms used in existing law.

- **"Groundwater augmentation"** means the planned use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system, as defined in Section 116275 of the Health and Safety Code. *(Previously referred to as indirect potable reuse (IPR) via groundwater replenishment reuse (GRR))*
- **"Reservoir water augmentation"** means the planned placement of recycled water into a raw surface water reservoir used as a source of domestic drinking water supply for a public water system, as defined in Section 116275 of the Health and Safety Code, or into a constructed system conveying water to such a reservoir. *(Previously referred to as IPR via surface water augmentation (SWA))*
- **"Raw water augmentation"** means the planned placement of recycled water into a system of pipelines or aqueducts that deliver raw water to a drinking water treatment plant that provides water to a public water system, as defined in Section 116275 of the Health and Safety Code. *(Previously referred to as direct potable reuse (DPR) into a raw water supply upstream of a drinking water treatment plant)*
- **"Treated drinking water augmentation"** means the planned placement of recycled water directly into a finished water distribution system of a public water system, as defined in Section 116275 of the Health and Safety Code. *(Previously referred to as DPR into a potable water supply distribution system downstream of a drinking water treatment plant)*

Regulations for groundwater augmentation became effective on June 18, 2014. Final recycling criteria for reservoir water augmentation were adopted by the SWRCB on March 6, 2018 (herein referred to as RWA Regulations) and became effective as of October 1, 2018.

Currently, raw water and treated water augmentation are not yet included as allowable use in California, though a report released by the State Board on December 26, 2016 concluded that it is feasible to develop and adopt regulations for raw water and treated drinking water augmentation, provided that certain research and key knowledge gaps are addressed[5]. AB 574, signed on July 5, 2017, further required the State Board to adopt uniform water recycling criteria for potable reuse through raw water augmentation on or before December 31, 2022. The SWRCB published a proposed framework for regulating DPR (SWRCB 2018), which evaluated how public health threats, risk management opportunities and permitting options vary between the range of potable reuse forms and how public health must and will be protected in all cases. The Framework also sets forth a schedule for completing the recommended research from the prior investigation of developing raw water augmentation criteria (WateReuse 2016).

The PREP Phase 1 Initial Study evaluated project alternatives for groundwater augmentation in the San Mateo Plain Basin, and RWA at CSR and at Bear Gulch Reservoir. Raw water or treated drinking water augmentation alternatives were not considered as part of the initial work.

For Phase 2, the PREP Parties agreed to proceed with the evaluation of RWA at CSR to confirm the ability to meet finalized RWA regulations, further explore cost beneficial pipeline alignments and facility siting options and assess community outreach needs.

The following sections focus on regulatory and treatment requirements for potable reuse via RWA.

3.2 Overview of Treatment Processes for Potable Reuse

Table 3-1 summarizes treatment processes considered for potable reuse. The AWPF treatment processes assumed for implementation of each potable reuse alternative is detailed in Section 4.

Table 3-1: Summary of Treatment Technologies

Treatment Process	Description
Tertiary Filtration	A wastewater post-treatment process that provides filtration to remove the majority of the remaining suspended solids and other pollutants using sand or media filtration.
Microfiltration (MF) or Ultrafiltration (UF)	A membrane-based, low-pressure-driven separation process that provides a barrier to the passage of solids and microorganisms. MF and/or UF does not remove salts (i.e., Total Dissolved Solids [TDS]) or other dissolved constituents like ammonia. For potable reuse applications, the primary goal of MF/UF is to provide pre-treatment for the reverse osmosis (RO) membranes, and to remove suspended particulate matter and larger microorganisms.

[5] State Board Press Release
https://www.waterboards.ca.gov/press_room/press_releases/2016/pr122916_dpr_report.pdf

Table3-1 (con't): Summary of Treatment Technologies

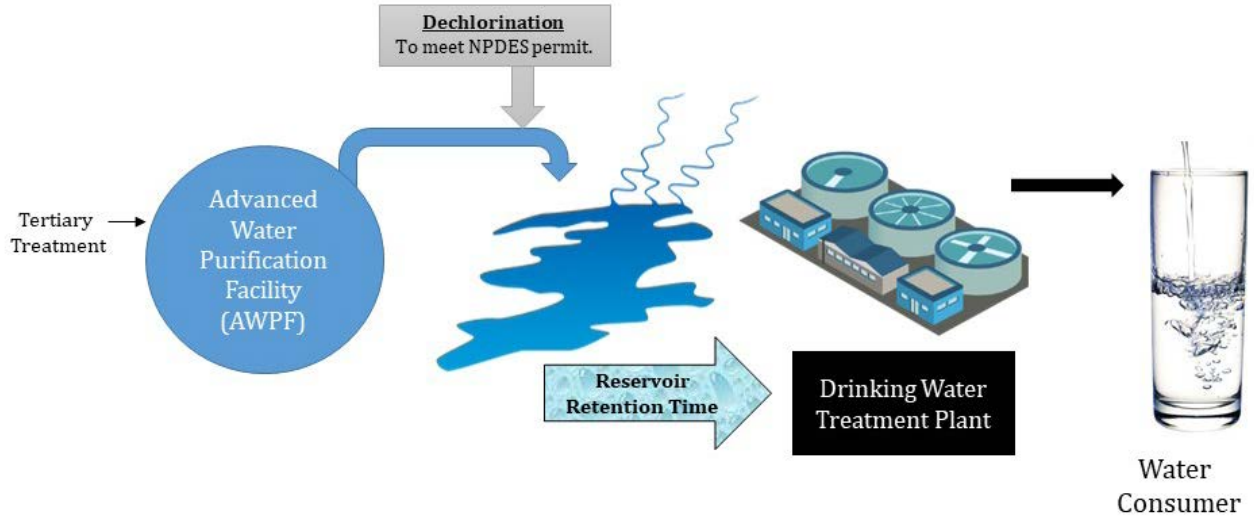
Treatment Process	Description
Membrane Bioreactors (MBR)	A MBR combines a bioreactor and microfiltration into one-unit process. The microfiltration membrane (cassette) is submerged in the bioreactor and water flows through the membrane either by vacuum or by gravity.
Reverse Osmosis (RO)	A membrane-based, high pressure-driven separation process that provides a barrier to the passage of particles, colloids, organics, bacteria and pathogens, and the vast majority of dissolved salts. RO produces a very low-TDS product stream and a high-TDS concentrate stream. Initially, RO was considered to be completely effective at removing all pathogens and chemicals; however, with improving analytical methods, a few trace organic compounds have been detected in RO permeate. This gave rise to the required advanced oxidation process following RO (discussed below).
Ultraviolet (UV) Disinfection	Treatment by applying a broad spectrum of radiation with intense peaks at certain wavelengths. UV light penetrates an organism's cell walls and disrupts the cell's genetic material, making reproduction impossible. With the proper dosage, UV irradiation has proven to be an effective disinfectant for bacteria, protozoa, and virus in water, while not contributing to the formation of disinfection byproducts (DBPs).
UV-based Advanced Oxidation Process (AOP)	Treatment by applying light in the presence of an auxiliary oxidant that has been added to the wastewater, such as hydrogen peroxide, ozone or chlorine. Photo-excited oxidants quickly degrade to form highly-reactive free radicals, which are strong oxidants capable of degrading most natural and synthetic organic compounds present in wastewater. The design of a UV-AOP typically requires UV doses in great excess of those needed for disinfection alone.
Ozone	To generate ozone (O_3), energy is added to oxygen (O_2), splitting the molecules into individual atoms which then collide with oxygen forming ozone. Ozone is then bubbled into water where it oxidizes compounds directly or forms hydrogen peroxyl (HO_2) and hydroxyl (OH) radicals, which oxidize certain contaminants.
Biological activated carbon (BAC)	A biologically enhanced granular activated carbon (GAC) process that removes dissolved organics through adsorption by the activated carbon and biodegradation by bacteria attached on the activated carbon. Biologically activated carbon (BAC) has not been used in a full-scale potable reuse project in California to date but is currently being pursued for the City of San Diego's RWA project. BAC filtration is often used after ozonation.
Chlorine-based Disinfection	The most common disinfection technology in wastewater treatment and reuse. Chlorine inactivates a diverse group of pathogens, including viruses, and residual chlorine prevents pathogen re-growth during storage and distribution. Free chlorine disinfection can be implemented to achieve virus and *Giardia* credits at multiple places in a potable reuse treatment train. Currently, California water recycling regulations do not differentiate between free and combined chlorine disinfection.

3.3 Reservoir water augmentation (RWA) Requirements

A potable reuse project via reservoir augmentation project involves the use advanced treated recycled water for augmenting a reservoir that is designated as a source of municipal water supply. According to the finalized RWA regulations, the viability of a RWA project depends on the dilution ratio and the retention time achievable in the reservoir. No RWA projects currently exist in California, although three are moving forward in southern California: (1) Pure Water San Diego[6], (2) East County Advanced Water Purification Program[7] and (3) Pure Water Project Las Virgenes-Triunfo[8].

The RWA concept is depicted in Figure 3-2. The PREP Phase 2 Concept Study explores augmentation with purified water in Crystal Springs Reservoir (CSR). The evaluation of dilution and retention of purified water in CSR is provided in Section 4.3.

Figure 3-2: RWA Concept



3.3.1 RWA Regulations

A RWA project is defined as a project that plans to use purified recycled water from a municipal wastewater facility for augmenting a reservoir that is designated as a source of domestic water supply. The final RWA Regulations set forth the following requirements:

1) An initial minimum theoretical retention time of no less than 180 days (calculated as total monthly volume divided by total monthly outflow); however, an alternative minimum theoretical retention time of no less than 180 days but no less than 60 days may be considered for approval.

[6] https://www.sandiego.gov/water/purewater/
[7] http://eastcountyawp.com/
[8] https://www.ourpureh2o.com/home

2) A dilution requirement in the reservoir of 100:1 (one percent by volume), or 10:1 (ten percent by volume) with an additional 1-log microbial pathogen treatment to demonstrate the percent of recycled water withdrawn from the reservoir, by volume, during any 24-hour period.

The Final RWA Regulations include an "alternatives clause", similar to the groundwater augmentation regulations. The intent of an "alternatives clause" is to provide adaptability to offer alternative permitting pathways for innovative projects that build off the expanding knowledge base (Trussell 2016). Alternative approaches could apply to the treatment train, monitoring plan or approaches used to demonstrate meeting minimum retention time (as noted in item 1 above). The Final RWA Regulations include language that allows for alternative approaches if it can be demonstrated to the State Board that the proposed alternative provides equivalent or better performance. Written approval from the State Board would be requested prior to implementation, and in some cases a public hearing may be required.

In addition, the Final RWA Regulations establish requirements for:

- Recycled water source control
- Treatment and pathogen removal
- Demonstration testing
- Operations and maintenance
- Effluent and process monitoring and reporting
- Reliability and redundancy
- Identification and responses to failure events
- Reservoir dilution, retention, tracer studies and monitoring
- Public comment and notification

A RWA project would likely be implemented within two key permits:

- State Board Division of Drinking Water (SBDDW) drinking water supply permit
- National Pollutant Discharge Elimination System (NPDES) permit issued by the San Francisco Bay Regional Water Quality Control Board (Regional Board) on behalf of the U.S. Environmental Protection Agency (EPA)

Current SBDDW drinking water supply permits implement applicable state and federal drinking water requirements and establish conditions under which a water supplier acquires, stores, treats, monitors, and distributes to a public water supply. Modification of the drinking water supply permit would be required as part of implementing a RWA project.

The Regional Board regulates discharges of recycled water to surface waters on behalf of the EPA through the issuance of NPDES permits. NPDES permits implement applicable state and federal water quality standards, policies, provisions, and prohibitions. NPDES permits would also incorporate applicable SBDDW recycled water and RWA requirements.

3.3.2 RWA Treatment Requirements

The treatment requirements for RWA require recycled water to be treated by full advanced treatment (i.e., RO and an AOP) prior to delivery to a reservoir. The treatment train must achieve a minimum of 8/7/8 microbial log-removal for virus, Giardia, and Cryptosporidium (V/G/C), with at least two separate treatment processes credited with no less than 1.0-log removal, and no separate treatment process credited with more than 6-log removal. The RWA Regulations require that any 24-hour input of recycled water into a reservoir must be mixed such that water withdrawn for use as drinking water never contains more than 1% recycled water.

For those projects where, recycled water delivered to a reservoir during any 24-hour period makes up 10% of water withdrawn for use as drinking water, the recycled water treatment train must achieve an additional 1-log removal (i.e., 9/8/9) with at least three separate treatment processes credited with no less than 1.0-log removal. In addition, although alternative minimum reservoir retention times as low as 60 days may be considered, RWA projects with minimum retention times of less than 120 days must provide an additional 1-log treatment. The RWA criteria and treatment requirements are summarized in Table 3-2.

Table 3-2: RWA Criteria and Treatment Requirements

Retention Time (days)[1]	Dilution (Volume:Inflow$_{day}$)[2]	Log Removal at AWPF (V/G/C)[3]	# of Treatment Processes
$\geq$ 120	100:1	8/7/8	2
	10:1	9/8/9	3
$\geq$ 60*	100:1	$\geq$ 9/8/9	2
	10:1	$\geq$ 10/9/10	3

[1] Retention time is calculated as total volume divided by total outflow

[2] Dilution of 100:1 = one percent, by volume, of purified water delivered to the surface water reservoir during any 24-hour period. Dilution of 10:1 = ten percent, by volume, of purified water delivered to the surface water reservoir during any 24-hour period

[3] Removal credits at a drinking water treatment plant (4/3/2 V/G/C) were previously included in the total LRV requirement in prior versions of the Draft RWA Regulations but are not included in the Final RWA Regulations.

Anticipated pathogen removal credits for treatment train processes are shown in Table 3-3. The ultimate inactivation credit achieved may be based on site-specific performance and/or a negotiated validation approach with SBDDW on a case-by-case basis. For example, the tertiary treatment process prior to the AWPF may receive additional inactivation credits for V/G/C and multiple disinfection processes, such as ozone and free chlorine in addition to UV-AOP, could provide for an additional 4 to 6 virus inactivation credits, respectively. Critical control points identified between individual treatment processes can provide both process control and be used to establish log reduction credits (WateReuse 2016).

Table 3-3: Anticipated Log-Reduction for Various RWA Treatment Process Options

Process	Sand Filtration	MBR	MF/UF	RO	Free Chlorine	UV low dose	UV high dose w/AOP	Ozone	Pasteurization
Virus	2	2	0	1.5	4 – 6	0.5 – 4	6	4	6
Giardia	2.5	2	4	1.5	0 – 3	4	6	Some	6
Crypto	2	2	4	1.5	0	4	6		

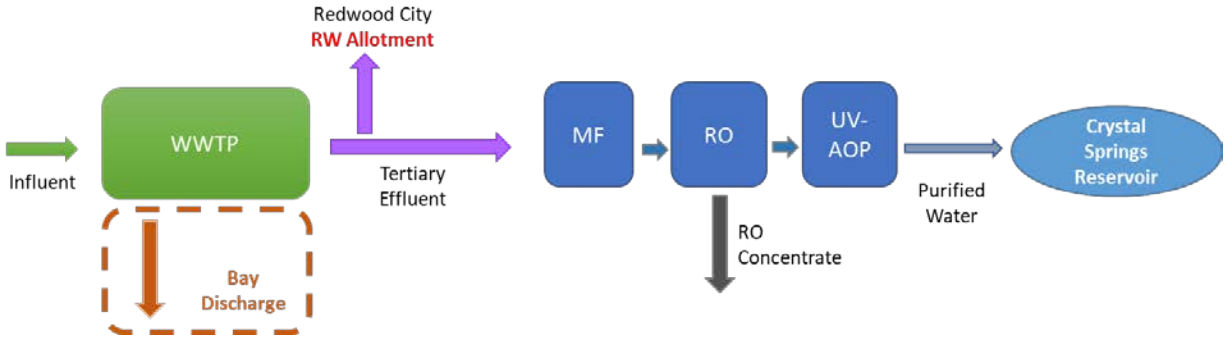
* The ultimate inactivation credit achieved for a given process may be based on site-specific performance and/or a negotiated validation approach with SBDDW on a case-by-case basis (WateReuse 2016).

3.4 Bay Discharge Requirements

Discharge of treated wastewater from SVCW's outfall is regulated under three (3) Waste Discharge Requirements (WDRs) / National Pollutant Discharge Elimination System (NPDES) permits, as summarized in Table 3-4.

Table 3-4: Summary of Existing and Future Regulations at SVCW Outfall to SF Bay

Permit	Permit Type	Key Relevant Items
SVCW WDR **ORDER No. R2-2018-0005** **NPDES No. CA0038369**	**Individual**	**Dry Season (May 1 to Sept 30) Effluent Limitations**
WDR for Mercury and PCBs **ORDER No. R2-2017-0041** **NPDES No. CA0038849**	**SF Bay Watershed**	**Year-Round Effluent Limits** Average annual – by mass Monthly and weekly – by concentration
WDR for Nutrients **ORDER No. R2-2014-0014** **NPDES No. CA0038873**	**SF Bay Watershed**	**Focus on Nutrients** 2014 – 2018: Concentration and load monitoring 2019 – 2024: Load targets 2025 onwards: Potential load caps



These permits establish requirements for the overall water quality-based effluent limitations, mercury and polychlorinated biphenyls limitations and nutrients monitoring requirements respectively. With an AWPF, the combined effluent discharged from SVCW's outfall will consist of RO concentrate from the AWPF blended with the remaining effluent. This combined effluent will need to meet the requirements described in the WDR/NPDES permits.

3.4.1 Existing SVCW NPDES Permit

This individual NPDES permit is specific to SVCW and includes effluent limitations and discharge specifications, and monitoring requirements. Effluent limitations include monthly, weekly, daily and instantaneous limits on CBOD, Total Suspended Solids (TSS), turbidity, total chlorine residual, ammonia and whole effluent acute toxicity. In general, the dry season limits are more stringent than the wet season limits. Receiving water limitations include limits on floating material, temperature changes and suspended material or coloration that cause nuisance. These limits are generally developed based on the Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan). Monitoring of constituents at one influent location, three effluent locations and one biosolids location is also described in this NPDES permit.

For this study, the ability to meet the more stringent dry season effluent limitations is evaluated. Compliance with other limitations and discharge specification would be assessed during future phases.

Table 3-5: Summary of SVCW Dry Season Effluent Limitations

Parameter	Units	Average Monthly	Average Weekly	Max Daily	Inst. Min	Inst. Max
CBOD5	mg/L	8	12	-	-	-
TSS	mg/L	8	12	-	-	-
Oil and Grease	mg/L	10	-	20	-	-
pH	s.u.	-	-	-	6	9
Turbidity	NTU	10	-	20	-	-
Chlorine, Total Residual	mg/L	-	-	-	-	0
Ammonia, Total	mg/L as N	170	-	250	-	-
Copper, Total Recoverable	ug/L	52	-	84	-	-
Cyanide, Total	ug/L	21	-	36	-	-

3.4.2 Existing Mercury and PCBs NPDES Permit

This order implements the waste load allocations and implementation requirements of the SF Bay mercury and PCBs Total Maximum Daily Load (TMDL) adopted in 2006 and 2008 respectively. This watershed permit applies to both municipal wastewater and industrial wastewater dischargers to SF Bay and requires them to monitor discharges for mercury and PCBs and comply with concentration and mass loading limits. Compliance with this NPDES permit would need to be assessed during future phases.

3.4.3 Existing and Future Nutrients NPDES Permit

The nutrient permit is another region-wide SF Bay watershed permit applicable to discharges to SF Bay. This permit addresses municipal wastewater discharges of nutrients such as nitrogen and phosphorus into the SF Bay. Similar to the Mercury and PCBs watershed NPDES permit, the nutrient watershed

permit complements SVCW's individual NPDES permit and stipulates additional requirements that relate to nutrients. The first nutrient watershed permit, the 2014 nutrient permit, did not include water quality-based limits for nutrients since the water board determined that there was insufficient evidence to conclude that nutrients contribute to biostimulation in the SF Bay. Effluent limitations for ammonia continue to be specified in individual WWTP NPDES permits.

The new 2019 permit, that was adopted on May 8, 2019 and will be effective on July 1, 2019, similarly does not specify effluent limitations for nutrients. In the meantime, municipal wastewater discharges described in the permit have and will continue to fund scientific studies to determine what nutrient load reductions are necessary to protect the SF Bay.

This 2019 permit includes effluent monitoring requirements for ammonia, nitrate-nitrite, total inorganic nitrogen and total phosphorus. While the 2019 nutrient watershed permit does not include effluent limitations, it includes 2024 load targets for inorganic nitrogen for each discharger. Since the growth-limiting nutrient for phytoplankton in the SF bay is nitrogen, only inorganic nitrogen load targets are included; there are no phosphorus load targets. The load targets are based on the historical 2014 – 2017 maximum dry season average loads, escalated to include a 15% growth buffer. It is anticipated that these load targets will turn into load caps during the 2024 permit cycle. It is also anticipated that the load caps will be implemented on a sub-embayment basis, with the potential for nutrient credit trading to meet compliance.

A summary of SVCW's nutrient loads are shown in Table 3-6.

Table 3-6: Summary of SVCW Nutrient Loads

Parameter	Inorganic Nitrogen
2014 – 2017 Max Dry Season Average Load	2,500 kg/day
2024 Dry Season Average Load Target	2,900 kg/day

*Dry Season = May 1 – Sept 30
Source: Table F-5 of San Francisco Bay Nutrient Watershed Permit, R2-2019-00XX (TBD once posted)

It should be noted that these load targets and load caps are mass-based and not concentration-based. Thus, RO concentrate from an AWPF would not negatively impact compliance with a potential new effluent nutrient limit that is load based. On the other hand, unlike a tertiary effluent recycled water project that removes nutrients from the discharge to SF Bay by allowing beneficial reuse, a potable reuse project that uses RO conveys the nutrients in the form of RO concentrate back to the outfall and will not reduce the overall nutrient loading to the bay.

3.5 CSR Augmentation Considerations

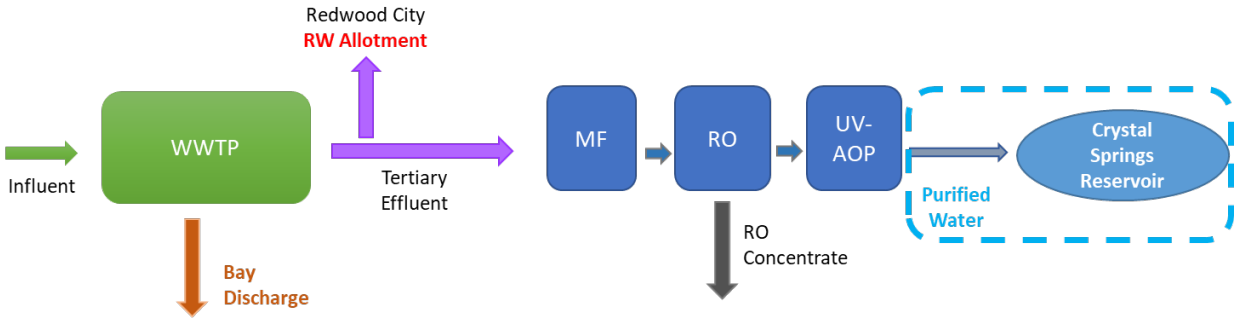
Any augmentation of CSR would not only need to comply with RWA requirements but would also need to meet local SF Bay Basin Plan requirements. In addition, the background water quality concentrations should also be considered. Table 3-7 provides a summary of the existing and future regulations related to augmenting CSR with purified water. Ammonia limits are controlled by the SF Bay Basin Plan

regulations which have more stringent water quality limits as compared to the background concentrations in CSR. Phosphorus limits are controlled by background CSR concentrations since there are no Basin Plan limits, but anti-degradation provisions apply.

The following sections discuss these requirements and considerations in more detail.

Table 3-7: Summary of Existing and Future Regulations related to Augmentation of CSR

Regulation / Permit	Key Relevant Items
RWA Requirements	**Discussed in Section 3.3**
SF Bay Basin Plan[1]	**Specific quantitative limits** ▪ Un-ionized Ammonia ▪ Annual median= 0.025 mg/L as N ▪ Maximum = 0.4 mg/L as N **Dissolved Oxygen – 7.0 mg/L for cold water habitats** ▪ General qualitative limits ▪ E.g. bioaccumulation, biostimulatory substances, population and community ecology etc. ▪ *There are currently no limits for phosphorus*
CSR Background Water Quality Considerations	**Existing Conditions** ▪ Ammonia = 0.01 – 0.45 mg/L as N (0.01 – 0.28 in Upper CSR and 0.01 – 0.45 in Lower CSR) ▪ Phosphorus = 0.03 – 0.63 mg/L (0.03 – 0.3 mg/L in Upper CSR and 0.04 to 0.63 mg/L in Lower CSR)



3.5.1 SF Bay Basin Plan Requirements

The Basin Plan guides specific quantitative and general qualitative limits related to the discharge of water into CSR; these limits will be implemented through the permit process. Relevant quantitative limits include limits on un-ionized ammonia and dissolved oxygen; there are no quantitative limits for phosphorus. Qualitative limits include limits on bioaccumulation, biostimulatory substances, population and community ecology etc. Purified water that is added to CSR will have to meet these regulatory limits.

3.5.2 CSR Background Water Quality Considerations

Some of the key background water quality parameters to consider for CSR include ammonia and phosphorus. Increasing nitrogen loads in CSR could potentially increase risk of algal blooms, which in turn raises the risk of cyanotoxins, and/or taste and odor compounds occurring in the reservoir during the summer months. The background ammonia and phosphorus concentrations are lower in Upper CSR than in Lower CSR. Since there are no phosphorus limits in the SF Bay Basin Plan, background phosphorus levels in CSR would form the basis for purified water quality evaluation for reservoir water augmentation at CSR. At this level of planning, it would be conservative to assume that the water quality of augmented water would need to match or be compatible with the background levels.

Section 4: Development of Alternatives

This section describes the development of RWA alternatives at a concept-level to provide a preliminary understanding of the viability and costs for a project on the San Francisco Mid-Peninsula. Two project alternatives were developed from these concepts:

- **Alternative 1:** 6-mgd RWA in Crystal Springs Reservoir
- **Alternative 2:** 12-mgd RWA in Crystal Springs Reservoir

Section 3 introduced potable reuse concepts and RWA treatment requirements. The following sections describe the AWPF assumptions, infrastructure requirements and conveyance considerations to repurpose existing assets, reusing abandoned resources, and utilizing existing right-of-ways (ROW) where possible.

4.1 Advanced Water Purification Facility (AWPF)

As discussed in Section 3, for potable reuse, additional treatment processes are added beyond secondary or tertiary treatment to remove dissolved solids and other contaminants. An AWPF provides the additional steps to purify recycled water. The specific combination of treatment processes needed for a given project will depend on the quality of the treated wastewater and the intended use. The following sections discuss the treatment capacity, additional treatment processes, AWPF locations, and RO concentrate disposal considerations assumed for the PREP Phase 2 Concept Study.

4.1.1 Treatment Capacity

The available wastewater supply and seasonality of wastewater flows can limit the capacity of a recycled water project. As previously shown on Figure 2-4, monthly wastewater flows at the SVCW facility generally increase during the winter wet-weather season, from December to March, and are at their lowest during summer months. Although an AWPF could be sized to treat peak winter flow, this would require a very large treatment facility with shutdown procedures to take membranes off-line and institute preservation protocols for periods when source water flows are low. This results in larger capital investment and a higher unit life cycle cost. Operating the AWPF at a relatively constant flow year-round is preferable to keep treatment facility costs down, simplify operations, and to maximize returns on economies of scale.

As discussed in Section 2, it is assumed that a potable reuse project would receive up to 8 mgd of tertiary effluent from the SVCW facility and up to 8 mgd from the City of San Mateo's future BNR/MBR facility, or a total of 16 mgd (approximately 18,000 acre-feet per year). Assuming a rejection rate of 25%, this would yield 12 mgd (approximately 13,500 acre-feet per year) of purified water.

Consistency Helps Efficiency
Operating an AWPF at a relatively constant flow year-round is preferable to keep treatment facility costs down, simplify operations, and maximize returns on economies of scale.

4.1.2 Advanced Treatment Process

For the alternatives evaluation, the AWPF train is assumed to consist of a low-pressure membrane (MF or UF) as pretreatment prior to the RO system. The next step would employ an advanced oxidation process (AOP), which typically combines UV treatment with the addition of an oxidant (e.g. hydrogen peroxide (H_2O_2) or ozone) to oxidize most remaining natural and synthetic organic compounds that make it through the RO process. A treatment train using ozone and biologically activated carbon (BAC) as the primary removal processes, is not considered, though this alternative treatment train is sometimes pursued as an alternative to RO/UV-AOP in areas where RO concentrate disposal is extremely costly or not an option.

The RO/UV-AOP combination of treatment processes, also referred to as Full Advanced Treatment (FAT), is assumed to be sufficient for a RWA project. As discussed in Section 3, additional treatment steps may be required, or preferred, including but not limited to:

- ✓ **Free chlorine or ozone addition** at the AWPF to provide additional log-removal credits for virus or giardia if the dilution credits are insufficient.
- ✓ **Dechlorination** prior to discharge into the reservoir to meet surface water requirements.
- ✓ **Nutrient removal** before or after the AWPF process to reduce nutrients prior to discharge into the reservoir to meet surface water requirements (further discussed in Section 4.3.4)

Further evaluation of additional treatment requirements and processes would be performed in future phases of a potable reuse program to provide the appropriate level of treatment and to optimize treatment process design.

4.1.3 Treatment Location

For the purpose of the PREP Phase 2 Concept Study, it is assumed that the AWPF facility would be located near the SVCW facility (herein referred to as the AWPF Site near SVCW), or at a site near the San Carlos Airport (herein referred to as the Hwy 101 AWPF Site), as shown in Figure 4-1. The cost to purchase or lease land for the AWPF has not been explored as part of this work. Based on initial discussions with SVCW, it is assumed that the AWPF would be an independent facility from SVCW. This could prove to be beneficial in terms of the potential positive public perception due to separation of wastewater and purified water systems.

The AWPF Site Near SVCW would require less pumping and shorter pipelines to convey tertiary effluent to the AWPF and RO concentrate from the AWPF, as compared to the Hwy 101 AWPF Site. There may also be holistic water cycle benefits for a location adjacent SVCW, for example, increasing awareness of what is eliminated through the wastewater treatment system. A siting study would be conducted to compare the benefits and limitations of these and other nearby sites prior to identification of a preferred AWPF site. Future discussions and agreements between the PREP Parties would determine preferences for ownership, operation and maintenance of the AWPF. The cost to purchase or lease land for the AWPF has not been explored as part of this work.

Figure 4-1: Potential AWPF Treatment Locations

Note: The areas within the orange dashed line are intended to represent a possible area that may be suitable for an AWPF. A future siting study would investigate the availability of areas within these boundaries, conflicts with other land use plans, environmental sensitivities and other benefits and limitations of these and other nearby sites prior to identification of a preferred AWPF site.

4.2 RO Concentrate Disposal

The advanced treatment of wastewater for potable reuse using a RO membrane would produce reject water (herein referred to as RO concentrate) for disposal. It is assumed that RO concentrate would be blended with remaining tertiary effluent and discharged via SVCW's existing ocean outfall pipeline to the SF Bay. The relevant permits that regulate SVCW's discharge to the bay are previously described in section 3.4.

For this study, the average monthly estimated combined RO concentrate, and tertiary effluent discharge is evaluated against the monthly limits shown in SVCW's individual permit. A more detailed evaluation of average weekly, maximum daily, instantaneous minimum and instantaneous maximum limits should be evaluated in future phases. As described in section 2.2, it is assumed that 1.8 mgd of tertiary effluent would be available to be blended with the RO concentrate. To be conservative, 75% recovery at the AWPF and 100% rejection of constituents at the RO is assumed. A summary of the estimated combined effluent concentrations with a 6 mgd or 12 mgd AWPF compared to the average monthly effluent limit is shown in Table 4-1.

Table 4-1: Summary of SVCW's Dry Season Effluent Limitations and Estimated Combined Effluent Concentrations

Parameter	Units	Average Monthly Effluent Limit	2013 - 2015 Three Month Consecutive Dry Months Averages	6 MGD AWPF[1]		12 MGD AWPF[2]	
				Estimated RO Conc	Estimated Combined Effluent[3]	Estimated RO Conc	Estimated Combined Effluent[3]
CBOD5	mg/L	8	2.4	9.5	6.2	9.5	7.3
TSS	mg/L	8	Removed by MF or UF treatment				
Oil and Grease	mg/L	10	Removed by MF/UF treatment				
pH	s.u.	-	Can be adjusted as part of treatment process to meet discharge requirements				
Turbidity	NTU	10	Removed by MF or UF treatment				
Chlorine, Total Residual	mg/L	-	ND	ND	ND	ND	ND
Ammonia, Total	mg/L as N	170	46.6	186.4	121.1	186	143.8
Copper, Total Recoverable	ug/L	52	4.9	19.7	12.8	19.7	15.2
Cyanide, Total	ug/L	21	4.1	16.2	10.5	16.2	12.5
Dioxin - TEQ	ug/L	$1.4x10^{-8}$	unk	unk	unk	unk	unk

[1] 6-mgd AWPF assumes source water from SVCW only.
[2]12-mgd AWPF assumed source water from SVCW and San Mateo.
[3] Combined effluent refers to RO concentrate blended with 1.8 mgd of SVCW tertiary effluent

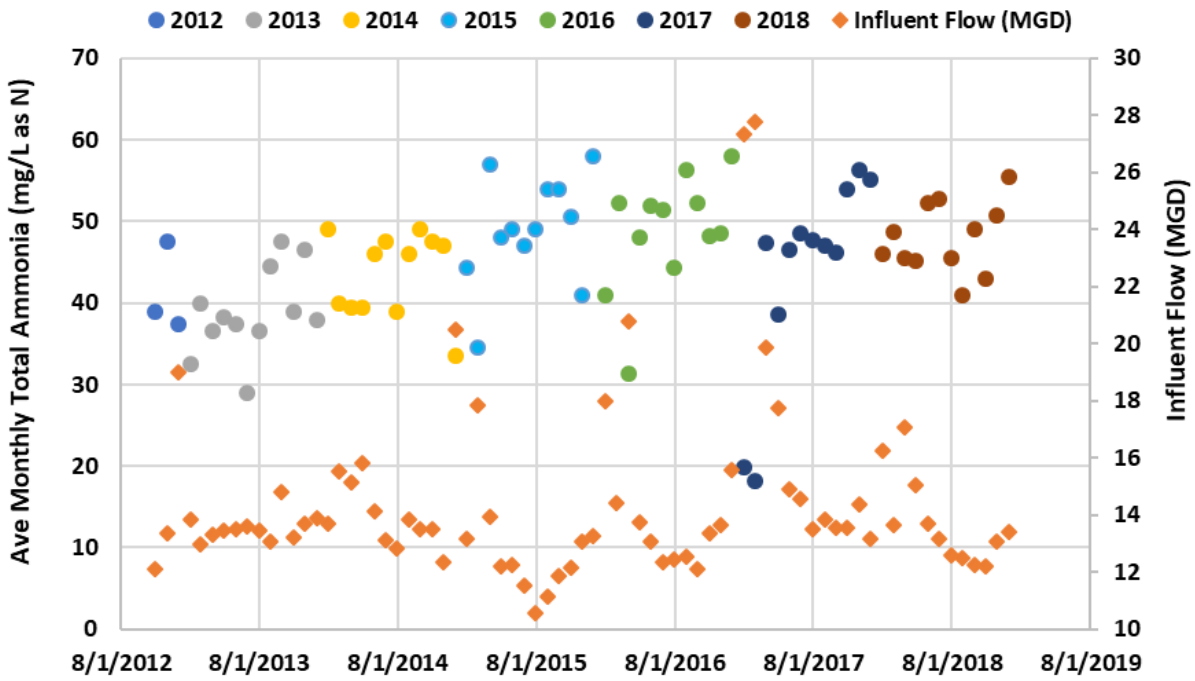
Given the level of analysis performed for this study, the following assumptions and considerations are noted:

- An initial estimate of RO concentrate Total Dissolved Solids (TDS) concentration is on the order of 4,000 mg/L, which is about 12% to 15% of the TDS in the South SF Bay. TDS is also not currently a regulated parameter in SVCW's NPDES permit.
- Toxicity is a key parameter that warrants additional evaluation in future studies, particularly during summer months when RO concentrate dominates the outfall discharge flow. SVCW's NPDES permit includes toxic pollutant effluent limitations. This is the case for both the 6-mgd and 12 -mgd scenarios.
- As discussed in section 3.4.3, the 2019 discharges to SF bay nutrient permit includes load target which are anticipated to turn into load caps as part of the next permit in 2024. Since these are load targets and not concentration-based targets, the combined RO and tertiary effluent discharge would not be impacted by the nutrient permit.
- The combined discharge would still have to meet the total ammonia effluent limits stipulated in SVCW's individual NPDES permit. Table 4-1 shows that the estimated combined effluent under both the 6-mgd and 12-mgd scenarios would likely meet this limit. Since SVCW's treatment process does not remove ammonia, higher flows coincide with lower ammonia concentrations due to dilution and do not typically occur during the dry season. It should be noted that the rate of increase in ammonia concentration is higher than the rate of increase of influent flows. This is a common trend seen at WWTPs in California over the past few years and is likely due to growth in the wastewater service area coupled with water conservation. Figure 4-2 shows the trend for average monthly total ammonia (mg/L as N) and influent flows (in mgd) from 2013 to 2018.
- CBOD is typically higher during the wet season as secondary effluent is routed around the tertiary filter during high flow periods. During dry weather periods, average monthly effluent CBOD is typically less than 30% of the average monthly effluent limit. While the RO concentrate CBOD is estimated to be higher than the CBOD monthly limit, the remaining tertiary effluent flow would likely be sufficient to dilute it to levels below the limit.
- TSS, Oil and Grease and Turbidity would mostly be removed by the MF or UF treatment process. MF or UF reject would be sent back to SVCW's headworks. As such, the RO concentrate is not anticipated to contain high levels of TSS, oil and grease, or turbidity.
- The AWPF would be able to meet pH effluent limits with the addition of chemicals to adjust the pH to be within the acceptable range. Typical chemicals used include sulfuric acid to decrease pH and sodium hydroxide to increase pH.
- Total residual chlorine levels have been below non-detect (ND) at SVCW's outfall over the past few years and are not anticipated to be an issue. Chlorine would likely be added as part of the AWPF process to prevent biofouling in the membranes. Sodium bisulfite (SBS) is typically added to the RO concentrate stream prior to discharge to ensure there is no remaining chlorine residual.

- Copper and Cyanide concentrations are anticipated to increase since these constituents are not removed by the MF or UF membranes. However, both the estimated RO concentrate and combined effluent concentrations are estimated to be below the average monthly limits.

Given the high-level analysis performed as part of this study, a more detailed analysis of water quality is warranted in future phases.

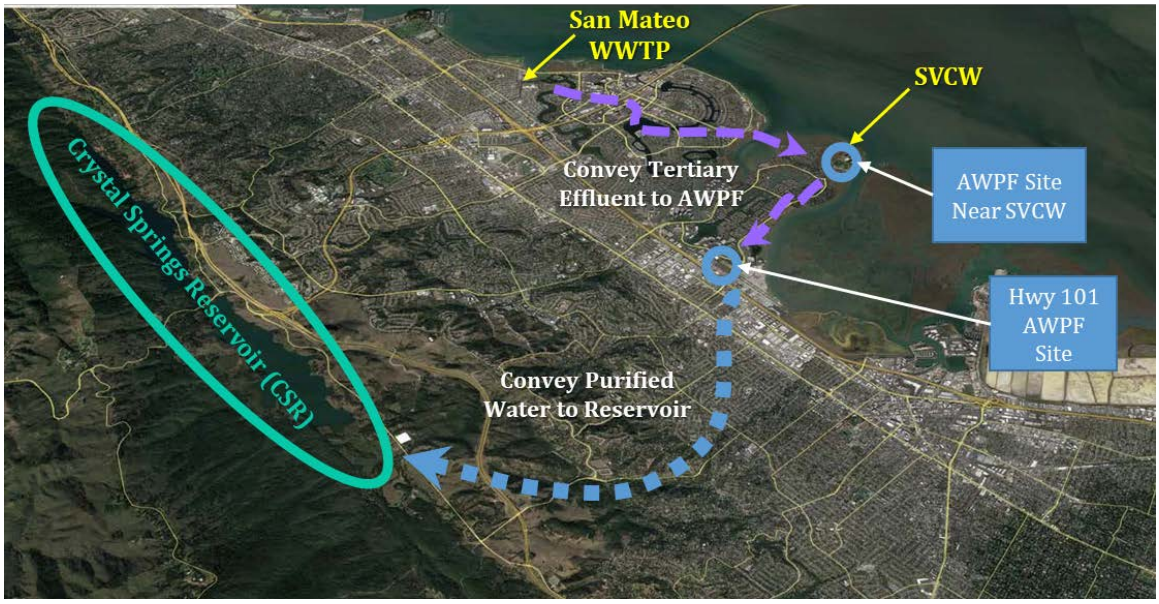
Figure 4-2: Average Monthly Total Ammonia (mg/L as N) and Influent Flow (MGD)



4.3 Reservoir water augmentation (RWA) Project Concept

The RWA project concept would treat tertiary effluent from SVCW and/or San Mateo WWTP at an AWPF and convey purified water to CSR (Figure 4-3) where it would be combined in the reservoir with surface water. After the required storage retention, waters would be transported downstream to a treatment facility for treatment and conveyed to drinking water users through the existing potable water distribution system. The following sections describe the analysis of the suitability of CSR to meet the anticipated RWA requirements discussed in Section 3.3.

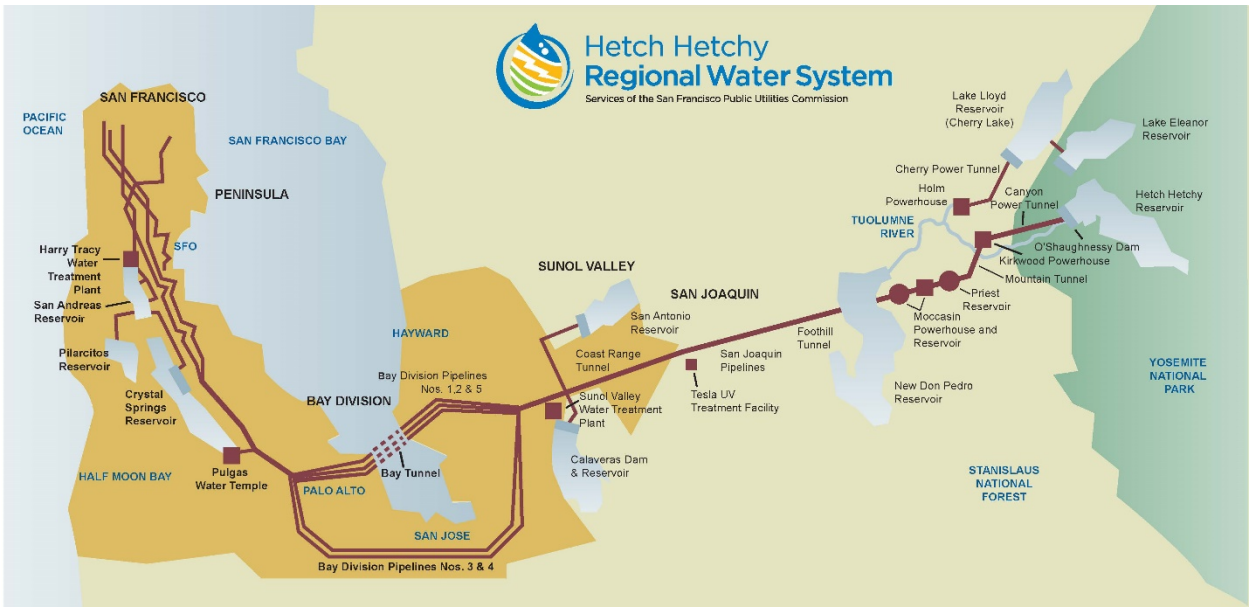
Figure 4-3: RWA Project Concept



4.3.1 Overview of CSR Operations

CSR consists of Upper Crystal Springs Reservoir, Lower Crystal Springs Dam and Reservoir, and San Andreas Reservoir. Upper and Lower CSR are hydraulically connected via two culverts and are operated as a single reservoir. Lower CSR is connected to San Andreas Reservoir in the north via the Crystal Springs Pump Station and Crystal Springs-San Andreas pipeline. The two-reservoir system (CSR and San Andreas Reservoir) is owned and operated as part of SFPUC's Hetch Hetchy Regional Water System (RWS), shown in Figure 4-4.

Figure 4-4: Hetch Hetchy Regional Water System



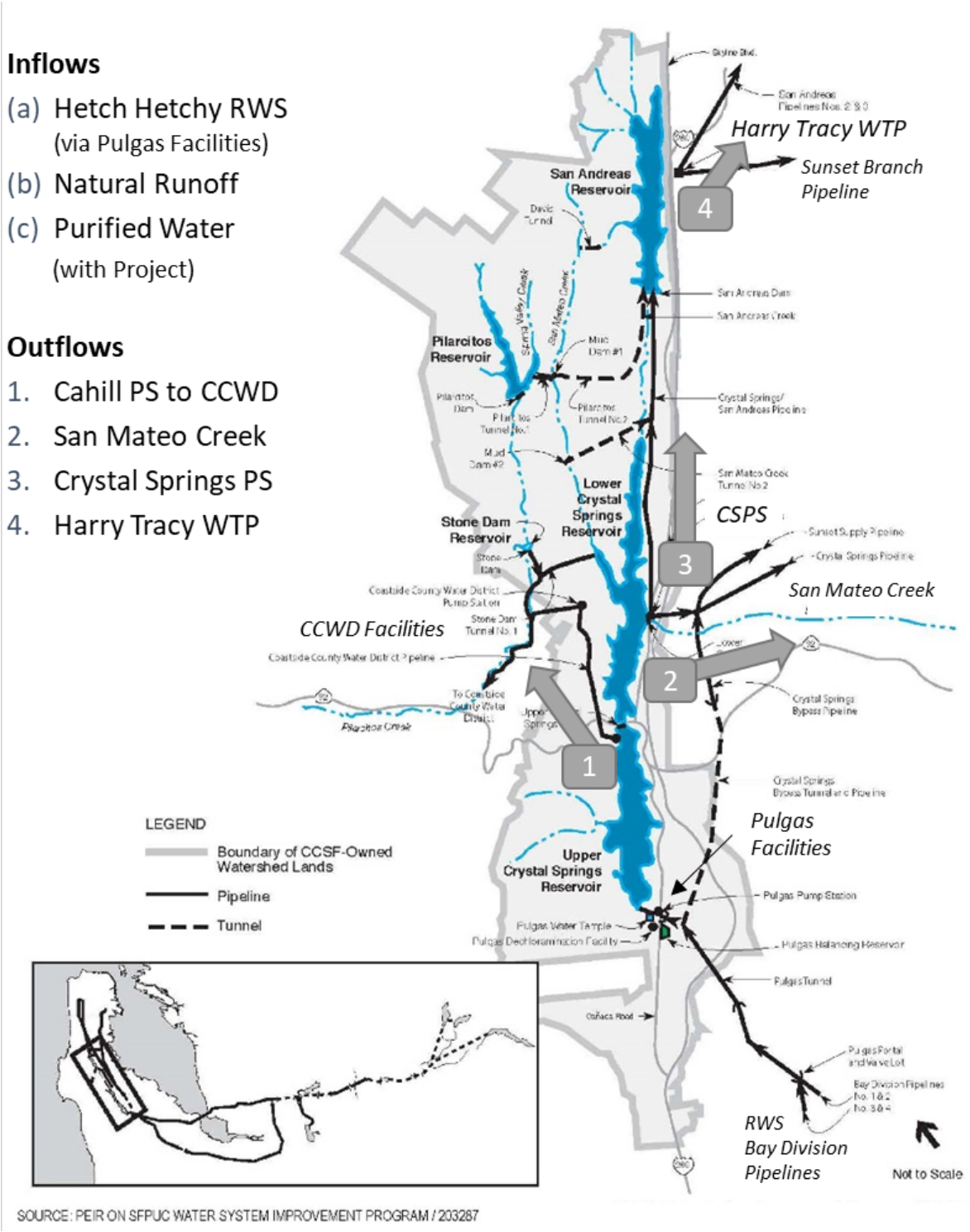
Treated drinking water in the RWS transmission system is dechloraminated and discharged into Upper CSR at the Pulgas Facilities. These two reservoirs also capture water from local runoff from the San Mateo Creek watershed. Water from the Pilarcitos Creek watershed is also periodically transferred to Lower CSR.

As illustrated in Figure 4-5, there are three main outflows from two-reservoir system.

1. Water is pumped out of Upper CSR through the Cahill Ridge Pump Station, over the mountain, to **Coastside County Water District (CCWD)** facilities to supplement the other three sources of supply for use in Half Moon Bay. All CCWD water supplies are treated at the Nunes Water Treatment Plant (Nunes WTP), which has a capacity of 4.5 mgd.
2. Stream releases to **San Mateo Creek** occur at the release structures in Lower CSR Reservoir. Water is released from Lower Crystal Springs Dam to San Mateo Creek based on a schedule. The minimum release depends on both the type of water year (normal/wet or dry) and time of year. In wetter years, additional releases from CSR to San Mateo Creek are made to keep the reservoir storage at the operational target.
3. Water is pumped through the Crystal Springs Pump Station (CSPS) from San Andreas Reservoir to the **Harry Tracy Water Treatment Plant (WTP)**, east of the reservoir, where it is treated before being supplied to drinking water customers. San Andreas Reservoir storage is generally maintained at rule-curve storage, so the CSPS rate tends to generally match Harry Tracy WTP production rate. Harry Tracy WTP production is generally operated at a low rate and ramped up as needed. Most flows go to San Francisco, but there are a few wholesale turnouts along the way (e.g. Daily City and South San Francisco). When running at peak capacity, Harry Tracy WTP can meet City demands plus demands for other RWS wholesalers on the peninsula, infrequently used during period of pipeline shutdown or emergencies.

The open culverts that connect Lower and Upper CSR are not considered an outflow but instead a static condition. The Sunset Branch pipeline, at Lower CSR, would only be used in an extreme emergency when raw water flows are needed to fight big fires (e.g. such as a fire at San Francisco Airport).

Figure 4-5: Crystal Spring Reservoir Inflows and Outflows



SOURCE: PEIR ON SFPUC WATER SYSTEM IMPROVEMENT PROGRAM / 203287

Other Hydraulic Features: Upper and Lower CSR are connected by an open culvert (i.e. static condition) and the Crystal Springs Pump Station (CSPS) conveys flows from Lower CSR to

CSR's large surface area (approximately 1,300 acres) and significant capacity (approximately 18 billion gallons) along with its existing infrastructure, make this reservoir a suitable alternative for RWA. The elongated shape with natural separations between each holding area is beneficial for meeting an extended retention time. The reservoir's overall large capacity provides for generous dilution even at high augmentation rates.

SFPUC's existing water treatment plant (Harry Tracy WTP) and the Pulgas Facilities at the southern end of CSR (Figure 4-5), including a dechloramination system and discharge facility, have sufficient capacity to accept purified water from a RWA project. The Pulgas Facilities are further discussed in Section 4.4.2. The following sections provide a high-level evaluation of estimated retention times, dilution and source water quality to assess the viability of a RWA project at CSR to meet existing regulations.

4.3.2 Crystal Springs Reservoir RWA Retention Time Evaluation

Per the Final RWA Regulations, an initial reservoir retention time of 180 days must be demonstrated, with flexibility for an alternative minimum theoretical retention time as low as 60 days on a case-by-case basis with State Board approval. As discussed in Section 3.3, RWA projects with minimum retention times of less than 120 days must provide an additional 1-log treatment. Reservoir retention time is defined as the total volume of the reservoir (V) divided by the total flow out of the reservoir (Q) during a given time period. Retention times are to be calculated at the end of each month based on the reservoir conditions for that month.

The RWA projects currently being pursued in Southern California are evaluating the ability to meet RWA criteria based on potential operating scenarios representing average, maximum and emergency situations. For the purpose of this analysis, three RWA Scenarios, described in Table 4-2, were evaluated to explore seasonal and extreme conditions, based on data from 2007 to 2018 and input from SFPUC.

Table 4-2: RWA Scenarios Evaluated

RWA Scenario	Storage	Outflow
Summer	Apr – Oct	Max Summer Month
Winter	Nov – Mar	Max Winter Month
Emergency	Minimum Month	Peak

The RWA Scenarios were combined with two reservoir system configurations, to anticipate a combination of scenarios that the SBDDW may be interested in seeing to ensure that the minimum retention and dilution criteria could be met.

A. **Upper CSR** as a standalone reservoir, which includes one outflow from the Cahill Ridge Pump Station that goes direct to a water treatment plant (CCWD's Nunes WTP)

B. **Full CSR + San Andres,** as a combined system, which includes three outflows to CCWD's Nunes WTP, San Mateo Creek discharges and SFPUC's Harry Tracy WTP.

Upper and Lower CSR were not evaluated as a standalone system because there is no new outflow to a water treatment plant. An argument could be made to assume Upper and Lower CSR essentially act as one reservoir because they are hydraulically connected; however, for the purpose of this study Upper CSR is considered as a standalone reservoir to be more conservative.

As shown in Table 4-3, the average retention time for Upper CSR only and CSR plus San Andreas Reservoir volumes would be over 120 days in all but the Emergency RWA Scenario, which at 115 days retention is still well above the 60-day minimum. Initiating the program during the summer, under full reservoir system storage conditions, the initial retention time criteria of 180 days would be easily met.

Table 4-3: CSR RWA Retention Time Evaluation

RWA Scenario	Reservoir Volume (MG)	Outflow (MGD)	Calculated Retention (Months)	Calculated Retention (days)
Upper Crystal Springs Reservoir Only				
Summer	7,400	2.0	119	3,700
Winter	6,700	1.4	154	4,786
Emergency	4,100	4.5	29	911
Full Reservoir System				
Summer	24,400	94	8	260
Winter	22,400	186	4	120
Emergency	15,600	135	4	115

RWA Scenario	Outflow	Summer Max Month MGD	Winter Max Month MGD	Emergency Peak MGD
Upper CSR Only	Cahill PS to CCWD [a]	2.0	1.4	4.5
Full Reservoir System	Cahill PS to CCWD [a]	2.0	1.4	4.5
	San Mateo Creek [b]	1.9	115	11
	Harry Tracy WTP [c]	90	70	120
	Total =	**94**	**186**	**135**

a. **Cahill PS to CCWD:** Max month pumping (2.0 mgd) based on 2010 – 2016 data. Peak capacity (4.5 mgd) represents the capacity of the Nunes WTP. For Emergency operations, peak assumes that Pilarcitos Lake is not available for water supply for CCWD, thus full flow from Crystal Springs is needed to meet CCWD demands.

b. **San Mateo Creek**: Summer and emergency releases based on 29 July 2010 letter "Operations of Crystal Springs Reservoir Before and After Lower Crystal Springs Dam Improvement Project and Minimum Water Release Requirement for San Mateo Creek". Peak winter releases, for boundary operations, are based on Jan 2017 historical data when reservoir levels needed to be reduced to protect the fountain thistle (per LCSD Biological Opinion) and provide space for storage (2017 was a wet year).

c. **Harry Tracy WTP:** Summer outflow is based on Average Monthly Production (MGD) from 2017-2018. Winter outflow is based on worst case historical shutdowns of the RWS in January 2016 and Jan/Feb 2017, and it looks like Harry Tracy WTP ran at about 70 MGD in both cases. These shutdowns were conducted during the annual low point in water demands. So, 70 is a realistic recent value for winter. Emergency outflow based on the max historical daily flow over the last 6 years, note that the max month was only 89 mgd. The capacity of Harry Tracy WTP is 140 mgd but appears to never have come close to using that daily let alone monthly. 120 mgd is also the max capacity of the CSPS, which SFPUC typically matches with Harry Tracy WTP outflows to maintain an inflow = outflow in San Andres (serving as an equalization reservoir)

In comparison, the City of San Diego is pursuing a 30 mgd reservoir augmentation project in the 5,800 AF capacity Miramar Reservoir, which would have an average retention time of just over two months. The City of San Diego was very active in the legislative and regulatory efforts to reduce the minimum required retention time to 2 months (60 days) so that RWA at Miramar (smaller and closer reservoir) would be viable for Phase 1. For the Eat County AWP Program, Padre Dam Municipal Water District (MWD) is exploring a 15 mgd reservoir augmentation project in Lake Jennings, which has a capacity of approximately 9,800 AF, which would have an average retention time of just over 200 days but a minimum retention time between 1.4 and 2.1 months. Padre Dam MWD is working with the SBDDW to demonstrate their ability to meet SWA criteria with specific operational accommodations during emergencies. Las Virgenes MWD's Pure Water Project is moving forward, with an 8,840 AF volume reservoir, their initial simulations of minimum retention time demonstrate the ability achieve greater than 2 months retention.

A RWA project may also need to demonstrate that the possibility of short-circuiting in the reservoir would be minimal or could be controlled. Given the geometry of CSR, with a long fetch between the inlet and outlet, it appears there would be a significant period of time for purified flows to travel from the point of augmentation, to the San Andreas Reservoir, then to Harry Tracy WTP, minimizing the risk of short circuiting. Future studies would be performed to evaluate dispersion, mixing characteristics and water quality in the reservoir, using hydrodynamic mixing analyses and/or modeling, to refine the RWA scenarios and confirm the ability to meet regulations.

4.3.3 Crystal Springs Reservoir RWA Dilution Evaluation

Per the Final RWA Regulations, pathogen removal requirements are also dependent on the reservoir's ability to dilute off-spec discharge flows. As previously shown in Table 3-2, standard pathogen removal requirements (i.e., 8/7/8 log removal for V/G/C) are based on achieving a 100:1 (or 1%) dilution of a 24-hour discharge of purified water and maintaining greater than 120 days retention time. If a reservoir achieves only 10:1 (10%) dilution of a 24-hour discharge of purified water, pathogen removal requirements are increased by a factor of 10 (i.e., 9/8/9 log removal for V/G/C).

The actual capacity of a reservoir to dilute off-spec discharge flows is dependent on several factors:

- Discharge facility location and depth
- Design of the discharge facility
- Reservoir hydrodynamics (i.e., mixing)
- Weather (i.e., wind and runoff) conditions

Reservoir modeling and tracer studies would be required to determine the practical amount of dilution provided by CSR in a 24-hour period. Discharge facility alternative design studies may also be needed if enhanced initial mixing is required.

For the purpose of this analysis, theoretical dilution ratios are computed as reservoir volume divided by the quantity of purified water delivered during the prior 24-hour period. Table 4-4 summarizes the theoretical dilution ratios at purified discharge flow rates of 6 mgd and 12 mgd for two reservoir scenarios, Upper CSR only, and the Full Reservoir System under the three RWA scenarios. Assuming complete mixing (i.e., 100% dispersion of purified water throughout the entire reservoir volume), dilution ratios equal to or greater than 2,000:1 would be possible.

In comparison, the City of San Diego's RWA at Miramar Reservoir and Padre Dam's project at Lake Jennings would have an estimated high dilution ratio of about 70:1 and 200:1 respectively. A RWA at CSR would allow at least 28 times and 10 times more dilution as compared to the San Diego and Padre Dam projects, respectively.

Looking at this from the other direction, the maximum theoretical purified water augmentation rates possible while still achieving dilution ratios of 100:1 and 10:1 could be over 150 mgd for the Full Reservoir System and over 40 mgd for Upper CSR. This is well above the available purified flow of 6 and 12 mgd being considered for PREP Phase 2.

Table 4-4: CSR RWA Dilution Evaluation

RWA Scenario	Reservoir Volume (MG)	Dilution Ratio based on Purified Water Added ($Inflow_{day}$: Vol)		Max Purified Water Augmentation Rate to meet Dilution Ratio (MGD)	
		6 mgd	12 mgd	6 mgd	12 mgd
Upper Crystal Springs Reservoir Only					
Summer	7,400	1,230 : 1	620 : 1	74	740
Winter	6,700	1,120 : 1	560 : 1	67	670
Emergency	4,100	680 : 1	340 : 1	41	410
Full Reservoir System					
Summer	24,400	4,070 : 1	2,030 : 1	244	2,440
Winter	22,400	3,730 : 1	1,870 : 1	224	2,240
Emergency	15,600	2,600 : 1	1,300 : 1	156	1,560

In operation, purified water released directly in the southern end of the reservoir during any 24-hour period would only mix with a portion of the reservoir volume, so actual dilution of a 24-hour pulse discharge would be significantly less than the theoretical dilutions computed under these assumed complete mixing conditions. Although actual dilution ratios are anticipated to be somewhat lower than the theoretical dilution ratios presented in Table 4-4, because proposed purified flows are so small relative to CSR's large reservoir storage volumes, it should be possible to design a dispersal/release system capable of achieving dilution ratios of at least 100:1 or greater under all operating conditions.

Based on the retention time and dilution evaluations, it is anticipated that the project would need meet pathogen removal requirements of 9/8/9 (v/c/g) based on a retention time < 120 days and dilution ratio

of 100:1. It is possible that upon further evaluation of the Emergency RWA Scenario assumptions, it may be possible to increase the retention time from 115 days to > 120 days, thereby reducing the pathogen removal requirements to 8/7/8. Demonstrated modeling and tracer studies would need to be conducted as part of the next steps to simulate than validate these assumptions.

4.3.4 Crystal Springs Reservoir RWA Water Quality Considerations

As described in Section 3.5, allowable water quality into CSR will likely be governed by the SF Bay Basin Plan and the background water quality in CSR. Specifically, ammonia concentrations are controlled by the basin plan limits and phosphorus concentrations are controlled by the background concentrations in Upper CSR.

Additional treatment would likely be required to reduce nutrient concentrations prior to release into CSR. As described in Section 4.1.2, the AWPF train is assumed to consist of MF or UF, followed by a RO system and an UV-AOP. Phosphorus removal by RO is typically more than 99%, while nitrogen removal, particularly ammonia nitrogen, is typically around 95%. Nutrients are not well removed by UV-AOP; thus, the nutrient levels of the purified water could be higher than the nutrient levels in CSR. Increasing nitrogen loads in CSR could increase risk of algal blooms, which in turn raises the risk of water quality deterioration. Closer examination of nutrient concentrations and loading limitations would be needed to determine if further treatment is required, and if so, what level of treatment would be required.

Table 4-5 contrasts nutrient levels present in SVCW effluent and San Mateo WWTP effluent before, and after RO treatment against existing nutrient levels present in CSR. Actual nutrient limits for a CSR RWA project would depend on site-specific conditions. Preliminary observations are:

- Treatment would be required to reduce nitrogen concentrations in purified water to, or below reservoir concentrations.
- Blending SVCW source water with San Mateo WWTP's anticipated source water quality would reduce nutrient concentrations and could decrease the amount of nutrient reduction required.
- With RO treatment, total phosphorus loading for either a 6-mgd or 12-mgd AWPF would likely remain below background conditions in CSR.
- Even with RO treatment, ammonia levels in the purified discharge to the reservoir are estimated to be approximately one to two orders of magnitude higher than existing reservoir conditions.
- Modification of the biological treatment process at SVCW to full, or partial denitrification would further reduce nitrogen concentrations in the purified water. Nutrient removal may also be accomplished in the purified water stream.
- Any volume of purified water added to the reservoir with higher nutrient concentrations than those existing in CSR would contribute mass loading to the reservoir. For example, if there is no additional nutrient removal at the WWTP, the estimated ammonia concentration (as nitrogen) in the purified water, using only SVCW effluent as source water, would be around 7 mg/L. This is

one to two orders of magnitude higher than the existing CSR conditions of around 0.01 mg/L to 0.45 mg/L. Assuming 6 mgd of purified water augmentation on average over the year, this could add more than 30,000 kg of ammonia (as nitrogen) to CSR annually.

Table 4-5: CSR RWA Water Quality Considerations

Nutrient	Source Water Quality				Potential WQ Limits	
	Source	Purified Flow Rate (mgd)	Dry Season Average (mg/L)	Estimated RO Permeate (mg/L)*	Upper CSR Existing Conditions	Basin Plan Limits
Ammonia as N (mg/L)	SVCW	6	42	7.05	0.01 to 0.28	Annual median = 0.025 mg/L as N Maximum = 0.4 mg/L as N
	SVCW and San Mateo	12	23	3.86		
Total P (mg/L)	SVCW	6	10	0.08	0.03 to 0.3	
	SVCW and San Mateo	12	2.6	0.02		

Sources: SVCW effluent water quality (BACWA 2016); Crystal Springs data provided by SFPUC on 3/8/17; San Mateo estimated effluent source water Ammonia at 1 mg/L and Total P at 1 mg/L per CH2M.
*** RO Product:** Assumes 95% removal of Ammonia; 99% removal of Total P.

At this level of planning, it would be conservative to assume that the water quality of augmented water would need to match or be compatible with the background levels in CSR.

4.4 Other Treatment Considerations

4.4.1 Nutrient Removal to Meet CSR Discharge Requirements

As described in Section 4.3.4, ammonia levels in the purified water would need to be reduced from by two orders of magnitude from about 4 – 7 mg/L as N to meet the annual median (0.025 mg/L as N) and maximum (0.4 mg/L as N) limits stipulated in the SF Basin Plan, or possibly lower to meet background conditions in Upper CSR.

Ammonia can be removed either in the purified water stream or before it enters the RO feed. Removing ammonia at the WWTP before it enters the AWPF has several benefits, including having one treatment system that can handle both nitrogen removal for the AWPF feed and for reducing nitrogen in the RO concentrate (if needed in the future). Nitrogen removal at the AWPF also has the benefit of allowing the biosolids to be disposed at existing sludge handling facilities at SVCW. The capacity of a RO permeate nutrient removal system would be much smaller, however, such a system would require carbon addition for biological denitrification which could impact other water quality considerations. In addition, because the RO permeate does not have other nutrients, phosphorus and micronutrients would also need to be added to support biological growth to allow biological denitrification.

A summary of considerations related to different nutrient removal strategies is presented in Table 4-6. While nutrient removal in the RO concentrate is not needed since the discharges to SF bay nutrient

permit is based on a load target/cap and not a concentration limit (see Section 3.4.3), RO concentrate considerations have also been included in the Table 4-6 should regulations change and this option be considered in the future.

Table 4-6: Nutrient Removal Strategies: at AWPF

Treatment Location	Nitrogen Removal	Phosphorus Removal (Not needed)
RO Feed	• RO permeate and concentrate nitrogen level reduced using one system. • Alkalinity and micronutrient in feed water can be used to buffer pH and support microbial growth • Biosolids can be disposed at existing sludge handling facilities	• RO permeate and concentrate phosphorus level reduced using one system • Chemical phosphorus removal system would need to be larger to support full AWPF flow
RO Permeate	• Carbon addition needed for biological denitrification could negatively impact water quality • Phosphorus and micronutrient addition needed to support biological growth could negatively impact water quality	• Phosphorus removal not required
RO Concentrate (not anticipated to be needed)	• High concentration and lower flow could allow for novel treatment processes (e.g. Anammox) to be used • A second system would be required for permeate nitrogen removal	• Chemical phosphorus removal kinetics and system size may be more optimal due to high concentrations and lower flows

Two nitrogen removal technologies that remove nitrogen at the RO feed were evaluated as a conceptual level: (1) Nitrification and Denitrification (NDN) filters and (2) Moving Bed Bioreactor (MBBR) systems. Advantages, disadvantages and cost ranges for these technologies are summarized in Table 4-7. NDN filters are commonly used for tertiary nitrogen removal and have a smaller footprint compared to MBBR systems. Both systems produce effluent that is low in Nitrogen, with the NDN filter producing effluent that is slightly lower than the MBBR. MBBR systems have a lower O&M costs, mainly due to lower energy requirements; while NDN have a high energy demand for aeration. For this study, it is assumed NDN filters will be installed to remove ammonia. MBBR or other technologies may also present viable candidates for NDN. The specific treatment process to be used for nutrient removal should be investigated in future phases.

As previously discussed, phosphorus removal would not be needed to meet SF Basin Plan requirements; however, there may be interest in managing phosphorus levels. Phosphorus removal strategies in RO concentrate are listed in Table 4-8.

Table 4-7: Nutrient Removal Strategies: Feed Water Treatment

Process	Advantages	Disadvantages	Cost
Nitrification and Denitrification (NDN) Filters	• Commonly used for tertiary nitrogen removal • Carbon not consumed in aerobic zone • Small footprint compared to MBBR • Very low solids production • Very low effluent N • Low effluent TSS	• Submerged filters have high energy demand for aeration • Carbon addition required • Backwash tank and solids handling required • Nitrifying trickling filters susceptible to predation • Higher pumping energy	**Cap. Cost ($/gpd):** N = 1.1 – 1.3 DN = 1.0 – 3.7 **Daily O&M Cost ($/MG):** N = 990 – 1,730 DN = 140 - 350
Moving Bed Bioreactor (MBBR)	• Small footprint compared to activated sludge (AS) systems • Higher treatment rates compared to AS • No sludge recycle • No backwashing required • Low solids production • Low effluent N	• Secondary settling tank required • Solids wasting and handling required • Carbon may be consumed in aerobic zone • Biofilm carrier media is patented and may only be provided by a single supplier	**Cap. Cost ($/gpd):** Small sys. = 9.1 Med sys. = 3.2 **Daily O&M Cost ($/MG):** Similar to AS plant = 160 - 220

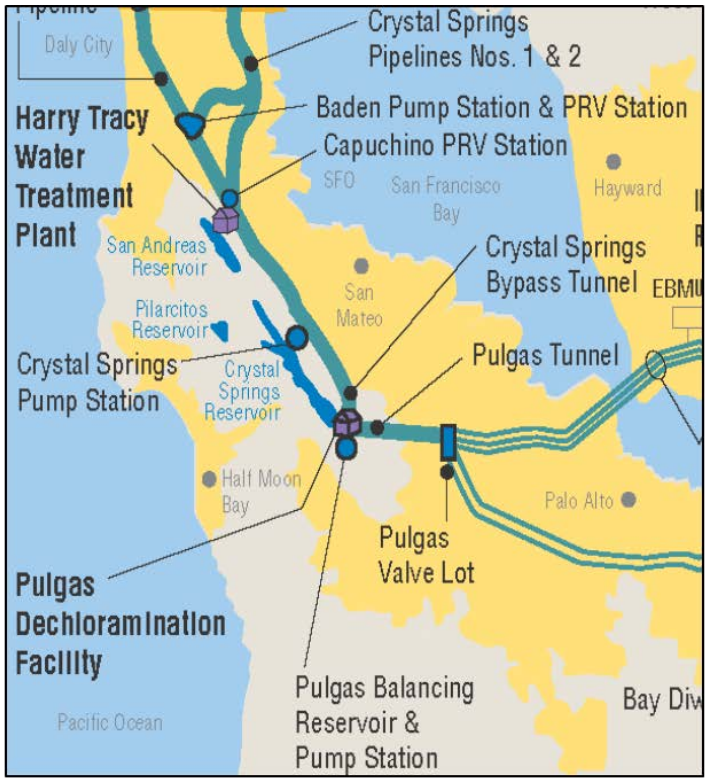
Table 4-8: Phosphorus Removal Strategies: RO Concentrate

Process	Advantages	Disadvantages	Cost
Chemical Addition + Moving Bed Filter (Continuous Backwash)	• Relatively constant headloss across filter due to continuous backwash • Small footprint • Readily available and uses common sand media • Long-lasting media requiring infrequent replacement and replenishment • Continuous filtration	• Higher pumping energy • Airlift pump to wash filter media required and continuously operated • High backwash rate, up to 5% of treated water volume	**Cap. Cost ($/gpd):** Package plant < 1 MGD = 2.5 **Daily Chem. Cost ($/MG):** Totes = 150 – 680
Chemical Addition + Cloth Disk Filter	• Consistent effluent water quality • Lower backwash rate, typically 5% of treated water flow • Lower pumping energy • Small footprint • Continuous filtration	• Specifically designed cloths • Cloths must be periodically replaced • Increased level of automation • Solids can settle in filter basin	**Cap. Cost ($/gpd):** Mini disk = 2.5 Single disk = 0.7 **Daily Chem. Cost ($/MG):** Similar to moving bed filter

4.4.2 Dechloramination at the Puglas Facilities

Purified water from the AWPF would be blended with raw water from the RWS at the Pulgas Facilities before entering Upper CSR. The Pulgas System includes the Pulgas Tunnel, Pulgas Pump Station, Pulgas Balancing Reservoir and Pulgas Dechloramination Facility, as shown in Figure 4-6. All water supplied from the RWS and the Sunol Valley Water Treatment Plant (SVWTP) is transmitted from the mid-Peninsula to the northern portion of the Peninsula and San Francisco via the Pulgas Tunnel. The Pulgas Tunnel conveys water from the Pulgas Valve Lot in Redwood City to either the Crystal Springs Bypass System or to the Pulgas Pump Station. The Crystal Springs Bypass System diverts water directly to the low-pressure zone transmission pipelines on the northern portion of the Peninsula thereby bypassing the Peninsula Reservoirs and Harry Tracy WTP. When the Pulgas Tunnel flowrate exceeds the demand downstream of the Crystal Springs Bypass System, the excess water fills the Pulgas Balancing Reservoir, and eventually is discharged to the Peninsula Reservoirs. The 60-MG Puglas Balancing Reservoir supplements the system during peak demand periods and is located across from the Pulgas Dechloramination Facility. The Pulgas Dechloramination Facility removes chlorine and ammonia and balances pH prior to releases to Upper CSR. Amongst other upgrades to the Pulgas Facilities implemented by SFPUC over the years, the Pulgas Discharge Channel discharge capacity will be restored to accommodate flows up to 250 mgd in the coming years.

Figure 4-6: RWS Pulgas Facilities



Above: Flows from the Pulgas Dechloramination Facility enter the Pulgas Discharge Chanel for release to Upper CSR.

Source: SFPUC Regional Water System Training Presentation
http://baywork.org/wp-content/uploads/2017/08/RegWtrSysOvrw_7-2017-sm.pdf

For the purpose of the PREP Phase 2 Concept Study, a connection from the new purified pipeline to the existing Pulgas Facilities is assumed. A specific point of connection has not been identified and would require further evaluation by SFPUC to identify an appropriate location. At this level of study, it would be conservative to assume that that the water quality of augmented water would need to match or be compatible with the background levels of water entering the Pulgas Facilities to aid in the treatment at the Pulgas Dechloramination Facility. Additional points of monitoring for flow and water quality, as well as flow control, would be warranted upstream of where the purified water enters the Pulgas Facilities to provide SFPUC with operational flexibility.

Given the planned increase in capacity of the Puglas Discharge Channel and current capacity of the Pulgas Dechloramination Facility no major capital infrastructure modifications are assumed. Annual O&M costs for dechloramination are based on current chemical costs and concentrations used at the Pulgas Facilities for carbon dioxide, sodium hypochrlorite and sodium bisulfite (quantities provided by SFPUC). O&M costs for the purified water flows through the discharge channel are not included.

4.4.3 Water Quality Improvement for Redwood City

Section 4.6.2 describes opportunities to utilize Redwood City's existing infrastructure, storage and pipelines, to reduce capital infrastructure costs for the project by utilizing existing assets. Another opportunity for regional benefits would be to blend the high-quality purified water with tertiary recycled water to improve water quality for Redwood City's existing non-potable recycled water system.

Redwood City's recycled water is high in both chlorides and ammonia, making the recycled water corrosive to pipelines. Redwood City's recycled water currently has a chloride concentration of about 250 mg/L. At these levels, corrosion to Type 304 stainless steel could occur and the more expensive Type 316 stainless steel would be needed. In addition, carbon steel and other pipeline materials that are even less resistant to corrosion are currently used in Redwood City's service area for indoor commercial use. Reducing the chlorides to below 200 mg/L would minimize the potential and impact for corrosion on recycled water pipelines. Ammonia concentrations will not be significantly reduced by blending with RO permeate and biological nitrogen removal would be required.

Redwood City has and continues to explore options to improve water quality, particularly related to controlling corrosion. Current efforts are evaluating piping alternatives for new commercial construction and code improvements for existing copper-plumbed buildings. Blending high-quality purified water with tertiary recycled water offers an opportunity to meet water quality objectives through treatment. Considering all water quality aspects such as pH, alkalinity, chloride concentrations as well as the aesthetic characteristics, a 50-50 blend could be beneficial, but would need to be further investigated with initial testing.

Water quantity, water quality and infrastructure considerations would need to be further explored to assess the viability and benefit of blending purified water with Redwood City's existing recycled water supply.

- **Water quantity** – would need to consider the availability of tertiary recycled water, the seasonal demand of Redwood City's existing non-potable users, and the additional 0.9 mgd allocation for future non-potable users. For example, if the influent to the AWPF is increased from 8 mgd to 8.9 mgd to utilize the remaining allocation, then AWPF capacity would need to be increased by just over 10% and the RO concentrate flow would also higher (~2.2 mgd instead of 2 mgd). This would result in a ratio of 1 : 3 for the purified water that would be blended with the existing 2 mgd of Redwood City's demand. Another option would be to run more of Redwood City's existing tertiary flow through the AWPF to increase the percent of purified water available for blending in for non-potable use to 50: 50. This would involve sending 1.66 mgd of Redwood City's overall 2.9 mgd allocation to the AWPF, which would in turn further require an increase in the AWPF capacity to 9.66 mgd. A follow-up study would be warranted to explore the benefit, limitations and costs of these options.
- **Water quality** - Closer examination of the entire water chemistry would be needed to decide on blending ratios in the long-term that would achieve effluent limits, reduce corrosion impacts as well as keep the water aesthetics unchanged compared to the current quality.
- **Infrastructure** – additional infrastructure would be required to blend back purified water into Redwood City's non-potable storage tank or directly into the distribution system. As noted, the AWPF facility may also need to be upsized to treat a portion of Redwood City's allocated supply without diminishing the amount of purified water produced for RWA.

One approach to exploring options to improve the water quality of Redwood City's non-potable supply would be to conduct a demonstration project. A demonstration project could serve multiple benefits for the project by providing a vehicle to test the most current treatment technologies directly on source water from SVCW and produce a purified product water that could be beneficially used to improve water quality for Redwood City in the near-term. The demonstration project could potentially transition into a permanent system to continue to treat a side stream of recycled water to serve Redwood City.

4.5 Development of RWA Alternatives

A RWA project would involve advanced treatment of tertiary recycled water from SVCW and/or San Mateo at a new AWPF and conveyance of purified water to CSR for augmentation. Key components of the RWA alternatives at CSR are summarized below:

- **Source Water:** 8 mgd (8,960 AFY) tertiary effluent from SVCW or 16 mgd (17,920 AFY) combined tertiary effluent from SVCW + San Mateo WWTP
- **Project Size:** 6 mgd (6,720 AFY) purified water or 12 mgd (13,440 AFY) purified water
- **Uses**: Augmentation of CSR.
- **Treatment Facilities:** AWPF near SVCW or at the Hwy 101 AWPF Site, site employing full advanced treatment with MF, RO and UV/AOP. Nutrient removal (nitrogen) before advanced treatment. Dechloramination prior to discharge into CSR via the Pulgas Facilities.
- **Brine Discharge:** RO concentrate discharge via connection to SVCW outfall to the Bay.

- **Pump Stations:** (1) SVCW to AWPF (tertiary effluent), (2) AWPF to CSR (purified water), (3) AWPF to SVCW Outfall (RO concentrate) and (4) San Mateo WWTP to the AWPF (tertiary effluent)
- **Pipelines: (1)** SVCW to AWPF (tertiary effluent), (2) AWPF to CSR (purified water), (3) AWPF to SVCW Outfall (RO concentrate) and (4) San Mateo WWTP to the AWPF (tertiary effluent)
- **Storage:** Convert RWC tank at SVCW for use as equalization prior to AWPF and new steel storage tank(s) for product water tank prior to conveyance to CSR
- **Discharge Facility:** Connect to Pulgas Facilities and utilize the existing Puglas Discharge Channel (no expansion or modification assumed)

Table 4-9 lists the two RWA alternatives evaluated as part of the Phase 2 Concept Study. A discussion of conveyance considerations and potential pipeline alignments is included in Sections 4.6 and 4.7, respectively. Details about estimated capital and O&M costs for selected sub-alternatives are provided in Section 5.

Table 4-9: Overview of RWA Alternatives

Alternative	Source Water	AWPF Location
Alternative 1 **6-mgd RWA at CSR**	SVCW (~8 mgd)	Near SVCW
		Hwy 101 Site
Alternative 2 **12-mgd RWA at CSR**	SVCW (~8 mgd) + San Mateo (~8 mgd)	Near SVCW
		Hwy 101 Site

4.6 Conveyance Considerations

Conveyance is a critical component of any recycled water system and often accounts for a large percentage of capital costs for a project. Repurposing existing infrastructure offers a unique opportunity to reduce costs and impacts associated with constructing new facilities. This section discusses the potential to reuse pipelines owned by SVCW, utilize existing recycled water facilities owned by the City of Redwood City, and leverage existing SFPUC facilities and the right-of-way for their Bay Division pipelines to save money and reduce environmental and community impacts.

4.6.1 Repurpose SVCW Abandoned Pipelines

SVCW has embarked on the SVCW Gravity Pipeline Project to replace a failing sewer force main with 17,600 feet of gravity sewer pipeline in a 16-foot diameter tunnel deep under Redwood Shores. Upon completion of the project in 2022, some of the existing 54" and 48" pipelines will be abandoned (Figure 4-7). This creates an opportunity to repurpose these valuable assets by installing and/or suspending a new pipeline within the abandoned pipe, as described below:

- **SVCW Influent Line:** is a 54-inch pipeline that will be abandoned in 2022. This segment is approximately three miles in length, and traverses through the Redwood Shores area, a community that is particularly sensitive to new construction. One, or possibly two, pipelines could be slip-lined into the abandoned pipeline and supported inside to convey: 1) purified

water to the place of use; 2) tertiary effluent to the AWPF at the Hwy 101 site; and/or 3) RO concentrate or reject water back to the SVCW outfall.

- **SVCW Abandoned Sewer Line:** includes 48-inch to 54-inch pipeline segments that are also planned to be abandoned in 2022 after the SVCW Gravity Pipeline Project is complete. This segment is approximately 2.4 miles in length and passes through an environmentally sensitive on Inner Bair Island (part of the Don Edwards San Francisco Bay National Wildlife Refuge managed by the US Fish and Wildlife Service), which would be a challenging and expensive stretch to lay new pipeline. A segment of the pipeline on Bair Island, now decommissioned and out of service, is subject to ground movement in poor soils and has had joint leaks while in service and operating under pressure.

Figure 4-7: Reuse of Abandoned SVCW Pipelines

The PREP Phase 1 Initial Study provided a high-level assessment of the cost implications of repurposing these pipelines by installing a purified water, tertiary effluent and/or RO concentrate pipeline within an abandoned segment to avoid new trenching or costly micro-tunneling. It was estimated that repurposing abandoned SVCW pipelines could realize a 10% overall project savings from those that assumed construction of all new pipelines.

The PREP Phase 2 Concept Study similarly assumed that SVCW's abandoned pipelines would be re-purposed where possible, in most cases by slip-lining a new pipeline inside the abandoned segment. Section 4.7 discusses assumptions related to the number of assumed access and receiving pits that would be required to slip line a new pipeline segments within an existing pipeline. A future study would be needed to confirm points of entry into the abandoned pipeline, insertion and receiving pits to pull the pipeline through, anchoring techniques and other risks and cost implications.

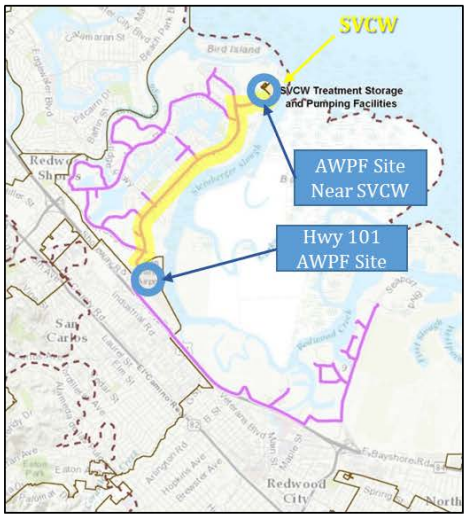
4.6.2 Utilize Redwood City Existing Infrastructure

Redwood City's Recycled Water Program was first introduced to the community in 2000, with a small trial in Redwood Shores. The program later expanded along the eastern edge of Hwy 101 from Redwood Shores to the Greater Bayfront Area, as shown in Figure 4-8. Redwood City owns and operates two 2-million-gallon storage tanks, a 1-million-gallon chlorine contact tank and a distribution pump station at the SVCW facility, and 17 miles of distribution pipelines to serve non-potable reuse customers.

Based on discussions with Redwood City, there is a potential opportunity to utilize their existing recycled water tanks (Figure 4-8) for source water equalization prior to the AWPF (if-needed). This would be a mutually beneficial opportunity to improve current recycled water quality in the tanks due to stagnant water and underutilized capacity, while reducing costs associated with the need for a new equalization storage for AWPF-produced purified water.

Figure 4-8: Redwood City Recycled Water Infrastructure

Redwood City's existing storage tanks
two (2) 2-MG recycled water tanks
one (1) 1-MG chlorine contact tank



Redwood City's existing recycled water pipelines

Repurposing the tanks to provide purified water equalization would likely require a revision of the recycled water Distribution Pump Station control strategy, which has taken the City several years to tune to its current operations, as well as modification of the current contract arrangement between SVCW and Redwood City. Structural modifications to the tank(s) would also be needed to install a new outlet

to convey flow to a new pump station that would send the stored water to the AWPF site, which could be near SVCW or at the Hwy 101 site. Further discussions with Redwood City would be warranted to explore opportunities for shared use of their infrastructure.

The PREP Phase 1 Initial Study assumed reuse Redwood City facilities, including the use of Redwood City's existing recycled water pipelines to convey tertiary flow from SVCW to an AWPF at the Hwy 101 Site and minor modifications to the existing Redwood City storage tank for use as source water equalization. The use of these facilities was assumed for all alternatives.

For PREP Phase 2 Concept Study it is similarly assumed that these facilities would be re-purposed where possible. Further discussions with Redwood City for use of their infrastructure would be needed to confirm risks and cost implications. As discussed in Section 4.4.3, there may also be an opportunity to blend high high-quality purified water from the project with tertiary recycled water to improve water quality in Redwood City's Title 22 system.

4.6.3 Treatment Location Conveyance Considerations

As discussed in Section 4.1.3, it is assumed that the AWPF facility would be located near the SVCW facility, or at the Hwy 101 Site. This section discusses opportunities to repurpose or utilize existing infrastructure to convey tertiary water to the AWPF, RO concentrate from the AWPF for discharge and purified water to the place of use.

AWPF at Highway 101 Site

Should the Highway 101 AWPF Site be selected, available capacity in the Redwood City recycled water system could be utilized to send available Title 22 flow from SVCW to a AWPF at the Hwy 101 Site via the existing recycled water main in Redwood Shores, shown by the highlighted segment in Figure 4-8. This would eliminate the need for 3 miles of new pipeline, reducing project costs and reducing impacts to the Redwood Shores community. The Redwood Shores recycled water pipeline would only be utilized for an alternative project that sends Title 22 flow from SVCW to Hwy 101 AWPF Site. As previously noted, further discussions with Redwood City would be warranted to explore opportunities and limitations for shared use of their infrastructure.

A RO concentrate pipeline would still be needed to send RO reject water from the AWPF back to the SVCW outfall, which could utilize the soon to be abandoned 54" force main located in Redwood Shores Parkway, previously shown in Figure 4-7. This would also eliminate the need for 3 miles of new open trenched pipeline, reducing costs and impacts to the Redwood Shores community. It is assumed that eleven (11) access or "insertion pits" and eleven (11) receiving or "pulling pits" would be required at consistent intervals or key locations where the pipe makes a bend (both horizontal and vertical) to slip line pipeline segments. Future alignment studies would be needed to refine exact pit locations and confirm cost implications and risks.

AWPF at Site near SVCW

Should an AWPF Site Near SVCW be selected, RO concentrate would be sent a short distance to the SVCW facility for treatment and blending prior to discharge. Purified water could be sent via a slip-lined pipeline in the soon to be abandoned 54" force main located in Redwood Shores Parkway. This would also eliminate the need for 3 miles of new open trenched pipeline, reducing costs and impacts to the Redwood Shores community. It is assumed that eleven (11) access and eleven (11) receiving pits would be required at consistent intervals or key locations to slip line pipeline segments. Future study would be needed to refine exact pit locations, anchoring techniques and confirm cost implications and risks.

AWPF to Treat San Mateo WWTP Flows

Tertiary effluent from the San Mateo WWTP could be treated at either the Hwy 101 Site or the Site near SVCW. Facility sizing and associated costs to treat additional flows from the San Mateo WWTP and to convey the associated purified water to the place of use have been included in this effort.

4.6.4 SFPUC Pipeline Alignment and Infrastructure Considerations

As the owner and operator of the Hetch Hetchy Regional Water System, including CSR, SFPUC could leverage opportunities within their right-of-ways (ROWs) and existing infrastructure at CSR to reduce costs for a RWA project. Appendix A includes a list of considerations, provided by SFPUC, for estimating preliminary pipeline routing and costs to CSR. In general, it is recognized that it would be possible to co-locate a potable reuse transmission pipeline in the SFPUC's ROW from the Redwood City area to CSR. Major exclusions noted by SFPUC include the need to steer clear of Bay Division Pipeline (BDP) #5 and find an alternative path under Hwy 280 to avoid the Pulgas Tunnel.

Other considerations related to co-locating a purified water pipeline in the SFPUC ROW due to challenges related to construction and meeting separation requirements. In Appendix A, it is noted that the SFPUC prefers 15-feet clear separation between pipelines and 5-feet between the pipeline and boundary, but "will allow situations where these requirements are not met for short distances, like where the lines cross, or where obstacles are skirted, but at those locations as everywhere, the State's requirements for separation of drinking water pipelines and non-potable water pipelines must be complied with, or State approved variances." Pipeline separation considerations are further discussed in the following section.

The use of the ROW and identification of potential fatal flaws issues have not been vetted by SFPUC's water supply and treatment team as part of this study. SFPUC has encountered issues on other projects related to putting purple pipe into a drinking water ROW, even in cases where regulatory requirements were met. Further consideration of the use of the SFPUC ROW requires further investigation, but for the purpose of this study an alignment in the SFPUC will move forward as one of the options.

As previously discussed in Section 4.4.2, SFPUC owns and operates the Pulgas Dechloramination Facility and a discharge facility that delivers Hetch Hetchy flows to CSR[9]. Purified water could potentially run through these facilities to save costs and avoid the need to build a new dechlorination system and a new discharge facility.

For the purpose of the PREP Phase 2 Concept Study, it is assumed that an alignment could be identified that would provide sufficient separation from BDP #5 and would not utilize the Pulgas Tunnel. Contingencies are included to address other considerations and preferences noted by SFPUC, recognizing that future studies would be needed to confirm alignments, construction methods and costs. Use of the SFPUC ROW is considered as one of three options to convey purified water to CSR.

4.6.5 Pipeline Separation Considerations

Current regulations clearly define separation requirements between potable water pipelines and other pipelines, such as sanitary sewers, raw water, recycled water and other non-potable fluids. Specifically, the California Waterworks Standards (CCR Title 22, Division 4, Chapter 16, Section 64572) establish criteria for the separation of new water mains and new supply lines from non-potable pipelines (excerpt included in Appendix B.1). This section also includes criteria for separation between purified water pipelines and potable water mains.

Separations between recycled water or purified water pipelines and other non-potable pipelines are not specified in regulations and are looked at by SBDDW on a case-by-case basis. Due to the lack of specific regulations or design requirements, the industry design standard for this scenario generally adheres to the separation requirements between potable water mainlines and non-potable water mains.

A 2017 SBDDW memo (included in Appendix B.2) addresses requests for alternatives to the waterworks standards. Specifically, it states that "The SBDDW recognizes that certain conditions may call for the installation of pipelines with less separation distance than what is required by the regulations. In these situations, the water system may propose an alternative pursuant to CCR, Title 22, Section 64551 ; 100". The request for a waiver must demonstrate the proposed alternative would at least provide the same level of protection to public health and a written approval from the SBDDW is required prior to implementation.

Other Considerations

As noted in Section 4.6.4, pipeline separation between a purified water pipeline and Bay Division pipelines carrying untreated RWS flows within SFPUC's ROW would need to be evaluated from a regulatory, risk, and operational perspective. Similarly, all tertiary, RO concentrate and purified water pipeline alignment traversing through San Francisco Mid-Peninsula region would require an in-depth

[9] Meets Title 17 regulations related to drinking water: http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/dwregulations-2017-04-10.pdf

study of existing water, wastewater and other utilities to ensure separation requirements and/or preferences are met.

Slip lining one, or more, pipelines into one of the abandoned SVCW pipelines would also warrant an assessment of separation criteria from a regulatory, risk and operational perspective. For example, placing a tertiary and a purified pipeline together in the abandoned 54”-dia SVCW influent line along Redwood Shores may not have specific regulatory separation requirements, however there may be some operational criteria related to O&M and access that may influence the design and viability. Permitting approval for slip lining a purified water pipeline into an abandoned sewer line may require specific installation, suspension or lining techniques, to address areas of poor soils or segments that have had prior joint leaks.

From a risk perspective, fused high density polyethylene (HDPE) pipeline could be used for conveyance of purified water and RO concentrate. HDPE pipelines do not have joints and therefore are not prone to cracking or joint failure that could lead to losses, which could create cross-contamination scenarios. Slip lined pipes in the abandoned SVCW RCP forcemain pipe would likely be surrounded by low-strength flowable grout that would support the pipes and contain any leaks at joints, if any. The use of grout and jointless pipes would reduce the risk of cross contamination between potable and non-potable slip lined pipelines, making the regulatory requirements the largest hurdle to overcome.

For the purpose of this study, the placement of a 20”-dia tertiary pipeline and a 24”-dia purified water pipeline together in the 54”-dia SVCW influent line, in the case of a 12-mgd RWA project with the AWPF located near SVCW, was considered but deemed not viable due to separation considerations as stated above. It was assumed that a new open trench pipeline would be required in Redwood Shores in addition to slip lining.

4.7 Potential Alignments and Pump Stations

This section discusses the potential alignments, by water type and starting and ending location and associated pump stations. Table 4-10 provide an overview of the pipeline alignments, sizing for Alternative 1 and Alternative 2 flows, and associated pump station requirements. A description of each alignment and a map is included in the sections that follow.

Table 4-10: Summary of Alignments and Pump Station Requirements

Pipeline Alignment	Pipe Length (miles)[1]	Alternative 1 6-mgd RWA at CSR		Alternative 2 12-mgd RWA at CSR		Installation
		Pipe Diameter (inch)	Pump Station TDH (feet)[2]	Pipe Diameter (inch)	Pump Station TDH (feet)	
Tertiary Water Alignment (SVCW to AWPF)						
RWC Tank to AWPF Near SVCW	0.6	20	30	28	30	Open trench
RWC Tank to AWPF Hwy 101 Site (Tertiary Option A/ Tertiary Option B)	2.9	20	110	28/20	[4] /110	Reuse RWC's recycled water pipeline
Tertiary Water Alignment (San Mateo to AWPF)						
Option A - Beach Park to SVCW Site	5.5	N/A[3]	N/A	20	160	Open trench + Micro-tunneling
Option B - Edgewater Blvd to Hwy 101 Site	5.8	N/A	N/A	20	180	Open trench + Micro-tunneling
RO Concentrate Alignment						
AWPF Near SVCW to SVCW Outfall	0.5	10	50	14	40	Open trench
AWPF Hwy 101 Site to SVCW Outfall	2.9	10	200	14	130	Slip line in SVCW 54"-dia influent line
Purified Water Alignment (AWPF Hwy 101 Site to CSR)						
Option 1: Woodside Road - SFPUC ROW	13.5	18	1260	24	1160	Open trench + Micro-tunneling
Option 2: San Carlos – Club Drive	6.8	18	1040	24	-	Open trench + Micro-tunneling
Option 3: Edgewood Road	9.3	18	850	24	-	Open trench + Micro-tunneling

[1] Pipe Length estimated from Google Earth®.
[2] TDH: Total Dynamic Head. TDH = discharge head + suction head + fraction loss along the pipeline.
[3] N/A: Not Applicable.
[4] Not Evaluated.

4.7.1 Tertiary Alignment from SVCW to AWPF

The following assumptions are made to estimate the conveyance requirements to deliver tertiary or Title 22 water from SVCW to an AWPF.

- **AWPF Site Near SVCW** – tertiary water from the repurposed Redwood City tank would be conveyed to the inlet of the AWPF via a new open trench pipeline. Since an exact location and layout for the AWPF has not been determined at this time, a conservative estimate of the required alignment length within the boundary shown in Figure 4-1 for the AWPF near SVCW site is assumed. A small tertiary pump station would be required to convey tertiary water from the tank to the AWPF.
- **Hwy 101 AWPF Site** – tertiary water from the repurposed Redwood City tank would be conveyed to the inlet of the AWPF by re-purposing Redwood City's recycled water pipeline. Since an exact location and layout for the AWPF has not been determined at this time, a conservative estimate of the required alignment length within the boundary shown in Figure 4-1 for the Hwy 101 AWPF site is assumed.

4.7.2 Tertiary Alignment from San Mateo to AWPF

Two tertiary alignments from the San Mateo WWTP to AWPF are evaluated, Option A and B. Potential non-potable recycled water customers in San Mateo and Foster City could be served along the way with a focus on landscape irrigation uses. The potential alignments and non-potable reuse (NPR) demands were developed based on the outcomes of the San Mateo Recycled Water Facilities Planning Study (RWFPS) (HydroScience 2017) and discussions with the Cities of San Mateo and Foster City. NPR Demand estimates are listed in Table 4-11.

Table 4-11: Summary of Tertiary Alignments from San Mateo WWTP to AWPF

Tertiary Alignment San Mateo to AWPF	AWPF	Pipe Length (miles)	Static Head (feet)	Adjacent NPR Annual Demand (AFY)	Adjacent NPR Peak Flow[4] (MGD)
Option A – Beach Park [1]	Near SVCW	5.3	7	200	0.4
	Hwy 101 Site	Not evaluated			
Option B – Edgewater Blvd[2]	Near SVCW[3]	8.7	9	360	0.7
	Hwy 101 Site	5.8	9	360	0.7

[1] Option A includes estimated demands for golf course on East 3rd Ave, parks and schools along Beach Park Blvd, and potentially residential customers at the end of Foster City Blvd.

[2] Option B includes estimated demands for commercial, industrial, schools and business park customers as well as medium- and high-density residential customers along Vintage Park Dr. and Edgewater Blvd. The assumed "Hwy 92 Crossing" may not be viable due to recent improvements that were made to the overpass in 2016.

[3] Assume open trench from the Hwy 101 Site to the recycled water tank at SVCW.

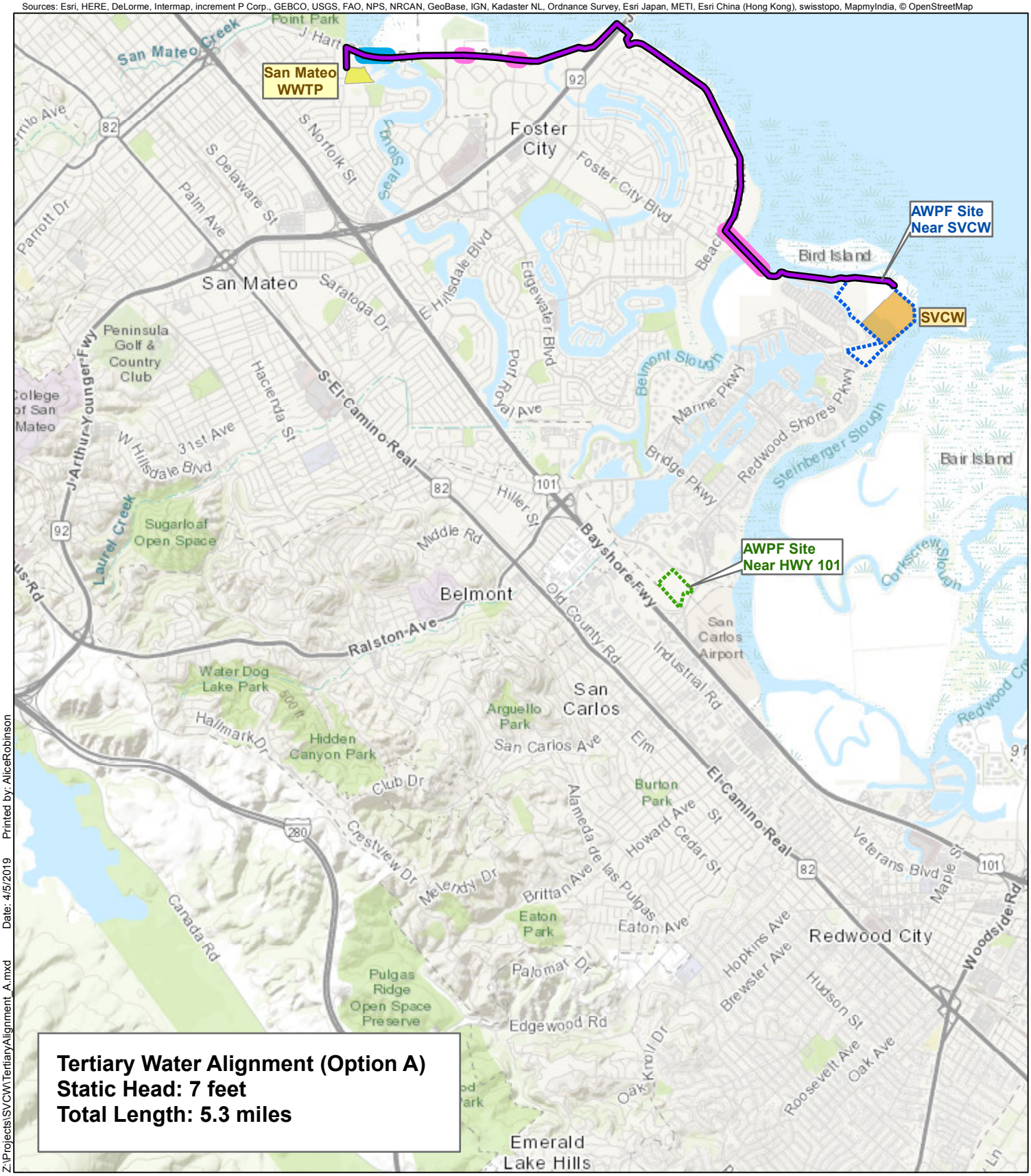
[4] Assume peak flows would need to be available in the summer months during irrigation period.

- **Option A - Beach Park Alignment to AWPF Site near SVCW** would be constructed primarily along the Beach Park Blvd., parallel to the levee, to the existing Redwood City storage tank at SVCW as shown in Figure 4-9. The most challenging section would be the crossing under Belmont Slough, which would require modified microtunnel construction due to the long crossing distance (>1000ft) and deep jacking & receiving pits (~100ft) due to subsurface geotechnical conditions (soil stratigraphy, groundwater level, etc.). Special shoring methods may be required for the open cut sections along the Bay to provide required lateral support associated with less stable soil such as young bay mud. Pipe suspension would be required when passing the bridge on East 3rd Ave, the constructability of which depends on future detailed review of the bridge design. Option B included estimated demands for adjacent NPR customers identified by Foster City, using similar unit demands from the San Mateo RWFPS.

- **Option A - Beach Park Alignment to Hwy 101 AWPF Site** was not evaluated because the alignment prior to the existing Redwood City storage tank at SVCW would be the same as the above option. The San Mateo tertiary water, combined with SVCW tertiary water, would be delivered to the Hwy 101 AWPF site by reusing the existing Redwood City recycled water pipeline, as discussed in Section 4.6.2.

- **Option B - Edgewater Blvd Alignment to Hwy 101 AWPF Site** would be constructed primarily in the roadway, as shown in Figure 4-10. This alignment crosses Belmont slough at the end of Buffin Street, which would also require modified microtunnel construction due to the long crossing distance (>1000ft) and bad soil conditions, but not as challenging and costly as Option A. Regular microtunnel construction is assumed at the Hwy 92 crossing and the end of the alignment to connect to the Hwy 101 AWPF site to protect wetlands around the potential AWPF site. Note that the Hwy 92 crossing at the location shown may not be viable due to recent improvements that were made to the overpass in 2016. Similar to Option A, pipe suspension would be required when passing the bridge on East 3rd Ave. Higher open trench unit costs are applied considering busy traffic and commercial areas along the alignment. Option B considered the adjacent NPR customers and demands identified in the San Mateo RWFPS that could be served tertiary RW in route to the AWPF.

- **Option B to AWPF Site near SVCW Site** would be similar to the alignment to the Hwy 101 AWPF with the addition of an open trench pipeline along Redwood Shores to the AWPF site near SVCW. The abandoned SVCW influent 54”-dia pipeline could not be utilized because a purified water pipeline from the AWPF would be slip lined into the pipeline and there are risks co-locating the pipelines due to potential separation requirements as discussed in Section 4.6.5.



Tertiary Water Alignment (Option A)
Static Head: 7 feet
Total Length: 5.3 miles

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Legend

- Potential Alignment
- Potential Micro-tunnel Segments
- Pipe Suspension Segment
- AWPF Site Near HWY 101
- AWPF Site Near SVCW
- San Mateo WWTP
- SVCW

N

0 3,000 6,000
Scale: Feet

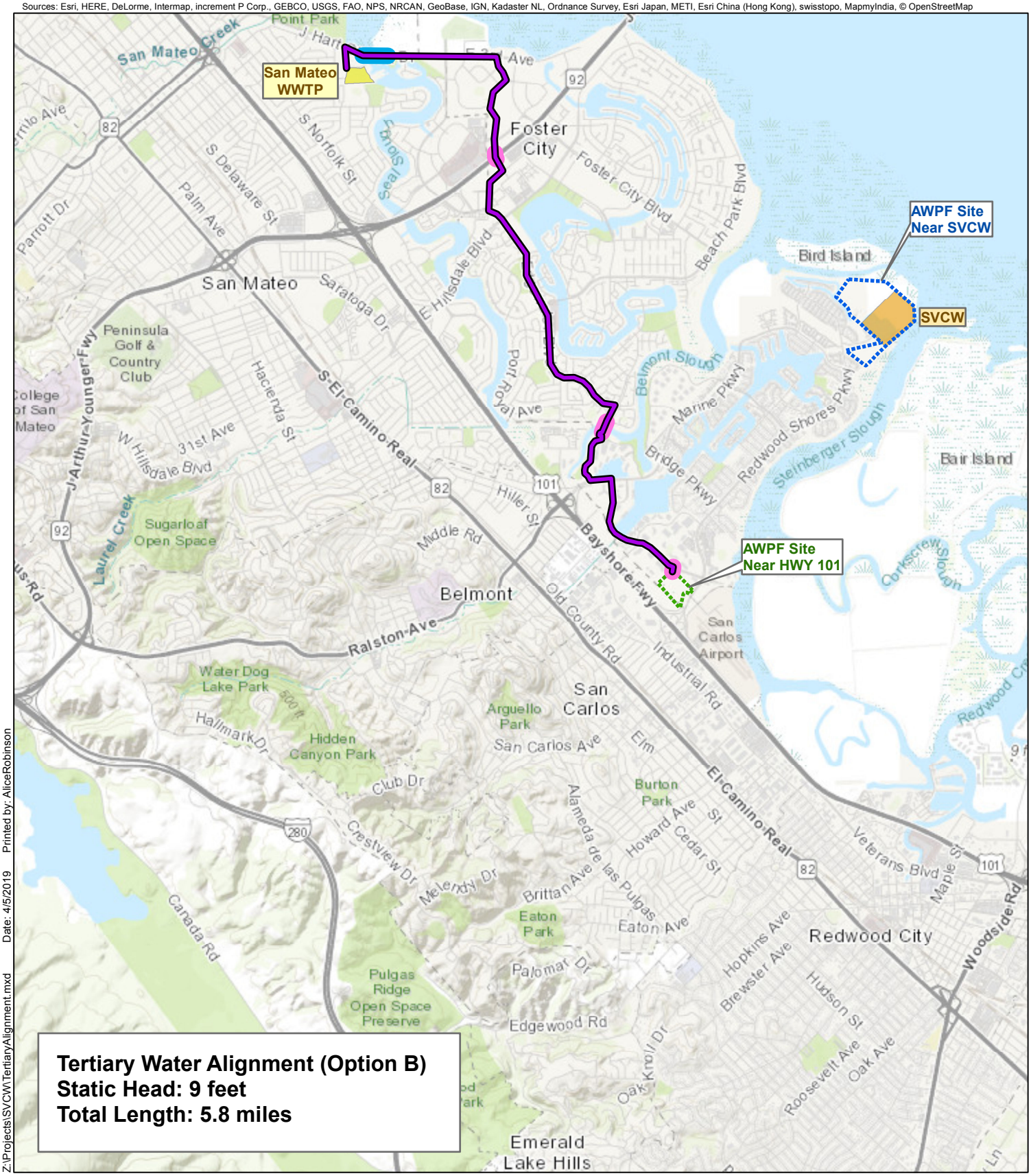
Kennedy Jenks

Potable Reuse Exploratory Partnership (PREP)
Phase 2 Concept Study

Option A: Beach Park

1668011*02

Figure 4-9



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Legend

- Potential Alignment
- Potential Micro-tunnel Segments
- Pipe Suspension Segment
- AWPF Site Near HWY 101
- AWPF Site Near SVCW
- San Mateo WWTP
- SVCW

N

0 3,000 6,000

Scale: Feet

Kennedy Jenks

Potable Reuse Exploratory Partnership (PREP)
Phase 2 Concept Study

Option B: Fashion Island Boulevard

1668011*02

Figure 4-10

4.7.3 RO Concentrate Alignment from AWPF to SVCW Outfall

The following alignments are evaluated to deliver RO concentrate from the AWPF site to existing SVCW ocean outfall at the northeast corner of SVCW.

- **AWPF Site near SVCW–** A short open trench pipeline would be constructed along the SF Bay to the SVCW outfall. Special shoring methods may be required to provide extra lateral support due to poor soil stability.
- **Hwy 101 AWPF Site –** A pipeline from Hwy 101 AWPF site to the SVCW outfall would be slip-lined in the existing 54"-dia SVCW forcemain along Redwood Shores Pkwy. It is assumed that eight (8) access and eight (8) receiving pits would be required at horizontal or vertical bends to slip line pipeline segments. Future study would be needed to refine exact pit locations and confirm cost implications and risks.

4.7.4 Purified Alignment to CSR

Three alignment options from the AWPF to CSR are evaluated to explore options to re-use infrastructure, avoid construction disruption in public ROWs through residential areas of the valley, utilize SFPUC's ROW, avoid the Pulgas Tunnel and minimize pipeline length and total lift. Each alignment option meets one or more, but not all, of these objectives. The three options are listed in Table 4-12. For the AWPF site near SVCW, the alignment from SVCW to Hwy 101 where the existing 54"-dia influent line ends are shared by all three options, as depicted on Figure 4-11 through Figure 4-13.

Table 4-12: Summary of Purified Water Alignments from AWPF to CSR

Purified Water Alignment	HWY AWPF 101 Site		*AWPF Site Near SVCW*	
	Pipe Length	Static Head	*Pipe Length*	*Static Head*
Option 1: Woodside Road - SFPUC ROW	13.5 miles	910 feet	16.4 miles	910 feet
Option 2: San Carlos – Club Drive	6.9 miles	820 feet	9.7 miles	830 feet
Option 3: Edgewood Road	9.3 miles	550 feet	12.2 miles	550 feet

Notes: Pipeline lengths include alignment along sections that could potentially repurpose existing assets (i.e. abandoned pipelines from SVCW)

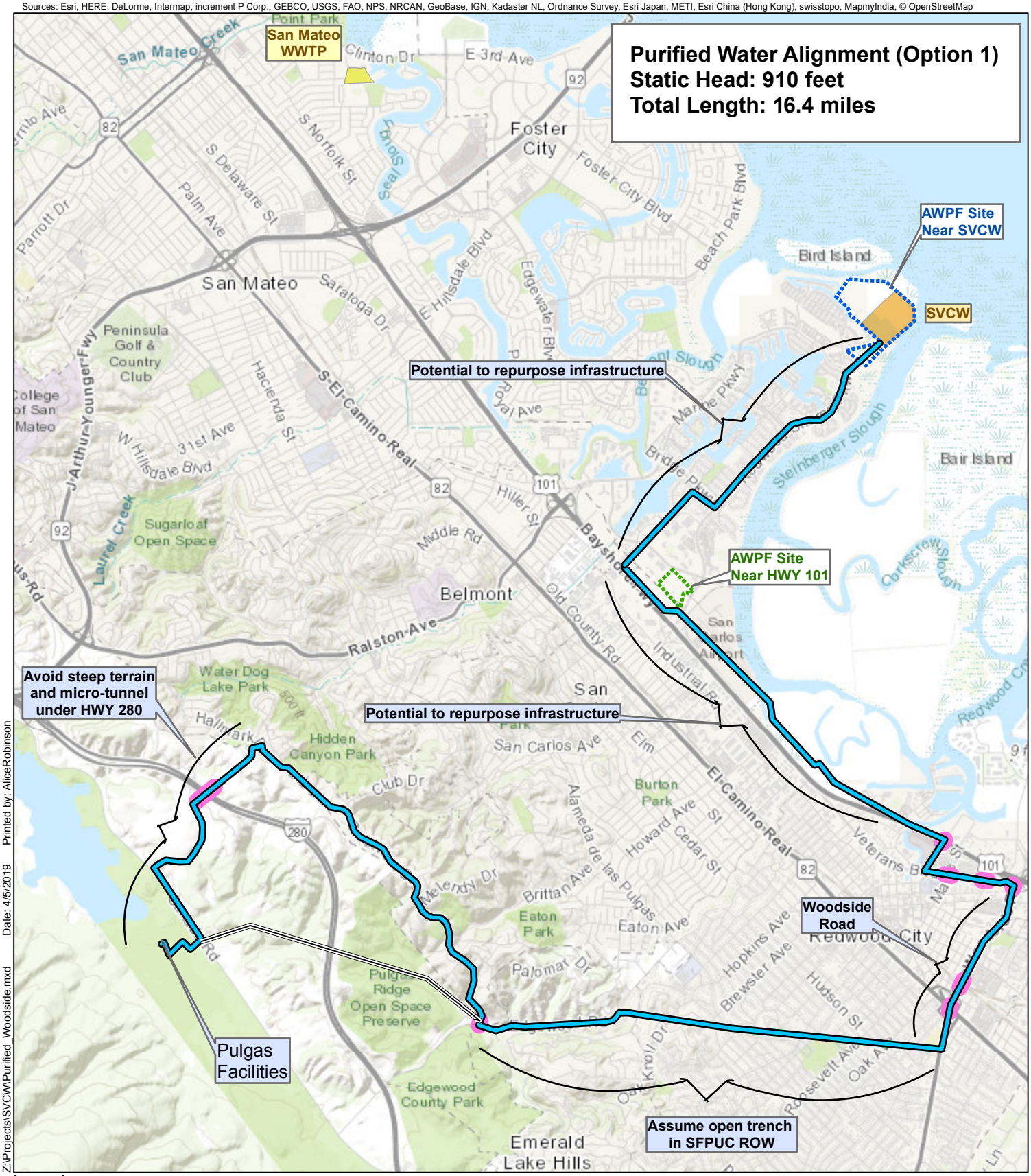
- **Option 1 - Woodside Road - SFPUC ROW –** represents the alignment that maximizes the use of SFPUC ROW and the reuse of infrastructure along Redwood Shores Pkwy and Bay Shore Rd. The concept is to co-locate a potable reuse transmission pipeline in SFPUC's ROW from the Redwood City area to CSR, which avoids construction disruption in public ROWs through residential areas of the valley. Major exclusions noted by SFPUC include the need to steer clear of Bay Division Pipeline (BDP) #5 and the need for an alternative path under Hwy 280 to avoid the Pulgas Tunnel. The majority of this pipeline would be constructed via open trench method. Microtunnel construction would be required when crossing highways, railroads and complex intersections such as El Camino Real and Woodside Rd. This is the longest alignment with the largest static

head (910 feet) among three options, thereby requiring more lifting stations and more energy. See Figure 4-11.

- **Option 2 - San Carlos – Club Drive –** represents the most direct alignment to CSR which includes the reuse of the existing SVCW 54"-dia influent line along Redwood Shores Pkwy, while avoiding the Pulgas Tunnel by going under Hwy 280. This alignment is approximately 50% shorter than Option 1, but would result in more disruption in public ROWs through residential and commercial areas of areas in San Carlos and Belmont. The direct alignment would require more complex construction methods (e.g. micro-tunneling) in reaches with complex intersections, sensitive habitats or vocal public opposition, as well as increased open trench costs to account for additional traffic control, public outreach, pavement repair, etc. Permitting and mitigation requirements would likely impact the construction schedule and cost of this alignment. There is a significant amount of uncertainty related to this alignment. See Figure 4-12.

- **Option 3 - Edgewood Road** - represents as an alternative to the SFPUC ROW alignment with the potential to repurpose a greater portion of infrastructure along Shoreway Rd. Microtunnel construction would be required when crossing highways, railroads and complex intersections. Similar to Option 2, higher open trench cost is assumed as the pipeline passes public ROWs though residential and commercial areas. This alignment also has the shortest lift (i.e., lowest static head), thereby requiring fewer lifting stations and less energy. See Figure 4-13.

A discussion of cost assumptions for the three alignments is provided in Section 5.



Legend

- Potential Alignment
- Pulgas Tunnel
- Potential Micro-tunnel Segments
- AWPF Site Near HWY 101
- AWPF Site Near SVCW
- San Mateo WWTP
- SVCW

N

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Scale: Feet

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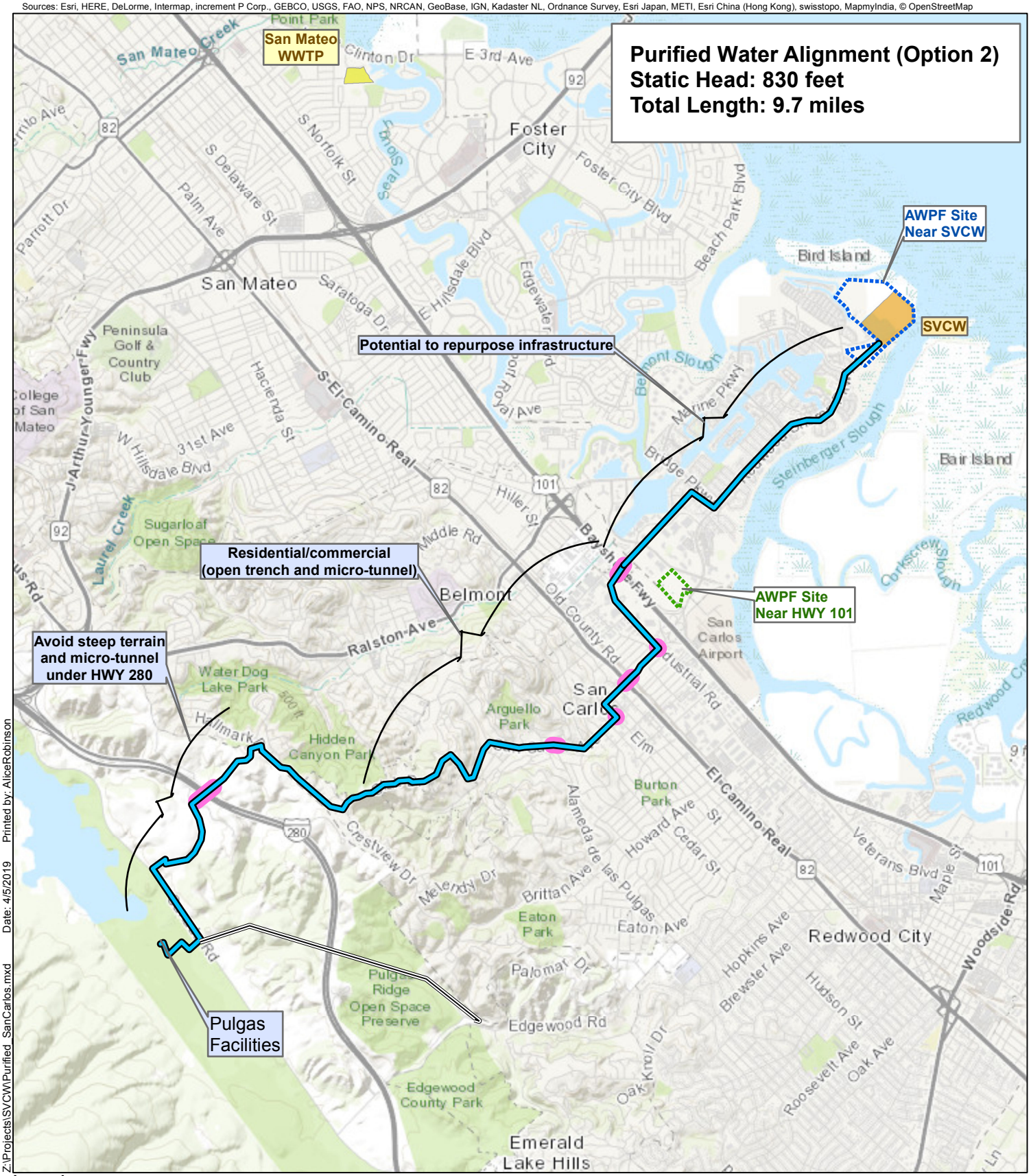
Option 1: Woodside Road - SFPUC ROW

1668011*02

Figure 4-11



Legend

- Potential Alignment
- Pulgas Tunnel
- Potential Micro-tunnel Segments
- AWPF Site Near HWY 101
- AWPF Site Near SVCW
- San Mateo WWTP
- SVCW

N

0 3,000 6,000

Scale: Feet

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Potable Reuse Exploratory Partnership (PREP)
Phase 2 Concept Study

Option 2: San Carlos - Club Drive

1668011*02

Figure 4-12

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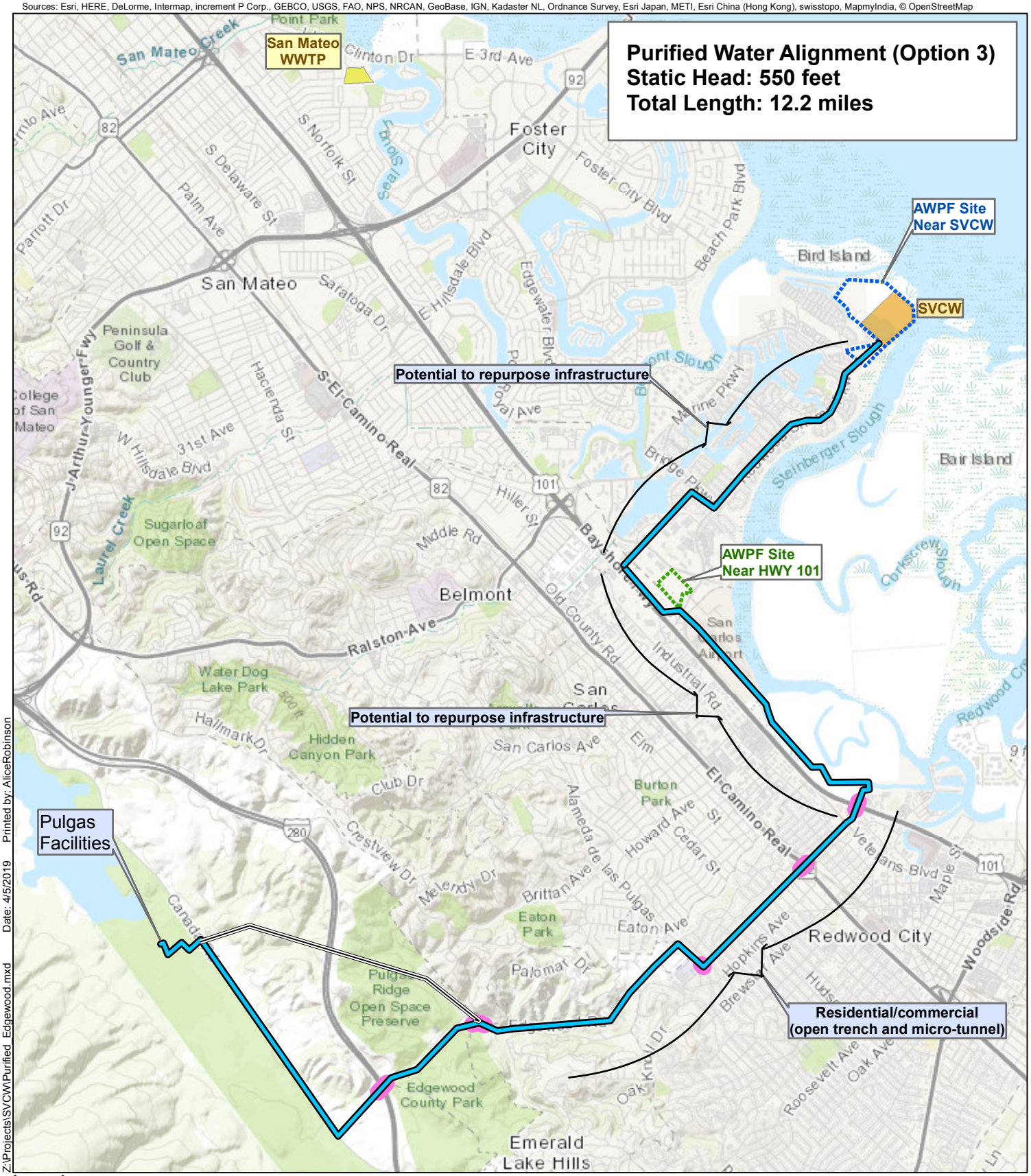

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Legend

- Potential Alignment
- Pulgas Tunnel
- Potential Micro-tunnel Segments
- AWPF Site Near HWY 101
- AWPF Site Near SVCW
- San Mateo WWTP
- SVCW

N

0 3,000 6,000

Scale: Feet

Kennedy Jenks

Potable Reuse Exploratory Partnership (PREP)
Phase 2 Concept Study

Option 3: Edgewood Road

1668011*02

Figure 4-13

4.7.5 Summary of Potential Alignments

Potential alignments explored as part of this study focused on :

(1) reusing pipelines owned and abandoned by SVCW,
(2) utilizing existing recycled water pipeline owned by the City of Redwood City,
(3) utilizing existing recycled water storage tanks owned by the City of Redwood City,
(4) leveraging existing SFPUC facilities and the right-of-way for their Bay Division pipelines,
(5) utilizing existing Pulgas discharge facilities,
(6) Identifying potential alignments to deliver RO concentrate from an AWPF to the SVCW outfall, located in the SF Bay deep water shipping channel.
(7) identifying two (2) potential alignments to deliver tertiary water from the San Mateo WWTP through San Mateo and Foster City to an AWPF.
(8) identifying three (3) potential alignments to deliver purified water from an AWPF through the valley to CSR.

Table 4-13 lists the various sub-alternative pipeline alignment combinations based on source water, AWPF locations and tertiary, RO concentrate and purified water alignments.

Construction of new infrastructure may:

- Provide more flexibility for design,
- Provide more reliable services,
- Disrupt community during construction (particularly in Redwood Shores),
- Require receiving/injection pit every 500-1000 feet for micro-tunneling segments,
- Require designs to accommodate subterranean conditions, bridge body and regulatory requirements, which may affect alignment and construction technology,
- Encounter utility conflicts associated with new open trench construction,
- Have high costs for design and construction,
- Have a greater environmental impact (particularly near the Bay), and
- Be limited by potential conflicts from other planned or unknown new projects.

Repurposing existing infrastructure may:

- Provide less flexibility for design and shorter lifespan depending on the condition assessment of the existing asset,
- Reduce public disruption during construction,
- Avoid utility conflicts associated with a new open trench construction,
- Require receiving/injection pits to slip-line new pipelines, depending on conditions, locations of horizontal and vertical bends in the existing pipelines and availability of land for pits.
- Have lower costs for design and construction than new construction,
- Have less environmental impacts from construction, and
- Be limited by other planned or unknown new projects (e.g. the schedule for the SVCW Gravity Pipeline Project would make some existing pipe alignments available 2022-2025).

Some considerations for the direct alignment include the following:

- New pipeline construction between US101 and El Camino would likely require extensive mitigation for community impact via the CEQA process.
- Heavily travelled residential streets may not have enough lane space and may arouse a vocal response from residents.
- Routes through central business district areas and up heavily travelled routes may be more complex in terms of avoiding existing utilities, construction methods, and traffic control.
- Additional permitting time and costs would be incurred to cross under the Caltrain grade separation/overpass, Hwy 101 and I-280, and work near San Carlos Airport.

Table 4-13: Overview of Sub-Alternative Pipeline Alignment Combinations

Alternative	Source Water (Tertiary)	AWPF Location [a]	Tertiary Alignment [b]	RO Concentrate Alignment [c]	Purified Alignment [d]	Sub Alternative
Alt 1 6-mgd RWA at CSR	SVCW (~8 mgd)	Near SVCW	Short Alignment	Short Alignment	Option 1	1a.1
					Option 2	1a.2
					Option 3	1a.3
		Hwy 101 Site	Repurpose SVCW Pipeline	Repurpose SVCW Pipeline	Option 1	1b.1
					Option 2	1b.2
					Option 3	1b.3
Alt 2 12-mgd RWA at CSR	SVCW + San Mateo (~16 mgd)	Near SVCW	Option A + Short Alignment	Short Alignment	Option 1	2a.1
					Option 2	2a.2
					Option 3	2a.3
			Option B + Redwood Shores Open Trench		Option 1	2b.1
					Option 2	2b.2
					Option 3	2b.3
		Hwy 101 Site	Option B + Repurpose RWC Pipeline	Repurpose SVCW Pipeline	Option 1	2c.1
					Option 2	2c.2
					Option 3	2c.3

[a] Assume 4 and 5.5 acres for 6 and 12 mgd capacity AWPF's respectively.
Exact footprint location, and land acquisition costs, to be determined in a future study.

[b] Short Alignment = connect Redwood City RW Tank to AWPF Inlet.
Repurpose SVCW Pipeline = slip-line in abandoned pipeline along Redwood Shores Parkway
Repurpose RWC pipeline = reuse Redwood City recycled pipeline to deliver tertiary water
Option A = Beach Park Alignment
Option B = Edgewater Blvd Alignment

[c] Short Alignment = AWPF to SVCW outfall.
Repurpose Pipeline = slip-line in abandoned pipeline along Redwood Shores Parkway

[d] Option 1 = Woodside Road - SFPUC ROW Alignment
Option 2 = San Carlos - Club Drive Alignment
Option 3 = Edgewood Road Alignment

Future studies are needed to assess the full range of conveyance options including the condition of existing assets, availability of ROWs and land for acquisition, subterranean conditions, existing utilities, hydraulic requirements, environmental impacts, community response and alternative alignments.

4.8 Environmental Review

A high-level environmental review was completed for potential pipeline alignments (discussed in Section 4.7) and potential AWPF site locations (discussed in Section 4.1.3) using The United States Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPAC) system and Redwood City's Geographic Information System (GIS). Shapefiles for the five potential pipeline alignments and two AWPF locations were uploaded to the IPaC system database to evaluate potential environmental considerations in each area, including endangered species, critical habitats, migratory birds, and wetlands (USFWS, 2019). Natural Hazard and Land Use information was summarized from the Redwood City GIS portal, including land use, and zoning information (Redwood City, 2019). IPaC natural resource lists and detailed maps are included Appendix C.

A summary of the environmental review findings for the pipeline alignments and potential AWPF locations can be found in Table 4-14 and Table 4-15 respectively.

Table 4-14: Environmental Review Summary of Potential Pipeline Alignments

Pipeline Alignment	Endangered Species Count	Critical Habitats Count	Migratory Birds Count	Wetlands Present	Approximate Area Disturbed (acres)	Potential Environmental Considerations
Tertiary Water Alignment (San Mateo to AWPF)						
Option A	21	0	39	YES	180	• Coastal waterway crossings • Coastal Zone Consistency
Option B	18	0	22	YES	190	• Coastal waterway crossings • Coastal Zone Consistency
Purified Water Alignment (AWPF to CSR)						
Option 1	24	1	24	YES	450	• San Francisco Bay National Wildlife Refuge crossing • Several coastal water crossings • Fish hatcheries • Coastal Zone Consistency
Option 2	20	1	24	YES	230	• Several wetland crossings
Option 3	24	2	24	YES	310	• San Francisco Bay National Wildlife Refuge crossing • Fish hatcheries • Coastal Zone Consistency

Source: (USFWS 2019; Redwood City 2019)

Table 4-15: Environmental Review Summary of Potential AWPF Locations

Potential AWPF Location	Endangered Species Count	Critical Habitats Count	Migratory Birds Count	Wetlands Present	Approximate Area Disturbed (acres)	Potential Environmental Considerations
AWPF Site Near SVCW	13	0	21	YES	4- 6 acres	• Wetland Planning, Permitting, and Mitigation • Sea level rise inundation • Coastal Zone consistency • Flood Zones AE, X • Land Use: Tidal Plain, Preservation
Highway 101 AWPF Site	18	0	21	YES	4- 6 acres	• Located Near Airport • Wetland Planning, Permitting, and Mitigation • Flood Zone X • Land Use: Community Park/ Preservation

Source: (USFWS 2019; Redwood City 2019)

Endangered Species

Species listed as endangered, threatened, proposed endangered, and proposed threatened are expected to potentially occur in each of the five (5) potential pipeline alignments and two (2) potential AWPF locations evaluated. Consultations should be made with local and Federal agencies to evaluate potential impacts to endangered species. Actions that are conducted, permitted, funded or licensed by federal agencies are subject to Section 7 of the Endangered Species Act (USFWS 2019).

Critical Habitat

Critical Habitats for listed endangered species are expected to overlap with three (3) of five (5) proposed pipeline alignments (USFWS 2019). Consultations should be made with local and Federal agencies to evaluate potential impacts to critical habitats that may occur within the proposed AWPF locations or alignments.

Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act. Migratory birds are expected to potentially occur in each of the five (5) potential pipeline alignments and two (2) potential AWPF locations evaluated (USFWS 2019). Consultations should be made with local and Federal agencies to evaluate potential impacts to endangered species. Biological surveys may be required to determine the likelihood of presence of endangered species and migratory birds. The proposed Hwy 101 AWPF Site

may require wildlife mitigation planning for migratory birds due to its proximity to San Carlos Airport (Redwood City, 2019).

Wetlands

Wetland areas are expected to overlap with the potential pipeline alignments and AWPF locations (USFWS 2019). Planning efforts should include consultations with the U.S. Army Corps of Engineers, for potential wetland determination, delineation and permitting requirements. Directional drilling should be considered for wetlands and sensitive crossings.

Soil Disturbance

Soil disturbance from excavation, grubbing, and grading is expected for each of the proposed pipeline alignments and AWPF locations is expected to range from 200-500 acres, assuming a 10-foot trench for the pipeline alignment and a 4 to 6-acre site. Planning should include erosion control measures and stormwater Best Management Practices (BMP).

Land Use

Land use and zoning restrictions are expected to affect the proposed pipeline alignments and AWPF locations. Land use zoning requirements should be reviewed with local planning agencies.

Flood, Zoning, and Coastal Hazards

The proposed conveyance pipeline alignments and AWPF locations are expected to be located within flood zones, flood fringe zones, or coastal zones. Consultations should be made to review requirements such as setbacks, waterproofing, and elevation. For proposed pipeline and AWPF locations in the coastal zone, a federal Coastal Zone Consistency determination may be required. Nuisance flooding and sea level rise are expected to affect both proposed AWPF locations. The proposed Hwy 101 AWPF Site is located near an airport, which may impose additional land use restrictions and planning requirements.

Section 5: Project Alternatives Costs

This section describes the engineer's opinion of probable costs developed for the RWA alternatives described in Section 4. As shown in Table 5-1, 15 sub-alternatives were developed to show all the potential combinations of treatment siting and conveyance. Alternative costs were developed for those indicated with a "*" in Table 5-1 to provide a representative range of costs associated with the location of the AWPF, the size of the AWPF, and the potential to repurpose infrastructure for comparison.

Table 5-1: Overview of Sub-Alternatives

Alternative	Source Water (Tertiary)	AWPF Location [a]	Tertiary Alignment [b]	RO Concentrate Alignment [c]	Purified Alignment [d]	Sub Alternative [e]
Alt 1 6-mgd RWA at CSR	SVCW (~8 mgd)	Near SVCW	Short Alignment	Short Alignment	Option 1	1a.1*
					Option 2	1a.2*
					Option 3	1a.3*
		Hwy 101 Site	Repurpose SVCW Pipeline	Repurpose SVCW Pipeline	Option 1	1b.1*
					Option 2	1b.2
					Option 3	1b.3
Alt 2 12-mgd RWA at CSR	SVCW + San Mateo (~16 mgd)	Near SVCW	Option A + Short Alignment	Short Alignment	Option 1	2a.1*
					Option 2	2a.2
					Option 3	2a.3
			Option B + Redwood Shores Open Trench		Option 1	2b.1*
					Option 2	2b.2
					Option 3	2b.3
		Hwy 101 Site	Option B + Repurpose RWC Pipeline	Repurpose SVCW Pipeline	Option 1	2c.1*
					Option 2	2c.2
					Option 3	2c.3

* Detailed cost sheets are provided for sub-alternatives indicated with a "*"

e. Assume 4 and 5.5 acres for 6 and 12 mgd capacity AWPF's respectively. Exact footprint location, and land acquisition costs, to be determined in a future study.

f. Short Alignment = connect Redwood City RW Tank to AWPF Inlet. Repurpose Pipeline = slip-line in abandoned pipeline along Redwood Shores Parkway. Option A = Beach Park Alignment; Option B = Edgewater Blvd Alignment

g. Short Alignment = AWPF to SVCW outfall. Repurpose Pipeline = slip-line in abandoned pipeline along Redwood Shores Parkway

h. Option 1 = Woodside Road - SFPUC ROW; Option 2 = San Carlos - Club Drive; Option 3 = Edgewood Road

e Detailed costs are provided for highlighted sub-alternatives only, see Appendix D for additional detail.

All sub-alternatives include the repurpose of infrastructure where appropriate, which may include some or all of the following:

- Utilize RWC storage tanks at SVCW,
- Repurpose SVCW Pipelines along Redwood Shores Pkwy.
- Repurpose SVCW Pipelines along Shoreway Rd.
- Utilize RWC Recycled water pipeline to Hwy 101 AWPF Site
- Utilize Puglas Dechloramination Facility
- Utilize Pulgas Discharge Facility

5.1 Engineers Opinion of Costs

The engineer's opinion of probable cost is based on a conceptual-level estimate of the capital and operating costs for each alternative considered. Conceptual -level opinions of capital, operations and maintenance (O&M), and lifecycle costs are developed to facilitate an economic comparison of the alternatives and sub-alternatives. Detailed cost sheets are provided in Appendix D.3.

Capital, annual, and life cycle costs are estimated for each alternative at a Class 5 level, representing Planning to Feasibility level information with an estimated accuracy range between -30 percent and +50 percent, summarized herein.

- **Capital Cost:** Unit capital costs and recent project experience were used to estimate facility costs for treatment, pipelines, pump stations, storage tanks, groundwater wells, and other facilities. Additional facility costs for site development, yard piping, electrical, and instrumentation and controls are assigned as a percent of facility costs. Sales taxes, mobilization costs, engineering and design, environmental permitting, contractor overhead and profit costs, and an estimate contingency are applied to all alternatives as a percent of facility direct costs. An annual inflation rate is applied to represent anticipated escalation to the mid-point of construction, based on an estimated construction schedule, which differs by alternative. Additional detail about capital cost assumptions are provided in Appendix D.1.

- **O&M Cost:** The estimated O&M costs include energy cost, labor costs, chemical costs and maintenance costs with a contingency applied to all O&M costs. Additional detail about O&M cost assumptions are provided in Appendix D.2.

- **Life Cycle Unit Cost:** Capital costs are converted to annualized lifecycle costs using basic assumptions about discount rates and life expectancy of project components and added to O&M annual costs to get a total annualized cost. Total annualized costs are then divided by the recycled water delivered over the life of the project to obtain a uniformly derived unit cost of water in dollars per acre-foot ($/AF), which is also converted to dollars per gallon ($/gal) and dollars per hundred cubic feet ($/CCF).

The following costs are not included in the cost estimate due to the need for additional information, studies, and in many cases negotiated agreements to provide a reasonable or justifiable unit cost estimate:

- **Land Acquisition:** for siting an AWPF, pump stations, storage tanks and other above ground facilities, including necessary ROW acquisitions, costs are not included due to the uncertainty related to the location and market value of available land. SVCW noted that Hwy 101 site would likely be leased at $1 million per year, but that it would depend on the amount of space required and the negotiation with the landowner.

- **Dechlorination:** it is assumed that treatment at the SFPUC Pulgas Dechloramination Facility could be used at no additional capital cost. Assume chemical costs similar to current use (unit costs and loads provided by SFPUC). Additional study would be required to address water quality and flow monitoring and treatment considerations and associated O&M requirements.

- **Reuse of Redwood City Facilities:** it is assumed that there would be no capital costs associated with the use of Redwood City's Title 22 pipelines to convey tertiary flow from SVCW to an AWPF at the Hwy 101 AWPF Site. A small cost was included to modify the existing Redwood City Storage tank for use as source water equalization. Further discussions with Redwood City for use of their infrastructure would be needed.

- **Future Studies:** A list of future studies and potential next steps is provided in Section 6.4. Costs for conducting these studies, including field testing, outreach efforts and a demonstration project can range considerably depending on the scope of the effort, and are therefore not included at this time.

Appendix D includes additional information about cost assumptions and provides a detailed opinion of probable costs for each sub-alternative.

5.2 Summary of Alternatives

A summary of the key components and infrastructure sizing for nine sub-alternatives, used to develop the cost estimates, is provided in Tables 5-2 and 5-3. Additional detail is provided in the detailed cost sheets in Appendix D.3 and a summary of costs is provided in Section 5.3.

Table 5-1: Summary of Alternative 1 Components – 6-mgd RWA at CSR

Component	Alt 1a.1 AWPF near SVCW	Alt 1a.2 AWPF near SVCW	Alt 1a.3 AWPF near SVCW	Alt 1b.1 Hwy 101 AWPF Site
Purified Alignment	Option 1 (Woodside Road - SFPUC ROW)	Option 2 (San Carlos - Club Drive)	Option 3 (Edgewood Road)	Option 1 (Woodside Road - SFPUC ROW)
Tertiary Alignment	Short Alignment from SVCW to AWPF	Short Alignment from SVCW to AWPF	Repurpose SVCW pipeline	Repurpose SVCW pipeline
Tertiary Water Inflow	8 mgd 8,960 AFY	8 mgd 8,960 AFY	8 mgd 8,960 AFY	8 mgd 8,960 AFY
Purified Water Produced	6 mgd 6,720 AFY	6 mgd 6,720 AFY	6 mgd 6,720 AFY	6 mgd 6,720 AFY
Pipelines[1]	16.4 miles – 18”-dia (purified) 0.5 miles – 20”-dia (tertiary) 0.6 miles – 10”-dia (RO concentrate)	9.7 miles – 18”-dia (purified) 0.5 miles – 20”-dia (tertiary) 0.6 miles – 10”-dia (RO concentrate)	12.2 miles – 18”-dia (purified) 0.5 miles – 20”-dia (tertiary) 0.6 miles – 10”-dia (RO concentrate)	13.5 miles – 18”-dia (purified) 2.9 miles – 20”-dia (tertiary) 2.9 miles – 10”-dia (RO concentrate)
Pump Stations	1 PS at SVCW (tertiary – 50 hp) 1 PS at AWPF (RO concentrate – 40 hp) 1 PS at AWPF (purified – 1900 hp)[3]	1 PS at SVCW (tertiary – 50 hp) 1 PS at AWPF (RO concentrate – 40 hp) 1 PS at AWPF (purified – 1600 hp)[3]	1 PS at SVCW (tertiary – 50 hp) 1 PS at AWPF (RO concentrate – 40 hp) 1 PS at AWPF (purified – 1400 hp)[3]	1 PS at SVCW (tertiary – 200 hp) 1 PS at AWPF (RO concentrate – 300 hp) 1 PS at AWPF (purified – 1900 hp)[3]
Storage	Convert existing Redwood City tank for equalization (tertiary) 1 MG Product Storage (purified)			
Discharge Facility[2]	Utilize Pulgas Discharge Facility (no infrastructure upgrades assumed)			

[1] Pipeline installation by open trench or micro-tunneling unless indicated as repurposed.
[2] Assumes Pulgas Discharge Facility has enough capacity to handle the purified flow of 6 mgd.
[3] Multiple lifting stations along the pipe alignment may be required due to large pump TDH.

Table 1-2: Overview of Alternative 2 – 12-mgd RWA at CSR

Component	Alt 2a.1 AWPF near SVCW	Alt 2b.1 AWPF near SVCW	Alt 2c.1 Hwy 101 AWPF Site
Purified Alignment	Option 1 (Woodside Road - SFPUC ROW)	Option 1 (Woodside Road - SFPUC ROW)	Option 1 (Woodside Road - SFPUC ROW)
Tertiary Alignment	Option A (Beach Park Blvd.)	Option B (Edgewater Blvd.)	Option B (Edgewater Blvd.)
Tertiary Water Inflow	16 mgd 17,920 AFY	16 mgd 17,920 AFY	16 mgd 17,920 AFY
Purified Water Produced	12 mgd 13,440 AFY	12 mgd 13,440 AFY	12 mgd 13,440 AFY
Pipelines[1]	16.4 miles – 24”-dia (purified) 0.5 miles – 28”-dia (combined tertiary) 5.3 miles – 20”-dia (San Mateo Tertiary) 0.6 miles – 14”-dia (RO concentrate)	16.4 miles – 24”-dia (purified) 0.5 miles – 28”-dia (combined tertiary) 8.2 miles – 20”-dia (San Mateo Tertiary) 0.6 miles – 14”-dia (RO concentrate)	13.5 miles – 24”-dia (purified) 2.9 miles – 20”-dia (SVCW tertiary) 5.8 miles – 20”-dia (San Mateo Tertiary) 2.9 miles – 14”-dia (RO concentrate)
Pump Stations	1 PS at SVCW (combined tertiary – 80 hp) 1 PS at San Mateo WWTP (San Mateo tertiary – 300 hp) 1 PS at AWPF (RO concentrate – 50 hp) 1 PS at AWPF (purified – 3300 hp)[3]	1 PS at SVCW (combined tertiary – 80 hp) 1 PS at San Mateo WWTP (San Mateo tertiary – 300 hp) 1 PS at AWPF (RO concentrate – 50 hp) 1 PS at AWPF (purified – 3300 hp)[3]	1 PS at SVCW (combined tertiary – 200 hp) 1 PS at San Mateo WWTP (San Mateo tertiary – 300 hp) 1 PS at AWPF (RO concentrate – 200 hp) 1 PS at AWPF (purified – 3100 hp)[3]
Storage	Convert existing Redwood City tank for equalization (tertiary) 1 MG Product Storage (purified)		
Discharge Facility[2]	Utilize Pulgas Discharge Facility (no infrastructure upgrades assumed)		

[1] Pipeline installation by open trench or micro-tunneling unless indicated as repurposed.
[2] Assumes Pulgas Discharge Facility has enough capacity to handle the purified flow of 12 mgd.
[3] Multiple lifting stations along the pipe alignment may be required due to large pump TDH.

5.3 Summary of Cost Conclusions

The engineer's opinion of probable capital, O&M, and annualized unit costs for each sub-alternative are summarized in Table 5-4 and Figure 5-1.

- When comparing a 12-mgd RWA project to a 6-mgd RWA project, the capital and O&M costs are higher for the larger facility, but not proportionally for the increased flow due to the scalability of treatment and conveyance facilities. Thus, the unit life cycle costs decrease by 25%, illustrating the economics of scale that could be realized by a larger project.

- Projects that repurpose SVCW pipelines (Alternatives 2a.2, 2a.3, 2c.2 and 2c.3) realize a 10% overall project savings from those that assumed construction of all new pipelines.

- Though shorter in length, a more direct alignment from Shoreway to CSR is estimated to cost between $20 to $100 million dollars more than the alignment to utilize the SFPUC ROW. In addition, the direct alignments through the local surface streets have greater uncertainty related to the optimal path to minimize costs, public opposition and mitigation measures. Therefor costs for the direct alignment through the valley are not provided as a separate alternative.

- The location of the AWPF does not significantly influence the overall cost due to the assumption that the existing Redwood City pipeline in Redwood Shores could be used to convey Title 22 flow, and the abandoned SVCW influent line could be used to slip-line a RO concentrate line. Costs for leasing the Hwy 101 AWPF Site or purchasing land near SVCW are not included and may have a greater influence on the preferred location.

- The overall confidence level for the conceptual-level analysis should be considered as low across all alternatives; primarily because preliminary design work has not been performed. Even though the project and infrastructure needs have been further defined in Phase 2, alternative alignment studies, hydraulic analysis, and treatment studies (particularly for nutrient removal) have not been conducted, which could influence more than 50% of the cost estimate. For this reason, an estimate contingency of 40% is included. For the purpose of this study, the cost estimate is appropriate to assess the viability of the program overall, allow for an apples-to-apples of comparison of alternatives based on capacity and key alignments and to provide an overall distribution of costs for major infrastructure.

As previously noted, the costs provided herein represent planning to feasibility level information with an estimated accuracy range between -30 percent and +50 percent. These are intended to be used for comparison of alternatives within the study, and not to be used for budgeting purposes.

Table 1-3: Summary of Opinion of Probable Costs

Sub-Alternative	Alt 1a.1	Alt 1a.2	Alt 1a.3	Alt 1b.1	Alt 2a.1	Alt 2b.1	Alt 2c.1
Source Water	SVCW (~8 mgd)				SVCW (~8 mg) + San Mateo (~8 mgd)		
AWPF Location	AWPF near SVCW			AWPF Near HW 101	AWPF near SVCW		AWPF Near HW 101
Tertiary Alignment	Short Alignment	Short Alignment	Short Alignment	Repurpose SVCW Pipeline	Option A (via Beach Park) + Short Alignment	Option B (via Edgewood Blvd) + Redwood Shores Open Trench	Option B (via Edgewood Blvd) + Repurpose SVCW Pipeline
Purified Alignment	Option 1 (via Woodside Rd)	Option 2 (via San Carlos Rd)	Option 3 (via Edgewood Rd)	Option 1 (via Woodside Rd)	Option 1 (via Woodside Rd)	Option 1 (via Woodside Rd)	Option 1 (via Woodside Rd)
Purified Water Delivered (mgd)	**6**	**6**	**6**	**6**	**12**	**12**	**12**
Purified Water Delivered (AFY)	**6,720**	**6,720**	**6,720**	**6,720**	**13,440**	**13,440**	**13,440**
Purified Water Delivered (MGs/year)	**2,190**	**2,190**	**2,190**	**2,190**	**4,380**	**4,380**	**4,380**
Reuse of Abandoned SVCW Pipeline	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	SVCW Pipeline along Redwood Shores Pkwy	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd
Facility Component							
Treatment	$226,000,000	$226,000,000	$226,000,000	$226,000,000	$400,000,000	$400,000,000	$400,000,000
Pipelines	$88,000,000	$59,000,000	$86,000,000	$83,000,000	$155,000,000	$170,000,000	$140,000,000
Pump Station	$21,000,000	$18,000,000	$16,000,000	$23,000,000	$38,000,000	$38,000,000	$41,000,000
Storage	$3,500,000	$3,500,000	$3,500,000	$3,500,000	$5,400,000	$5,400,000	$5,400,000
Connection to Pulgas Facilities	$3,300,000	$3,300,000	$3,300,000	$3,300,000	$4,300,000	$4,300,000	$4,300,000
Total Construction Cost ($)	**$341,800,000**	**$309,800,000**	**$334,800,000**	**$338,800,000**	**$602,700,000**	**$617,700,000**	**$590,700,000**
Estimated Project Construction Cost ($mil)	**$342**	**$310**	**$335**	**$339**	**$603**	**$618**	**$591**
Annualized Cosntruction Cost ($mil/yr)	$10.8	$9.8	$10.6	$10.8	$13.8	$14.3	$13.4
Annualized Project Buildout Unit Construction Cost ($/AF)	**$1,610**	**$1,450**	**$1,580**	**$1,600**	**$1,020**	**$1,060**	**$1,000**
Annual O&M Cost ($/yr)	$19,180,000	$18,020,000	$18,010,000	$20,000,000	$35,650,000	$35,900,000	$35,610,000
Annual O&M Cost ($/AF)	$2,850	$2,680	$2,680	$2,980	$2,650	$2,670	$2,650
Unit Cost ($/AF)	**$4,460**	**$4,130**	**$4,260**	**$4,580**	**$3,670**	**$3,730**	**$3,650**
Unit Cost ($/CCF)	**$10.2**	**$9.5**	**$9.8**	**$10.5**	**$8.5**	**$8.6**	**$8.4**

Assumptions:

1. Utilize RWC storage tanks at SVCW, Pulgas Dechloramination facility and Pulgas Discharge facility for all alternatives.
2. Repurpose SVCW pipeline along Redwood Shores Pkwy for all alternatives.
3. Repurpose SVCW pipeline along Redwood Shores Pkwy for all alternatives except 1a.2.
4. Utilize RWC RW pipelines from storage tanks at SVCW to Highway 101 for alternative 1b.1 and 2c.1.

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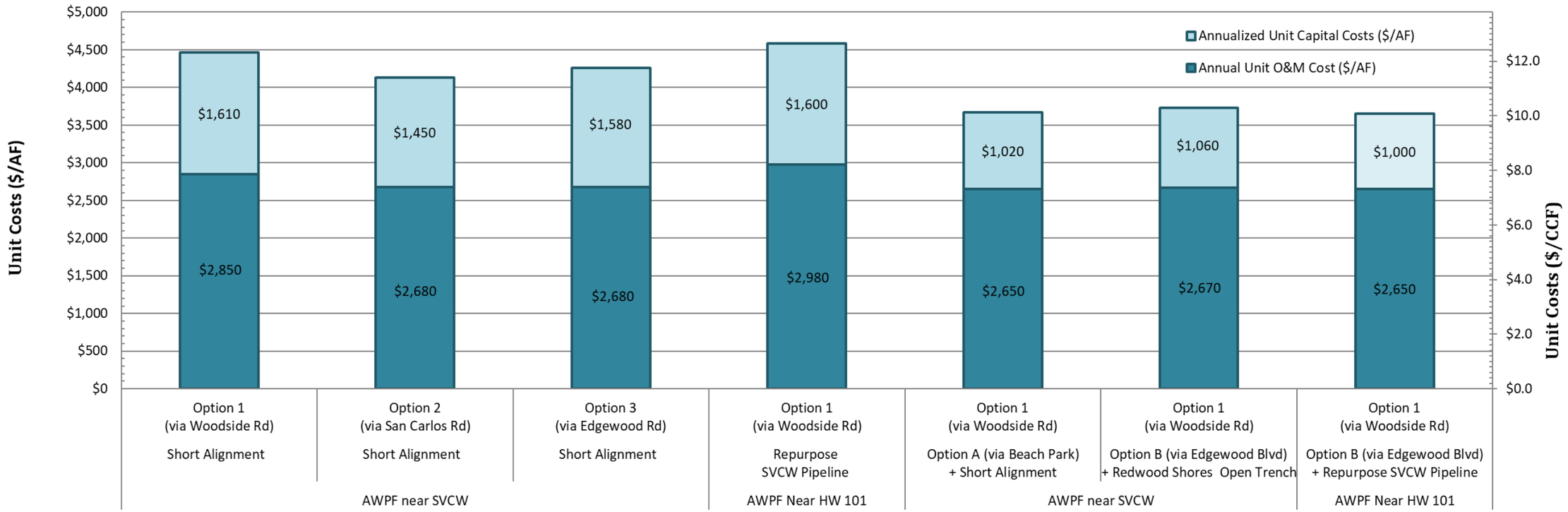
Comparable Advance Treatment Costs

The conceptual-level treatment costs included in the PREP Phase 2 Concept Study are within the range of AWPF's in California that are currently in operation or planned for construction, which indicate capital loaded costs ranging from $9/gal to $16/ gal (adjusted to 2019 dollars).

Figure 1-1: Summary of Annul Unit Costs



Notes: 1. The stacked bars represent the life cycle unit cost for each project (left y-axis).
2. Land Acquisition costs for siting an AWPF and other above ground facilities, including necessary ROW acquisitions, are not included due to the uncertainly related to the location and market value of available land.
3. Costs for use of Redwood City's capital investments are not included.
4. It is assumed that the SFPUC Pulgas Dechloramination Facility and Pulgas Discharge Channel could be used at no additional cost, though an estimated cost is included for connecting to the Pulgas Facilities.

Section 6: Conclusions

The PREP Phase 2 Concept Study provides a conceptual-level evaluation of facilities and costs to implement a regional potable reuse project on the San Francisco Mid-Peninsula to provide a local, drought-resistant, sustainable water supply, and enhance regional self-reliance through integrated water management, as well as improve the reliability of the Hetch Hetchy Regional Water System. The intent of this Phase 2 Concept Study is to further refine the reservoir water augmentation (RWA) concept developed in the Phase 1 Initial Study such that the PREP Parties can determine whether to proceed with continued exploration of, and investment in, potable reuse through this partnership.

Table 6-1 summarizes the direct costs to implement the RWA alternative project explored as part of this study. Cost ranges shown represent variations due to the location of the AWPF, pipeline alignments and pumping requirements.

Table 6-1: Summary of Probable Costs of Alternatives

Alternative	Alternative 1 6 mgd RWA	Alternative 2 12 mgd RWA
Purified Water Delivered (AFY)	6,720	13,440
Purified Water Delivered (mgd)	6	12
Loaded Facility Component Cost ($mil)		
Treatment	$226	$400
Pipelines	$59 to $88	$140 to $170
Pump Station	$16 to $23	$38 to $41
Storage	$3.5	$5.4
Connection to Pulgas Facilities	$3.3	$4.3
Total Construction Cost ($)	**$310 to $342**	**$591 to $618**
Annual O&M Cost ($mil/year)	**$10 to $11**	**$13 to $14**
Unit Cost ($/AF)	$4,130 to $4,580	$3,650 to $3,730
Unit Cost ($/CCF)	$10 to $11	$8 to $9
Unit Cost ($/gal)	$0.013 to $0.014	$0.011 to $0.012

Units: AFY = acre-feet per year, mgd = million gallons per day, $/AF = dollars per acre-foot, $/gal = dollars per gallon, $/CCF = dollars per hundred cubic feet (of puriried water delivered).

The following sections describe some of the other potential benefits, challenges and future efforts, which can help guide the next steps on the path to potable reuse.

6.1 Potential Benefits and Challenges of a Regional RWA Project

Overall, a regional RWA project on the San Francisco Mid-Peninsula could:

1. Enhance water supply reliability
2. Reduce discharges to the San Francisco Bay
3. Move towards integrated water management to support regional self-reliance that will provide multiple economic, environmental, and social benefits

A potable reuse project could provide an integrated approach to producing sustainable regional water supplies and bring together a number of stakeholders in the region. For water providers, augmenting surface water reservoirs with a reliable supply can benefit the environment and provide more effective management and flexibility for operations. For wastewater providers, a potable reuse program offers an opportunity to proactively address future discharge compliance requirements, benefit the environment, and recover resources. Working together as a region would also enhance grant and loan funding opportunities, which will help support regional infrastructure and the economy.

Potabe reuse projects are inherently scalable due to the modular nature of membrane treatment technologies, and the often consistent year-round demand for purified water. Regional projects provide an opportunity to allow phasing larger projects that expand from a backbone system to realize the benefits of economy of scale over the long-term. For example, a regional project could start as a small demonstration project that would prove technological reliability, safety, and viability of this new water resource. Upsizing the initial civil and conveyance infrastructure could realize significant cost benefits from economies of scale in the long-term that would accommodate future growth. Actual regional demands for purified water and associated long-term cost-benefit analyses, would need to be determined through future studies.

There are potential and significant challenges to implementing an potable reuse project in any community. The high costs required to construct, operate, and maintain an AWPF and convey purified water to a place of use can be difficult to justify. Siting facilities, particularly those that are above ground and require ongoing maintenance activities, can arouse opposition and often come with high land acquisition costs. The regulatory requirements to obtain approval for a RWA project requires an extensive permitting process with intensive monitoring and reporting requirements.

Public support and regional partnerships can be both challenging and rewarding. These two topics are discussed in the following sections.

Regional Integrated Water Management
Offers an opportunity to improve water supply reliability and wastewater efficiencies, while realizing the benefits of shared infrastructure to recover resources, realize economies of scale, and competitively pursue regional funding.

6.2 The Path to Public Support

The community's understanding, support, and comfort level with the health and safety aspects of potable reuse can make or break a project. There is a great deal of existing literature that provides a variety of approaches and suggestions for engaging the community in discussing incorporation of purified water into the water supply, including public outreach to understand potable reuse.

Four prominent studies by the WateReuse Research Foundation, now merged into the Water Research Foundation (WRF), evaluated and addressed public communication approaches for non-potable and potable reuse projects:

- WRRF 13-02 - Model Public Communication Plans for Increasing Awareness and Fostering Acceptance of Potable Reuse – Millan, Tennyson & Snyder
- WRRF-01-004 Public Perceptions of Indirect Potable Reuse - John Rutten
- WRRF 09-07 Pharmaceuticals and Personal Care Products Communications Toolkit – Recycled Water: How safe is it? - Kennedy, Debroux & Millan
- WRRF 03-05 Marketing Non-Potable Recycled Water: A Guidebook for Successful Public Outreach & Customer Marketing – Humphreys

There are consistent lessons and recommendations throughout the non-potable and potable reuse outreach literature. These generally suggest beginning outreach early, developing consistent terminology and messaging, having the utility sponsor become a source of trusted information, and focusing on water quality rather than its history. Additionally, it is commonly stated that knowledge and understanding of the water treatment process increases acceptance of water reuse. Specifically cited are the benefits derived from using demonstration treatment sites as a tool for informing and educating the public. Use of such sites has been found to be fundamental toward increasing community knowledge and education in understanding the potential of new water resource technologies.

The literature and surveys described above cite many frameworks, steps, principles, and timelines for effective community outreach efforts. Much of this work is synthesized in the recent World Health Organization's publication, "WHO Guidelines for Potable Reuse" (WHO 2017) particularly the chapter entitled Potable Reuse and the Art of Engagement. The PREP Parties can utilize these tools to help define a path to public acceptance of water reuse on the San Francisco Mid-Peninsula.

Thoughtful Outreach Early & Often

It is possible to gain social acceptance for potable reuse with a strong outreach effort that begins in the infancy of the program, builds trust through communication, and sustains the conversation through consistent messaging.

6.3 Building Regional Commitments

Even with the most willing partners, regional projects require the development of partnerships and agreements, requiring cooperation, coordination, and legal support. The MOU between the initial PREP Parties to conduct Phase 1 and Phase 2 of this work was a crucial first step in declaring a regional commitment to exploring potable reuse through integrated water management by proactively reducing wastewater discharges and increasing water supply resiliency. BAWSCA, Cal Water, SFPUC and SVCW, agreed to conduct regional activities in an inclusive manner that improves water supply reliability in the region. Within months of initiating the PREP Phase 1 Initial Study, the City of Redwood City and City of San Mateo expressed interest in joining the Parties to explore regional solutions that may offer additional economies of scale, and opportunities to share resources and infrastructure. Amendment No. 1 to the MOU expanded the PREP Parties to include BAWSCA, Cal Water, SFPUC, SVCW, City of Redwood City and City of San Mateo. Foster City also participated in many of the webinars and workshops.

Together, these Parties have chosen to use the results of this PREP Phase 2 Concept Study to determine the next steps in exploring regional opportunities for potable reuse. Representatives from each agency have formed a Technical Advisory Committee (TAC) to review the findings of the PREP Phase 2 Concept Study, and potentially develop new scopes and priorities, craft a consistent message, define decision points, and establish a timeline to further explore regional potable reuse in the San Francisco Mid-Peninsula region.

Timing is important
Coordinating and collaborating with regional partners demonstrates good stewardship through thoughtful planning and consideration of potential impacts to affected communities.

Based on the findings from the PREP Phase 2 Concept Study, it appears possible that a RWA project could offer benefits for Bay Area water and wastewater utilities; the environment, local communities and regional economy.

6.4 Institutional Findings

A parallel study, ***PREP Institutional Considerations*** (Kennedy Jenks 2019), provides a preliminary evaluation of institutional considerations related to the implementation of a potable reuse project that augments CSR with purified water. A four-step approach (illustrated below) was employed to understand the parties' perspective on institutional matters relevant to their agencies, explore potentially viable project structures to implement a RWA Project and identify potential beneficiaries and functional roles to implement a RWA project.

Based on survey questionnaires, interviews and a workshop with the PREP Parties, it appears that, collectively, the PREP Parties have all of the required functional and legal capacity to finance and deliver the project. Therefore, the project is institutionally feasible – it can be done. At present, however, there is no designated project sponsor (lead agency) or committed off-takers (customers) for the purified water produced by the facilities. Two primary reasons explain this absence:

1. Potential off-takers do not have an immediate need for new water supply, and
2. Institutional and physical means of achieving drought-year reliability at CSR (through some form of water banking) do not exist at this time.

This lack of current off-taker demands due to the timing for new water supply needs and the institutional and physical infeasibility of banking water diminishes the current interest in project sponsorship. These circumstances could change in the future.

6.5 Future Studies for RWA at CSR

If the PREP Parties agree to proceed with a RWA at CSR, additional studies would be warranted to take the next steps to demonstrating the ability to meet RWA regulations, evaluate pipeline alignments and facility siting, explore treatment options for purification and nutrient removal, and initiate outreach to the community to gain social acceptance for reuse. A preliminary list of potential future studies and next steps is summarized in this section and a potential schedule for implementation is shown in Figure 6-1. The intent of this schedule is to provide a conservative estimate of when major activities would occur over a 15-year period. This timeline could be reduced by overlapping activities and reducing time between activities, depending on project drivers. This preliminary schedule is based loosely on the duration and schedule for other RWA projects in progress by East County Advanced Water Purification Program and Pure Water Project Las Virgenes-Triunfo.

Figure 6-1: Potential Timeline for Major Activities

Activity	Years 1-3						Years 4-7														Years 8-11												Years 12-15											
	2017		2018		2019		2020				2021				2022				2023				2024				2025				2026				2027				2028				2029			
	Q1	Q4	Q1	Q4	Q1	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
#1. ASSESSING FEASIBILITY																																											
Phase 1: PREP Initial Study																																												
Phase 2: PREP SWA Concept Study																																											
Phase 3:																																											
#2. PRELIMINARY ANALYSIS to DEFINE the PROJECT																																											
Technical Studies																																											
Alternative Analysis							NAR /AAR																																					
Reservoir Mixing / Modeling											CSR Modeling								Tracer Study/Test/Validate																									
Advanced Treatment Evaluation (AWPF/Brine)							Process/Siting																																					
Nutrient Treatment Evaluation (WWTF/AWPF/Brine)							Options/Parameters																																					
Alignment Studies							Routes/Methods																																					
Conceptual Engineering Report															CER																													
Land Acquisition / ROW								Prelim Assess							Refine									Confirm											Secure										
Environmental Documentation							Strategy								Checklist								CEQA/EIR or MND																Field Observation / Mitigation							
Regulatory Requirements							Strategy								Engage DDW/SWRCB								Title 22 Eng Report																						
Independent Advisory Panel (IAP)											IAP Review													IAP Review																					
Financial Evaluations & Funding							Strategy								Finance/Revenue Plan								Apply for Design $$											Apply for Construction $$											
Stakeholder/ Public Outreach							Strategy								Engagement Activities								Demo Tours								Outreach / Education													
Institutional Agreements and Partnerships							Strategy				Operations/Ownership Models												Partner Agreements and Terms											Final Purschase Agreements											
#3 TESTING CONCEPTS (to support prelim analysis /implementation)																																											
Demonstration Project											Demo Concept				Design				Construct				Operate	Performance Evaluation																				
Water Quality Sampling (WW/Demo/Reservoir)								WW				Demo			Reservoir								As-Needed…																						
Source Water Control Programs															Research								Outreach				Implement																	
#4 IMPLEMENTATION																																												
Design																							Preliminary Design								Detailed DESIGN				BID									
Operations															Conceptual Ops Plans									Prelim O&M Plan								O&M Plan/Manual					Detailed SOPs				Training			
Power															Power Avaibility/Needs												Will-Serve Letter/Purchase Agreement																
Permitting															Demo Approvals								Prelim Approvals (SWA, NPDES, CalTrans, BCDC…)									Construction Permits											
Construction																															Pre-Procure				CONSTRUCTION									
Start-up																																										Testing			

PHASE:	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**		**Phase 6**	**Phase 7**
Description:	**Initial and Concept-Level Studies**	**Alternatives Analysis & Strategy Development**	**Proof of Concept & Demonstration**	**CEQA & Preliminary Design**	**Detailed Design**	**Construction**	**Commission & Deliver**

*The **intent of this schedule** is to provide a conservative estimate of when major activities would occur over a 16-year period. This timeline could be reduced by overlapping activities and reducing time between activities, depending on project drivers. This preliminary schedule is based loosely on the duration and schedule for other RWA projects in progress by Padre Dam and Las Virgenes MWD.*

Technical Studies and associated strategy items could be condensed or extended and may be potential elements to explore as part of a PREP Phase 3 effort. Alternatively, a Direct Potable Reuse concept study and/or initial considerations for a demonstration project could be options for a Phase 3 effort.

The following list describes the phased activities shown in Figure 6-1 to plan, design and construct a RWA Project.

Phase 1: Initial and Concept-Level Studies - COMPLETED

- **PREP Phase 1 Initial Study:** looked at groundwater replenishment reuse and RWA projects. Completed in 2017.
- **PREP Phase 2 Concept Study:** further defined a RWA project including preliminary discussions of institutional considerations. To be completed in 2019.
- **PREP Phase 2 Institutional Study:** provides a preliminary evaluation of institutional considerations related to the implementation of a potable reuse project that augments CSR with purified water.
- **PREP Phase 3:** the PREP Parties are currently considering a third phase of study to maintain momentum and explore other technical, institutional and regulatory options. The scope of Phase 3 has not been determined at the time of this Study.

Phase 2: Alternatives Analysis & Strategy Development

- **Needs Assessment Report (NAR):** defines the need for a project, goals and objectives, initiate interagency coordination, and identify project alternatives. This could be performed prior to or part of an alternative analysis report.
- **Alternatives Analysis Report (AAR):** develops design alternatives, perform triple bottom line (or similar) screening assessment, initiate public outreach and preliminary CEQA review. Address nexus of alternatives with other planned improvements (e.g. SVCW, San Mateo WWTP, Redwood City, SFPUC) and provide an assessment of existing facilities (e.g. Pulgas dechlorination and discharge facility, Redwood City storage tank, SVCW outfall point of connection, etc.)
- **Other Technical Studies:** may be developed before, as part of, or after the AAR to provide a more in-depth analysis, these may include but not be limited to
    - **Reservoir Mixing / Modeling:** perform hydrologic, hydraulic, limnological evaluations and/or modeling of the reservoir to confirm assumptions regarding reservoir operations and mixing. May include an assessment of existing system capacities and infrastructure requirements to utilize the SFPUC Pulgas Facilities.
    - **Advanced Treatment Evaluation:** explore treatment train/process options to produce purified water at the AWPF, evaluate approaches to dispose/discharge RO concentrate, perform treatment facility siting assessments including land acquisition, facility/process layouts and estimate pathogen log reductions for each treatment train process.
    - **Nutrient Treatment Evaluation:** consider treatment train/process options at the WWTF, as part of the AWPF or on RO concentrate to meet discharge objectives and other regional benefits.
    - **Alignment Studies:** refine concept level pipelines alignments and conveyance requirements for tertiary, purified and RO concentrate, including a preliminary assessment of land acquisition and ROWs. Incorporate desktop studies of geotechnical, utility, environmental and other information to refine routes and installation methods.

Reuse of SVCW abandoned pipelines may require separate studies to confirm existing conditions and assess installation/suspension techniques. Reuse of Redwood City storage, pumping and pipelines may require separate studies for hydraulic modeling and to confirm existing system capacities and infrastructure requirements. Focus of studies would be to identify cost-effective alignments that minimize impacts.

- **Develop Programmatic Strategies:** for environmental documentation (e.g. NPDES requirement for discharge to CSR, CEQA checklist, potential mitigation requirements, other documentation), regulatory strategy and engagement to meet RWA requirements, financial and funding options, stakeholder and public outreach, and institutional agreements and partnerships.
- **Water Quality Sampling:** preliminary study and sampling to support treatment process evaluation and ongoing sampling if needed. May include monitoring for specific constituents and surrogates, identifying type and frequency of monitoring and analytical methodology to be used.
- **Demonstration Concept:** develop strategy to compare treatment process technologies, demonstrate innovative strategies for compliance, verify treatment process performance, and serve as public outreach tool.
- **Independent Advisory Panel (IAP):** initial coordination with regulatory agencies and presentation of initial outcomes to external experts (IAP or Blue Ribbon Panel) for validation and input to guide demonstration testing and reservoir tracer study

Phase 3: Proof of Concept & Demonstration

- **Tracer Study and Validation Modeling:** to test and validate detention projections and mixing in the reservoir.
- **Conceptual Engineering Report (CER):** initial design drawings, continued public outreach, finalize CEQA checklist, cost-benefit analysis, define legal authority, procedures, local limits, enforcement response plan, etc.
- **Develop Programmatic Strategies:** for environmental documentation engaging SBDDW/SWRCB, develop finance and revenue plan, stakeholder and public engagement activities, and define institutional operations and ownership models and roles for partners.
- **Demonstration Design and Construction:** building off demonstration project concept
- **Water Quality Sampling:** If needed to calibrate a reservoir model or to support baseline surface water quality monitoring efforts.
- **Source Water Control:** identify existing chemical constituent source control and industrial/commercial pretreatment programs and identify potential modifications, improvements and/or additional programs.
- **Implementation Strategies:** develop initial conceptual operations plans for major facilities, including integration with existing operations (e.g. Redwood City's recycled water system, SFPUC Pulgas Facilities). Evaluation of power availability and needs.

Phase 4: CEQA & Preliminary Design

- **Environmental documentation:** complete CEQA, EIR or MND, NEPA if needed.
- **Regulatory requirements:** complete a Title 22 report and any updated studies required for SBDDW drinking water supply, Regional Board NPDES and Bay discharge permits, including applicable state and federal water quality standards, policies, provisions, and prohibitions.
- **Independent Advisory Panel (IAP):** follow up coordination with regulatory agencies and presentation of project updates to external experts on demonstration testing, reservoir tracer study and Title 22 Report outcomes to secure preliminary approvals from SBDDW and the Regional Board.
- **Funding:** apply for design dollars and administer grant/loan if successful. Consider alternate delivery and financing approaches (e.g. design-build, design-bid-build, design-build-operate, etc.)
- **Demonstration Operation and Performance Evaluation:** use as a tool to support public outreach, refine treatment design and validate performance for LRV credits.
- **Institutional Agreements and Terms:** develop a partnership framework to guide contracts, cost sharing and commitments between parties. Draft purchase agreements, will serve letters and other contracts as-defined by the framework.
- **Continue to Implement Testing Concepts**: to support implementation, such as continued water sampling and monitoring, outreach for the source water control program
- **Preliminary Design:** of major facilities for treatment, conveyance, discharge and other infrastructure, including confirmation of land acquisition/ROW, including obtaining preliminary approvals for construction. Information used to support CEQA/EIR and provide for greater cost certainty.
- **Preliminary O&M Plan:** to describe treatment facility and reservoir operations, management plans and operator requirements.

Phase 5: Detailed Design

- **Secure:** land, ROW, construction permits and other approvals necessary to finalize design and move to construction
- **Financing and Funding:** apply for construction dollars and administer grant/loan if successful. Secure financing and/or alternative delivery approach.
- **Stakeholder and Public Outreach:** ongoing to educate, gain support for RWA project, and address concerns regarding construction and operational activities.
- **Institutional Agreements:** finalize contracts, purchase agreements and other binding documents.
- **Design:** detailed design, specifications and preparation of bid documents.
- **Detailed O&M Plans/Manuals:** Develop an Operations Plan to guide activities for RWA operational scenarios. Create a Contingency Plan to respond to potential water quality excursions and to ensure inadequately treated recycled water will not be used for potable purposes. Conduct a Critical Control Points (CCP) Study to identify locations to detect treatment

lapses (should they occur) and time to implement contingency plans. Demonstrate ability to provide adequate failure response time (FRT). Develop a Monitoring and Reporting Plan to meet regulatory/permitting requirements (e.g. the frequency and duration of monitoring and reporting will be outlined in the permitting requirements for the project).

- **Pre-procurement:** of treatment equipment, if-preferred

Phase 6: Construction

- **Construction:** Bid, Award, Construction, Startup
- **Operation:** develop Standard Operating Procedures (SOPs) and conduct training.

Phase 7: Commission and Deliver

- **Startup and testing**
- Public outreach and celebration of success

6.6 Phase 3 Options

The PREP Parties have expressed interest in leveraging the success of the Phase 1 and 2 PREP studies and their commitment to exploring potable reuse opportunities in the Mid-Peninsula region.

- The **PREP Phase 1 Initial Study** evaluated opportunities for indirect potable reuse via groundwater replenishment in the San Mateo Plain Basin and reservoir augmentation (RWA) at CSR and Bear Gulch Reservoir. The Phase 1 findings indicated that a RWA project at CSR merited additional study.
- The **PREP Phase 2 Concept Study** focused on RWA at CSR to confirm the ability to meet finalized RWA regulations, further explore cost-effective pipeline alignments and facility siting options and assess institutional considerations. The Phase 2 findings indicated that RWA Project is viable and could produce reliable water that may be comparable to the costs of other new sources of supply.

The Parties decided not to evaluate potable reuse via raw water augmentation or treated drinking water augmentation (previously referred to as direct potable reuse or DPR[10]) as a part of the Phase 1 or 2 efforts since these forms of potable reuse are not currently practiced, nor regulated, in California. Assembly Bill (AB) 574, signed on July 5, 2017, further required the State Board to adopt uniform water recycling criteria for DPR through raw water augmentation (upstream of a drinking water treatment plant) on or before December 31, 2022. In 2018, the SWRCB published a proposed framework for regulating DPR (SWRCB 2018), which evaluated how public health threats, risk management opportunities and permitting options vary between the range of potable reuse forms and how public

[10] AB 292, introduced in January 2019, aims to eliminate the distinctions of "indirect potable reuse" and "direct potable reuse" and define "potable reuse" to include groundwater augmentation, reservoir water augmentation, raw water augmentation, treated drinking water augmentation.

health must and will be protected in all cases. A timeline for regulations for a treated water augmentation (downstream of a drinking water treatment plant) has not been established at this time.

Once regulations for all forms of potable reuse are established, additional project structures may become feasible. Exploration of **raw water augmentation or treated drinking water augmentation** potable reuse concepts may be beneficial for the PREP Parties to provide a broad assessment of all the potable reuse opportunities in the Mid-Peninsula region. A Phase 3 study could explore how decentralized potable reuse could create a local resource program to reduce demands on the Regional Water System, while recognizing the growing interest of communities to protect their right to the wastewater produced in their service area. The potential beneficiaries and functional roles could be described as part of an assessment of institutional considerations for raw water or treated drinking water augmentation.

Another future study of interest could be a **demonstration project** concept study, which could serve multiple benefits for the project by providing a vehicle to test the most current treatment technologies directly on source water(s) and provide educational opportunities for the community. Implementation of a demonstration project can have the added benefit of supporting integrated planning between water and wastewater agencies. The concept for a demonstration project would depend on the proposed end use of the purified water, the identified source water and to some degree the institutional structure, since it would be advantageous for the project sponsor to lead the study. Development of a demonstration project concept study could identify the scale of investment, the information needed/wanted, the anticipated value of the demonstration project outcomes and the parties interested in implementing and funding the demonstration project.

Should the PREP Parties decide to further pursue a RWA project in Phase 3, a future study of **RWS and CSR operational scenarios** may be beneficial to evaluate how the project could be improved by incorporating wet-weather banking as a means of offsetting base-loaded flows through an AWTF. The Phase 3 study could model potential scenarios to facilitate storing, exchanging or banking water in CSR, or other options that may allow the parties to more clearly define beneficiaries or storage and the institutional functional roles that may be desirable.

The continued development of an RWA or other potable reuse alternative concepts would help justify future water supply reliability or wastewater regulatory compliance projects and offer an alternative needed for future CEQA documents. Future studies can compare the relative costs, benefits and limitations of non-traditional, local, sustainable supplies and provide leadership and staff with current knowledge regarding new technical, regulatory developments over time. Future studies would also allow the parties to more clearly define beneficiaries, functional roles and address other institutional considerations.

Section 7: References

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Appendix A: SFPUC Considerations for Estimating Preliminary Pipeline Routing and Cost

Source: SFPUC 4/28/17

Crystal Springs ROW Use for Potable Reuse Water Pipeline
Considerations for Estimating Preliminary Pipeline Routing and Cost

It would be possible to co-locate a potable reuse transmission pipeline in the SFPUC's ROW from the Redwood City area to Crystal Springs Reservoir.

Bay Division Pipelines in ROW

- There are three pipelines (Bay Division 1, 2 and 5) in the ROW on Edgewood Road. In the vicinity of Edgewood Road and Cordilleras Road, the three pipelines converge with two more (Bay Division 3 and 4).
- Five Bay Division pipelines jog NW to Hassler Road where they enter into the Pulgas Tunnel at the horseshoe of Hassler Road.
- Pulgas Tunnel is approximately two miles in length.

Co-locating a potable reuse transmission pipeline in the ROW

- Allow for uncertainty in the project's consideration of alternatives.
- There is a limit to confirming the feasibility of locating a pipeline in the ROW.
- Assuming an 18" transmission pipeline.
- The terrain looks to be difficult for heavy equipment access in the ROW.
- Would not be able to put the potable reuse transmission pipeline in the tunnel. Would have to open cut around the tunnel area.
- Would need to tunnel under 280.
- Need to steer clear of Bay Division 5
- 15' clear between lines and 5 feet clear between pipeline and boundary.
    - The SFPUC will allow situations where these requirements are not met for short distances, like where the lines cross, or where obstacles are skirted, but at those locations as everywhere, the State's requirements for separation of drinking water pipelines and non-potable water pipelines must be complied with, or State approved variances.
    - Consider allowing that the location of the drinking water pipelines is only approximately known – this means that separation requirements are not to be violated if the drinking water pipelines are found to occupy a space closer than expected to the proposed pipeline's alignment. In such cases the proposed pipeline must be realigned and/or State-approved measures for separation of potable and non-potable water pipelines must be provided.
- Pulgas Tunnel daylights at Pulgas Water Temple. Pulgas Water Pipeline runs from Water Temple to the Pulgas Dechloramination Facility, then into reservoir.

- SPFUC would own and operate the section of pipeline in the SFPUC's ROW.

There are other special considerations of locating a non-potable water pipeline within the SFPUC's drinking water pipeline ROW:

- Design life and duty – the line should be designed to serve trouble-free for at least 75 years and to withstand heavy pipeline construction loading
- Construction materials – no element of the proposed facility should ever require painting within its lifespan
- ROW – any pipeline project is to conform and protect the earth cover of existing drinking water pipelines and provide for their structural protection from construction loading, as well as provide finish grading to assure positive drainage of the entire width of the ROW and provide for proper conveyance of ROW drainage to local storm water systems
- Depth of burial – finished grading is to allow for a minimum of 4' of soil cover to top of proposed pipe, except where shallower installation is specifically confirmed by maintenance engineering analysis
- Appurtenances – all air-release, vacuum relief, blow-off and any fill or sample extraction appurtenances are to be provided with water-tight containment and water-tight drainage to sanitary sewer systems
- Zone valving stations are to allow isolation and drainage of reaches of 2 miles or less
- Monitoring and automation – instrumentation and SCADA is to be provided to monitor pressures in each reach of the proposed pipeline and automatic shutdown in the event of sudden pressure loss
- Corrosion protection – cathodic protection is to be provided to assure design life and, the proposed water pipeline in no way contributes to the corrosion of drinking water pipelines in the ROW – galvanic corrosion from contact with dissimilar metals is prohibited
- Earthquake design criteria – seismic hardness and performance criteria of the proposed pipeline are to meet or exceed the standards established for pipelines under WSIP (Wellhead Shut In Pressure)
- Pressure design criteria – transient pressure performance criteria of the proposed pipeline are to meet or exceed the standards established for pipelines under WSIP
- It is likely that there will not be a contiguous ROW for this pipeline, however, it should be obtained.

Operations

- Water Quality would need to meet the requirements in the NPDES permit for Crystal Springs. Requirements are unique and have to do with wildlife and plants. Need to look at the parameters in the permit, and what the quality would be from the Advanced Water Purification Facility.
- Water quality would need to be monitored.
- Could potentially run water through Pulgas Dechloramination facility if necessary.

Appendix B: Pipeline Separation References

B.1 California Code of Regulations (CCR), Title 22, Division 4, Chapter 16, Section 64572 Water Main Separation

B.2 State Water Resources Control Board – Division of Drinking Water (SBDDW) 2017 - Separation of Water Mains and Non-Potable Pipelines – Requests for Alternatives to the Waterworks Standards

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§ 64572. Water Main Separation.
22 CA ADC § 64572
BARCLAYS OFFICIAL CALIFORNIA CODE OF REGULATIONS

Barclays Official California Code of Regulations Currentness
Title 22. Social Security
Division 4. Environmental Health
Chapter 16. California Waterworks Standards
Article 4. Materials and Installation of Water Mains and Appurtenances

22 CCR § 64572

§ 64572. Water Main Separation.

(a) New water mains and new supply lines shall not be installed in the same trench as, and shall be at least 10 feet horizontally from and one foot vertically above, any parallel pipeline conveying:

(1) Untreated sewage,

(2) Primary or secondary treated sewage,

(3) Disinfected secondary-2.2 recycled water (defined in section 60301.220),

(4) Disinfected secondary-23 recycled water (defined in section 60301.225), and

(5) Hazardous fluids such as fuels, industrial wastes, and wastewater sludge.

(b) New water mains and new supply lines shall be installed at least 4 feet horizontally from, and one foot vertically above, any parallel pipeline conveying:

(1) Disinfected tertiary recycled water (defined in section 60301.230), and

(2) Storm drainage.

(c) New supply lines conveying raw water to be treated for drinking purposes shall be installed at least 4 feet horizontally from, and one foot vertically below, any water main.

(d) If crossing a pipeline conveying a fluid listed in subsection (a) or (b), a new water main shall be constructed no less than 45-degrees to and at least one foot above that pipeline. No connection joints shall be made in the water main within eight horizontal feet of the fluid pipeline.

(e) The vertical separation specified in subsections (a), (b), and (c) is required only when the horizontal distance between a water main and pipeline is less than ten feet.

(f) New water mains shall not be installed within 100 horizontal feet of the nearest edge of any sanitary landfill, wastewater disposal pond, or hazardous waste disposal site, or within 25 horizontal feet of the nearest edge of any cesspool, septic tank, sewage leach field, seepage pit, underground hazardous material storage tank, or groundwater recharge project site.

(g) The minimum separation distances set forth in this section shall be measured from the nearest outside edge of each pipe barrel.

(h) With State Board approval, newly installed water mains may be exempt from the separation distances in this section, except subsection (f), if the newly installed main is:

(1) less than 1320 linear feet,

(2) replacing an existing main, installed in the same location, and has a diameter no greater than six inches more than the diameter of the main it is replacing, and

(3) installed in a manner that minimizes the potential for contamination, including, but not limited to:

(A) sleeving the newly installed main, or

(B) utilizing upgraded piping material

Note: Authority cited: Sections 116271, 116350 and 116375, Health and Safety Code. Reference: Sections 116275 and 116375, Health and Safety Code.

HISTORY

1. New section filed 2-8-2008; operative 3-9-2008 (Register 2008, No. 6).

2. Change without regulatory effect amending subsection (h) and Note filed 6-2-2015 pursuant to section 100, title 1, California Code of Regulations (Register 2015, No. 23).

This database is current through 5/3/19 Register 2019, No. 18

22 CCR § 64572, 22 CA ADC § 64572

END OF DOCUMENT

CALIFORNIA Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board
Division of Drinking Water

December 14, 2017

Separation of Water Mains and Non-Potable Pipelines – Requests for Alternatives to the Waterworks Standards

Dear Public Water System Owners and Operators:

This letter supersedes prior guidance regarding the separation of water mains and non-potable pipelines, including Guidance Memo 2003-02, dated October 16, 2003. Guidance Memo 2003-02 and previous versions should be discarded.

The California Waterworks Standards (California Code of Regulations (CCR), Title 22, Division 4, Chapter 16, Section 64572) establish criteria for the separation of new water mains from non-potable pipelines. Public water systems should ensure that these distances are met, whenever feasible, for all new construction. The Division of Drinking Water (Division) recognizes that certain conditions may call for the installation of pipelines with less separation distance than what is required by the regulations. In these situations, the water system may propose an alternative pursuant to CCR, Title 22, Section 64551.100:

§64551.100. Waivers and Alternatives.

(a) A water system that proposes to use an alternative to a requirement in this chapter shall:
(1) Demonstrate to the State Board that the proposed alternative would provide at least the same level of protection to public health; and
(2) Obtain written approval from the State Board prior to implementation of the alternative.

In proposing an alternative to the Waterworks Standards, water systems should observe the following:

- The water system must accept responsibility for the adequacy of the proposed alternative. The Division may require a written statement, signed by the water system's management, certifying that the proposed alternative adequately protects public health.
- In most circumstances, the Division cannot offer technical assistance with pipeline or infrastructure design. The water system proposing an alternative must demonstrate adequate expertise on the part of its own personnel or its hired consultants.
- The water system should describe how the proposed alternative provides at least the same level of protection to public health as the minimum separation distances prescribed in the regulation.
- While exorbitant cost may present a hardship in meeting the regulatory separation requirements and can be considered, public health must be prioritized above construction costs in determining an acceptable alternative.

The Division has prepared an application checklist that may be used by water systems in proposing an alternative to the Waterworks Standards (Enclosure). The purpose of the checklist is to ensure that the Division has sufficient information to evaluate the proposal. **The water system may submit the information in a different format from the checklist, provided that the submittal provides adequate information.** The checklist may also be used to provide written certification that the proposed alternative adequately protects public health.

If you have any questions, please contact the Division office that oversees your water system.

Sincerely,

Darrin Polhemus, P.E.
Deputy Director
Division of Drinking Water

Enclosure: Waterworks Standards Main Separation Alternative Request Example Checklist

Appendix C: Supporting Information for Environmental Review

APPENDIX C.1

IPaC Information for Planning and Consultation **U.S. Fish & Wildlife Service**

IPaC resource list OPTION 1

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

San Mateo County, California

Local offices

Sacramento Fish And Wildlife Office

(916) 414-6600
(916) 414-6713

Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

San Francisco Bay-Delta Fish And Wildlife

(916) 930-5603
(916) 930-5654

650 Capitol Mall
Suite 8-300
Sacramento, CA 95814

http://kim_squires@fws.gov

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse Reithrodontomys raviventris No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/613	Endangered

Birds

NAME	STATUS
California Clapper Rail Rallus longirostris obsoletus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern Sterna antillarum browni No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
Marbled Murrelet Brachyramphus marmoratus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/4467	Threatened
Western Snowy Plover Charadrius nivosus nivosus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8035	Threatened
Yellow-billed Cuckoo Coccyzus americanus There is **proposed** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/3911	Threatened

Reptiles

NAME	STATUS
Alameda Whipsnake (=striped Racer) Masticophis lateralis euryxanthus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/5524	Threatened
Green Sea Turtle Chelonia mydas No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6199	Threatened

San Francisco Garter Snake Thamnophis sirtalis tetrataenia — Endangered
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5956

Amphibians

NAME	STATUS
California Red-legged Frog Rana draytonii There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander Ambystoma californiense There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt Hypomesus transpacificus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/321	Threatened
Tidewater Goby Eucyclogobius newberryi There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/57	Endangered

Insects

NAME	STATUS
Bay Checkerspot Butterfly Euphydryas editha bayensis There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2320	Threatened
Mission Blue Butterfly Icaricia icarioides missionensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/6928	Endangered
Myrtle's Silverspot Butterfly Speyeria zerene myrtleae No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6929	Endangered

San Bruno Elfin Butterfly Callophrys mossii bayensis — Endangered
There is **proposed** critical habitat for this species. The location of the critical habitat is not available.
https://ecos.fws.gov/ecp/species/3394

Crustaceans

NAME	STATUS
Vernal Pool Fairy Shrimp Branchinecta lynchi There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/498	Threatened

Flowering Plants

NAME	STATUS
Fountain Thistle Cirsium fontinale var. fontinale No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7939	Endangered
Marin Dwarf-flax Hesperolinon congestum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5363	Threatened
San Mateo Thornmint Acanthomintha obovata ssp. duttonii No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2038	Endangered
San Mateo Woolly Sunflower Eriophyllum latilobum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7791	Endangered
Showy Indian Clover Trifolium amoenum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6459	Endangered
White-rayed Pentachaeta Pentachaeta bellidiflora No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7782	Endangered

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
California Red-legged Frog Rana draytonii https://ecos.fws.gov/ecp/species/2891#crithab	Final

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act

[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY

	BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Allen's Hummingbird Selasphorus sasin This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31
Black Oystercatcher Haematopus bachmani This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9591	Breeds Apr 15 to Oct 31
Black Skimmer Rynchops niger This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15
Black Turnstone Arenaria melanocephala This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Burrowing Owl Athene cunicularia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9737	Breeds Mar 15 to Aug 31
California Thrasher Toxostoma redivivum This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jan 1 to Jul 31

Clark's Grebe Aechmophorus clarkii This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jan 1 to Dec 31
Common Yellowthroat Geothlypis trichas sinuosa This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/2084	Breeds May 20 to Jul 31
Golden Eagle Aquila chrysaetos This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31
Gull-billed Tern Gelochelidon nilotica This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9501	Breeds May 1 to Jul 31
Lawrence's Goldfinch Carduelis lawrencei This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9464	Breeds Mar 20 to Sep 20
Long-billed Curlew Numenius americanus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5511	Breeds elsewhere
Marbled Godwit Limosa fedoa This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9481	Breeds elsewhere
Nuttall's Woodpecker Picoides nuttallii This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9410	Breeds Apr 1 to Jul 20
Oak Titmouse Baeolophus inornatus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9656	Breeds Mar 15 to Jul 15

Rufous Hummingbird selasphorus rufus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8002	Breeds elsewhere
Short-billed Dowitcher Limnodromus griseus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Song Sparrow Melospiza melodia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Feb 20 to Sep 5
Spotted Towhee Pipilo maculatus clementae This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/4243	Breeds Apr 15 to Jul 20
Tricolored Blackbird Agelaius tricolor This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3910	Breeds Mar 15 to Aug 10
Whimbrel Numenius phaeopus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9483	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wrentit Chamaea fasciata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 10

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

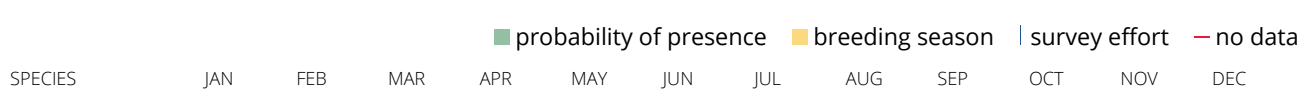
Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Allen's Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Bald Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

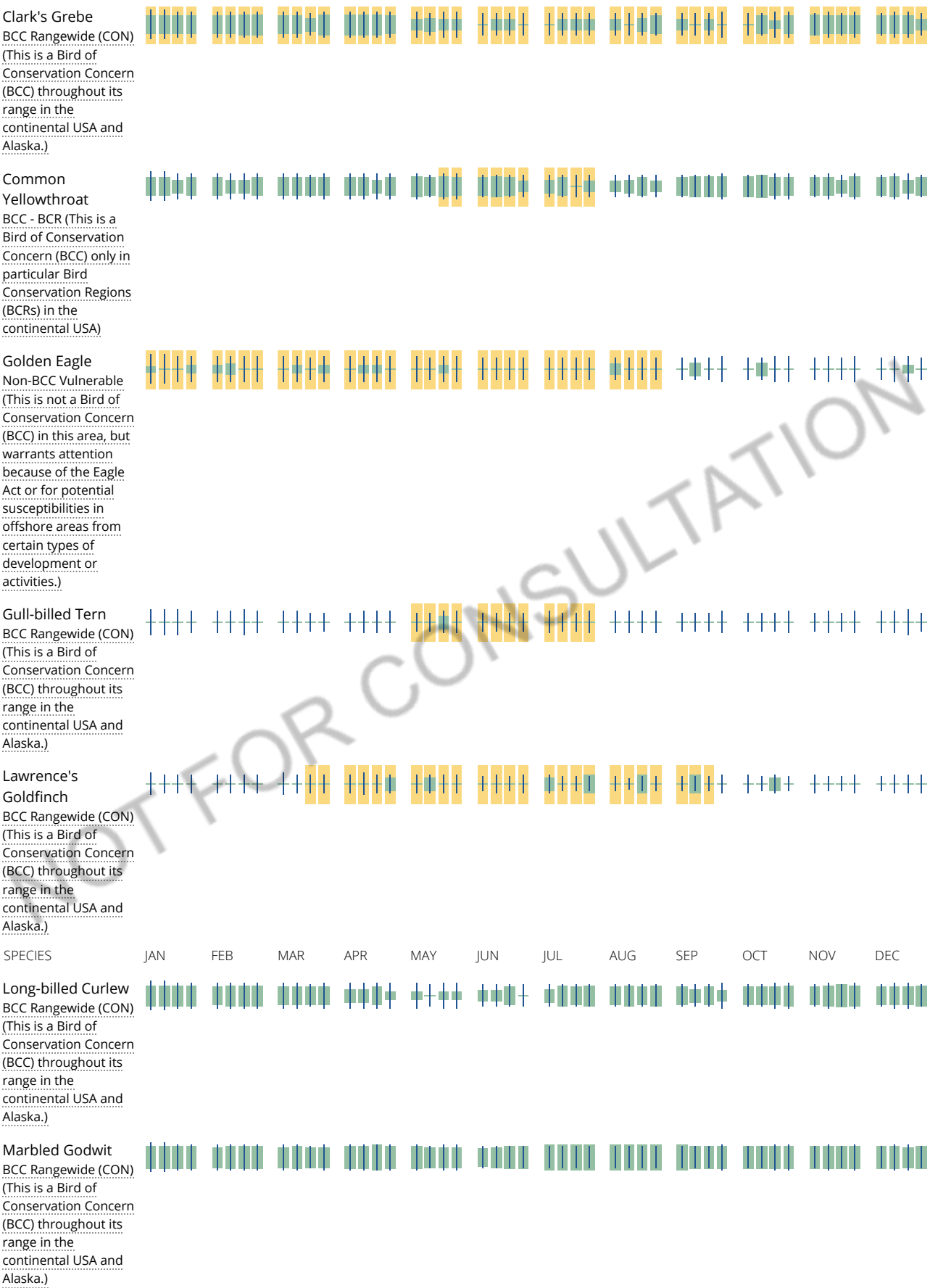
Black Oystercatcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Black Skimmer
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Black Turnstone
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Burrowing Owl
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

California Thrasher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



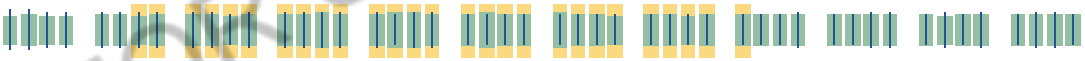
Nuttall's Woodpecker
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Oak Titmouse
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Rufous Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

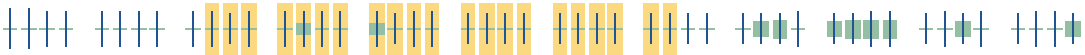
Short-billed Dowitcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Song Sparrow
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



Spotted Towhee
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

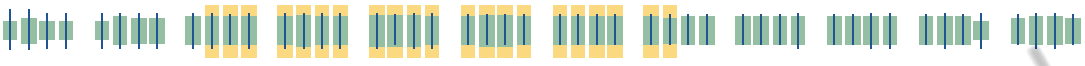
Tricolored Blackbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Whimbrel
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Willet
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Wrentit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC use to generate the migratory birds potentially occurring in my specified location”. Please be aware this report provides the “probability of presence” of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey

effort (indicated by the black vertical bar) and for the existence of the “no data” indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ “Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds” at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

This location overlaps the following National Wildlife Refuge lands:

LAND	ACRES
Don Edwards San Francisco Bay National Wildlife Refuge	24,718.59 acres

(510) 792-0222
(510) 792-5828

1 Marshlands Road
Fremont, CA 94555

https://www.fws.gov/refuges/profiles/index.cfm?id=81648

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

ESTUARINE AND MARINE DEEPWATER
- E1UBL

ESTUARINE AND MARINE WETLAND
- E2EM1N
- E2SBNx
- E2EM1Nh
- E2USN
- E2SBN

FRESHWATER EMERGENT WETLAND
- PEM1Ch

FRESHWATER FORESTED/SHRUB WETLAND
- PSSC
- PSSAh
- PFOA

FRESHWATER POND
- PUSCh
- PUBFh
- PUBH

LAKE
- L2UBHh3

RIVERINE
- R4SBC
- R4SBCx
- R5UBF
- R4SBAx

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

APPENDIX C.2

IPaC Information for Planning and Consultation **U.S. Fish & Wildlife Service**

IPaC resource list OPTION 2

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

San Mateo County, California

Local office

Sacramento Fish And Wildlife Office

(916) 414-6600
(916) 414-6713

Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse Reithrodontomys raviventris No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/613	Endangered

Birds

NAME	STATUS
California Clapper Rail Rallus longirostris obsoletus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern Sterna antillarum browni No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
Marbled Murrelet Brachyramphus marmoratus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/4467	Threatened
Western Snowy Plover Charadrius nivosus nivosus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8035	Threatened

Reptiles

NAME	STATUS
Green Sea Turtle Chelonia mydas No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6199	Threatened
San Francisco Garter Snake Thamnophis sirtalis tetrataenia No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5956	Endangered

Amphibians

NAME	STATUS
California Red-legged Frog Rana draytonii There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/2891	Threatened

California Tiger Salamander Ambystoma californiense — Threatened
There is **final** critical habitat for this species. Your location is outside the critical habitat.
https://ecos.fws.gov/ecp/species/2076

Fishes

NAME	STATUS
Delta Smelt Hypomesus transpacificus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/321	Threatened
Tidewater Goby Eucyclogobius newberryi There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/57	Endangered

Insects

NAME	STATUS
Bay Checkerspot Butterfly Euphydryas editha bayensis There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2320	Threatened
Mission Blue Butterfly Icaricia icarioides missionensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/6928	Endangered
Myrtle's Silverspot Butterfly Speyeria zerene myrtleae No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6929	Endangered
San Bruno Elfin Butterfly Callophrys mossii bayensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/3394	Endangered

Flowering Plants

NAME	STATUS
Fountain Thistle Cirsium fontinale var. fontinale No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7939	Endangered

Marin Dwarf-flax Hesperolinon congestum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5363	Threatened
San Mateo Thornmint Acanthomintha obovata ssp. duttonii No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2038	Endangered
San Mateo Woolly Sunflower Eriophyllum latilobum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7791	Endangered
White-rayed Pentachaeta Pentachaeta bellidiflora No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7782	Endangered

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
California Red-legged Frog Rana draytonii https://ecos.fws.gov/ecp/species/2891#crithab	Final

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act

[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php

- Measures for avoiding and minimizing impacts to birds
  http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds
  http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Allen's Hummingbird Selasphorus sasin This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31

Black Oystercatcher Haematopus bachmani — Breeds Apr 15 to Oct 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9591

Black Skimmer Rynchops niger — Breeds May 20 to Sep 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5234

Black Turnstone Arenaria melanocephala — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Burrowing Owl Athene cunicularia — Breeds Mar 15 to Aug 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9737

California Thrasher Toxostoma redivivum — Breeds Jan 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Clark's Grebe Aechmophorus clarkii — Breeds Jan 1 to Dec 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Common Yellowthroat Geothlypis trichas sinuosa — Breeds May 20 to Jul 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/2084

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Gull-billed Tern Gelochelidon nilotica — Breeds May 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9501

Lawrence's Goldfinch Carduelis lawrencei — Breeds Mar 20 to Sep 20
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9464

Long-billed Curlew Numenius americanus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5511

Marbled Godwit Limosa fedoa — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9481

Nuttall's Woodpecker Picoides nuttallii — Breeds Apr 1 to Jul 20
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9410

Oak Titmouse Baeolophus inornatus — Breeds Mar 15 to Jul 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9656

Rufous Hummingbird selasphorus rufus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8002

Short-billed Dowitcher Limnodromus griseus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9480

Song Sparrow Melospiza melodia — Breeds Feb 20 to Sep 5
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Spotted Towhee Pipilo maculatus clementae — Breeds Apr 15 to Jul 20
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/4243

Tricolored Blackbird Agelaius tricolor This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3910	Breeds Mar 15 to Aug 10
Whimbrel Numenius phaeopus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9483	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wrentit Chamaea fasciata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 10

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

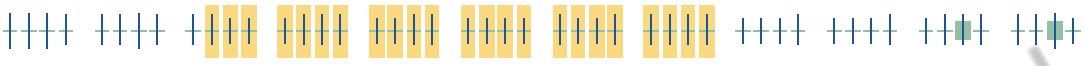
No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

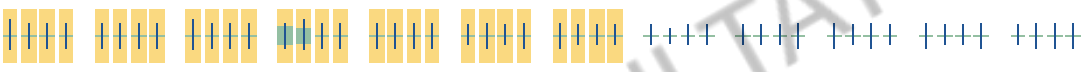
Black Skimmer
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Black Turnstone
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

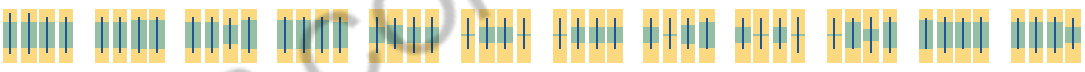
Burrowing Owl
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



California Thrasher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

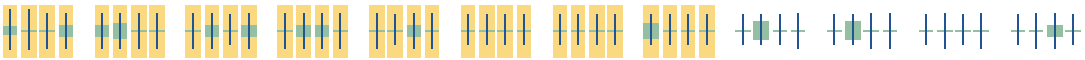


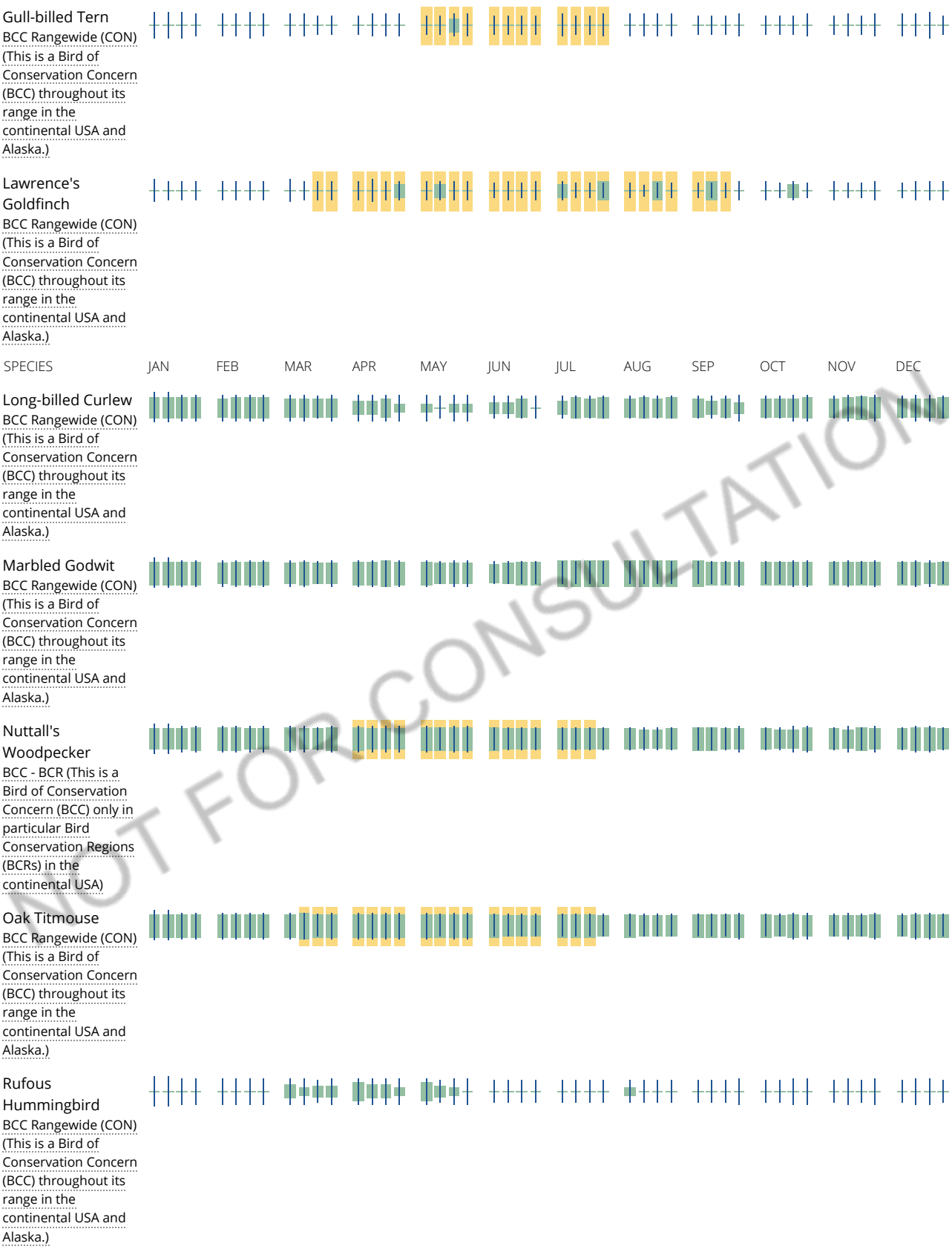
Clark's Grebe
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

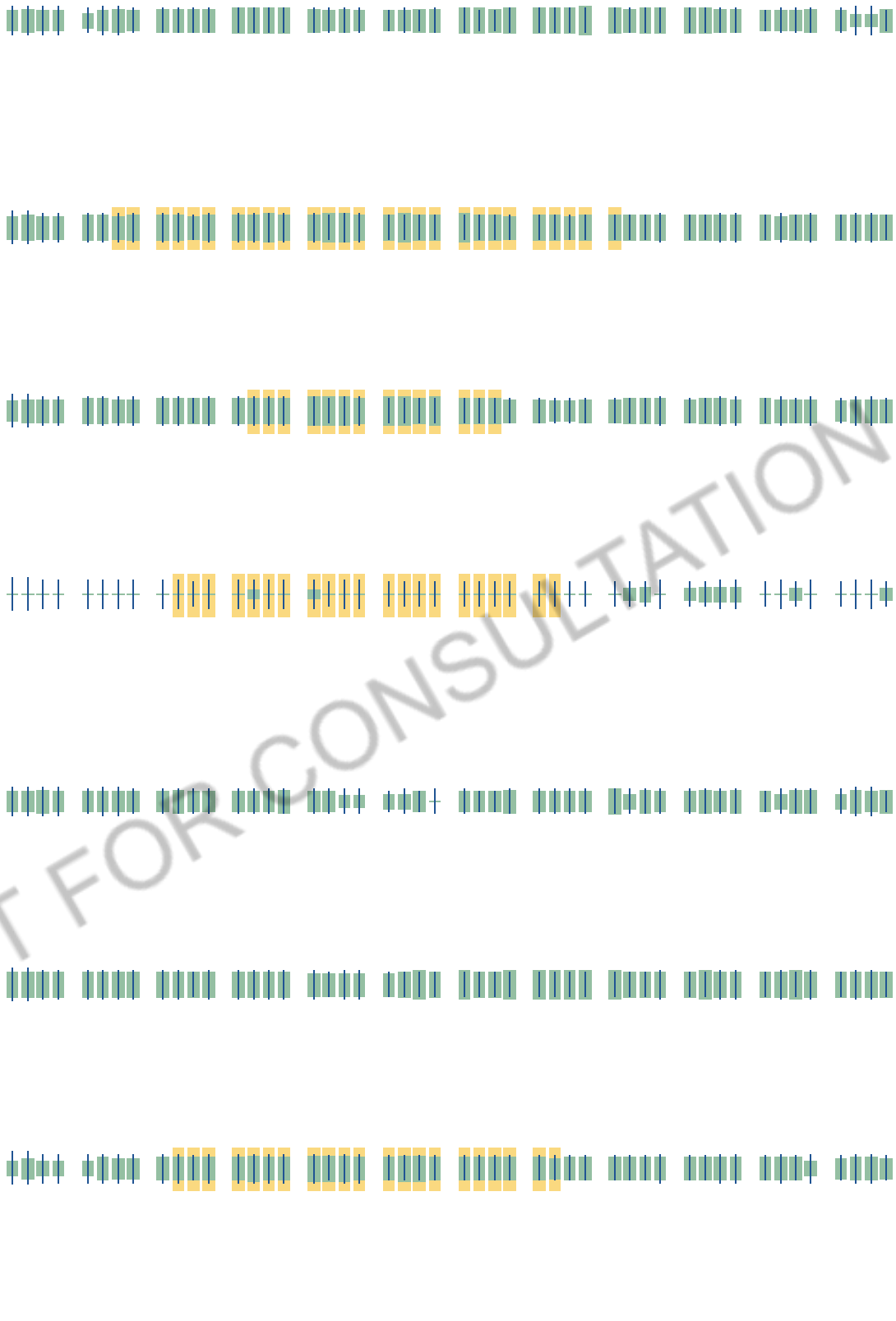


Common Yellowthroat
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Golden Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)







Short-billed Dowitcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Song Sparrow
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Spotted Towhee
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Tricolored Blackbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Whimbrel
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Willet
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Wrentit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding

their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

- PEM1Ch

FRESHWATER FORESTED/SHRUB WETLAND

- PSSC
- PSSAh
- PFOA

FRESHWATER POND

- PUSCh
- PUBFh

RIVERINE

- R4SBCx
- R4SBAx
- R5UBF
- R4SBC

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

APPENDIX C.3

IPaC Information for Planning and Consultation **U.S. Fish & Wildlife Service**

IPaC resource list

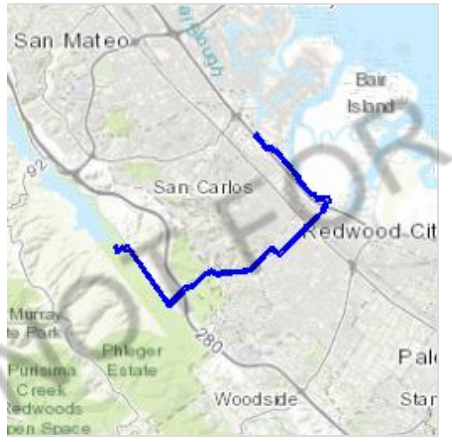
OPTION 3

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

San Mateo County, California



Local offices

Sacramento Fish And Wildlife Office

(916) 414-6600
(916) 414-6713

Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

San Francisco Bay-Delta Fish And Wildlife

(916) 930-5603
(916) 930-5654

650 Capitol Mall
Suite 8-300
Sacramento, CA 95814

http://kim_squires@fws.gov

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse Reithrodontomys raviventris No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/613	Endangered

Birds

NAME	STATUS
California Clapper Rail Rallus longirostris obsoletus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern Sterna antillarum browni No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
Marbled Murrelet Brachyramphus marmoratus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/4467	Threatened
Western Snowy Plover Charadrius nivosus nivosus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8035	Threatened
Yellow-billed Cuckoo Coccyzus americanus There is **proposed** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/3911	Threatened

Reptiles

NAME	STATUS
Alameda Whipsnake (=striped Racer) Masticophis lateralis euryxanthus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/5524	Threatened
Green Sea Turtle Chelonia mydas No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6199	Threatened

San Francisco Garter Snake Thamnophis sirtalis tetrataenia — Endangered
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5956

Amphibians

NAME	STATUS
California Red-legged Frog Rana draytonii There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander Ambystoma californiense There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt Hypomesus transpacificus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/321	Threatened
Tidewater Goby Eucyclogobius newberryi There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/57	Endangered

Insects

NAME	STATUS
Bay Checkerspot Butterfly Euphydryas editha bayensis There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/2320	Threatened
Mission Blue Butterfly Icaricia icarioides missionensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/6928	Endangered
Myrtle's Silverspot Butterfly Speyeria zerene myrtleae No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6929	Endangered

San Bruno Elfin Butterfly Callophrys mossii bayensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/3394	Endangered

Crustaceans

NAME	STATUS
Vernal Pool Fairy Shrimp Branchinecta lynchi There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/498	Threatened

Flowering Plants

NAME	STATUS
Fountain Thistle Cirsium fontinale var. fontinale No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7939	Endangered
Marin Dwarf-flax Hesperolinon congestum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5363	Threatened
San Mateo Thornmint Acanthomintha obovata ssp. duttonii No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2038	Endangered
San Mateo Woolly Sunflower Eriophyllum latilobum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7791	Endangered
Showy Indian Clover Trifolium amoenum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6459	Endangered
White-rayed Pentachaeta Pentachaeta bellidiflora No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7782	Endangered

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
Bay Checkerspot Butterfly Euphydryas editha bayensis https://ecos.fws.gov/ecp/species/2320#crithab	Final
California Red-legged Frog Rana draytonii https://ecos.fws.gov/ecp/species/2891#crithab	Final

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act

[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Allen's Hummingbird Selasphorus sasin This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31
Black Oystercatcher Haematopus bachmani This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9591	Breeds Apr 15 to Oct 31
Black Skimmer Rynchops niger This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15
Black Turnstone Arenaria melanocephala This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Burrowing Owl Athene cunicularia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9737	Breeds Mar 15 to Aug 31
California Thrasher Toxostoma redivivum This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jan 1 to Jul 31

Clark's Grebe Aechmophorus clarkii — Breeds Jan 1 to Dec 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Common Yellowthroat Geothlypis trichas sinuosa — Breeds May 20 to Jul 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/2084

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Gull-billed Tern Gelochelidon nilotica — Breeds May 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9501

Lawrence's Goldfinch Carduelis lawrencei — Breeds Mar 20 to Sep 20
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9464

Long-billed Curlew Numenius americanus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5511

Marbled Godwit Limosa fedoa — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9481

Nuttall's Woodpecker Picoides nuttallii — Breeds Apr 1 to Jul 20
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9410

Oak Titmouse Baeolophus inornatus — Breeds Mar 15 to Jul 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9656

Rufous Hummingbird selasphorus rufus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8002	Breeds elsewhere
Short-billed Dowitcher Limnodromus griseus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Song Sparrow Melospiza melodia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Feb 20 to Sep 5
Spotted Towhee Pipilo maculatus clementae This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/4243	Breeds Apr 15 to Jul 20
Tricolored Blackbird Agelaius tricolor This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3910	Breeds Mar 15 to Aug 10
Whimbrel Numenius phaeopus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9483	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wrentit Chamaea fasciata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 10

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

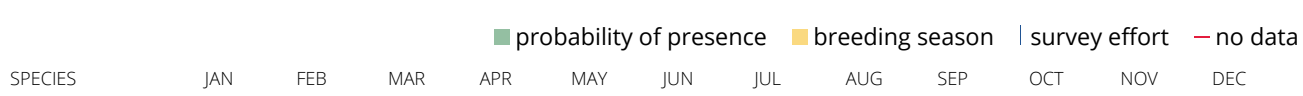
Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

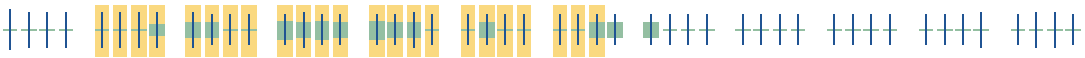
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

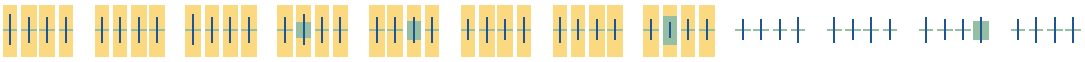
Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



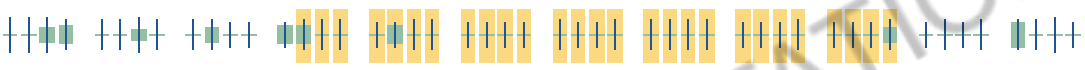
Allen's Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Bald Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



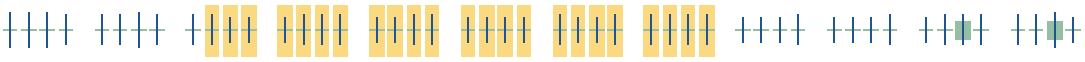
Black Oystercatcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



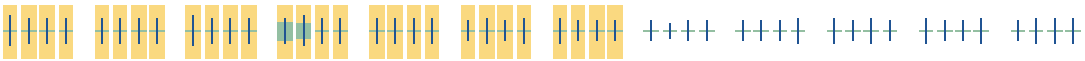
Black Skimmer
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

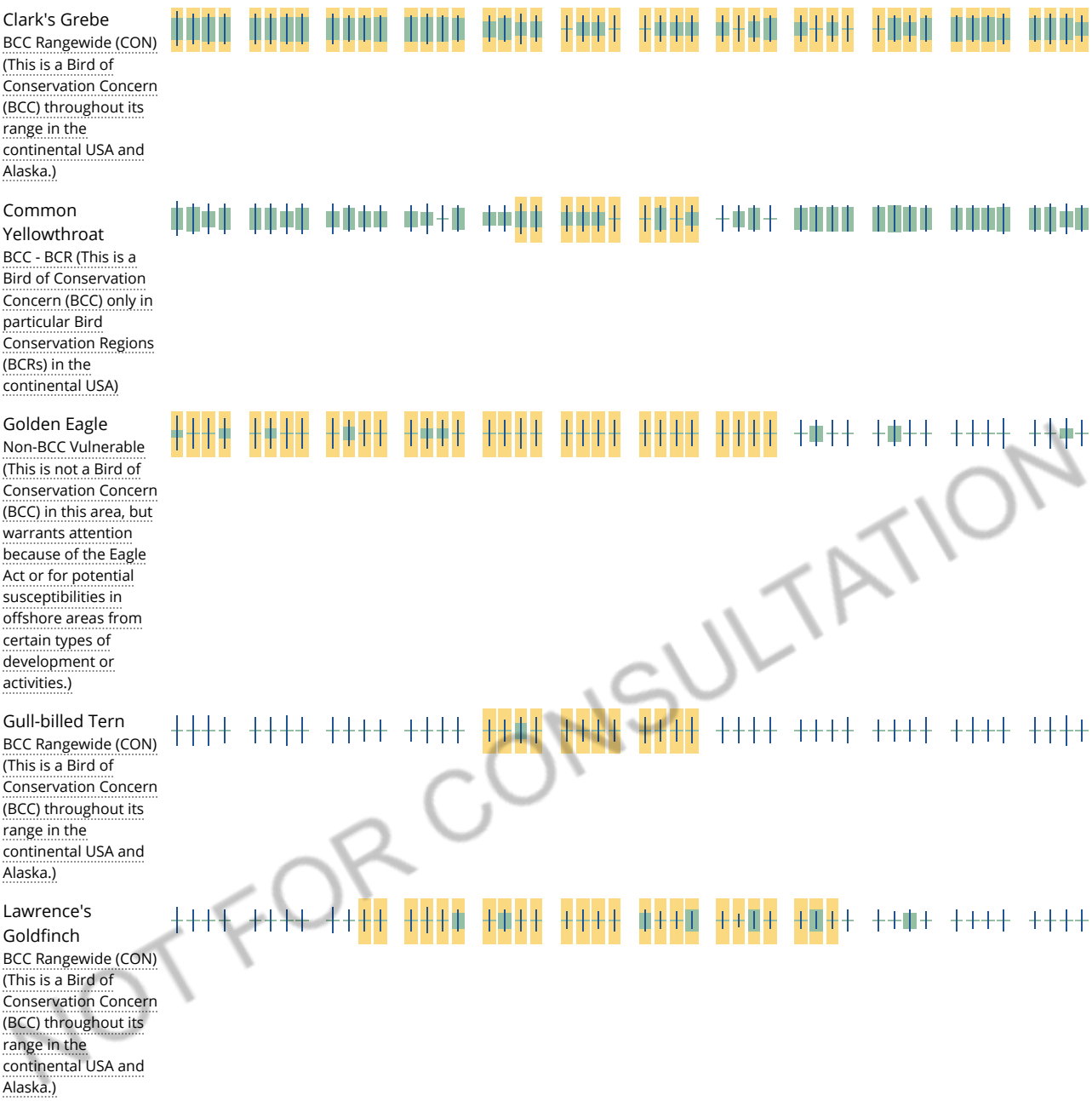
Black Turnstone
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Burrowing Owl
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



California Thrasher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)





Nuttall's Woodpecker
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Oak Titmouse
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

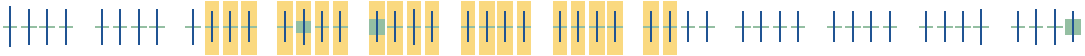
Rufous Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

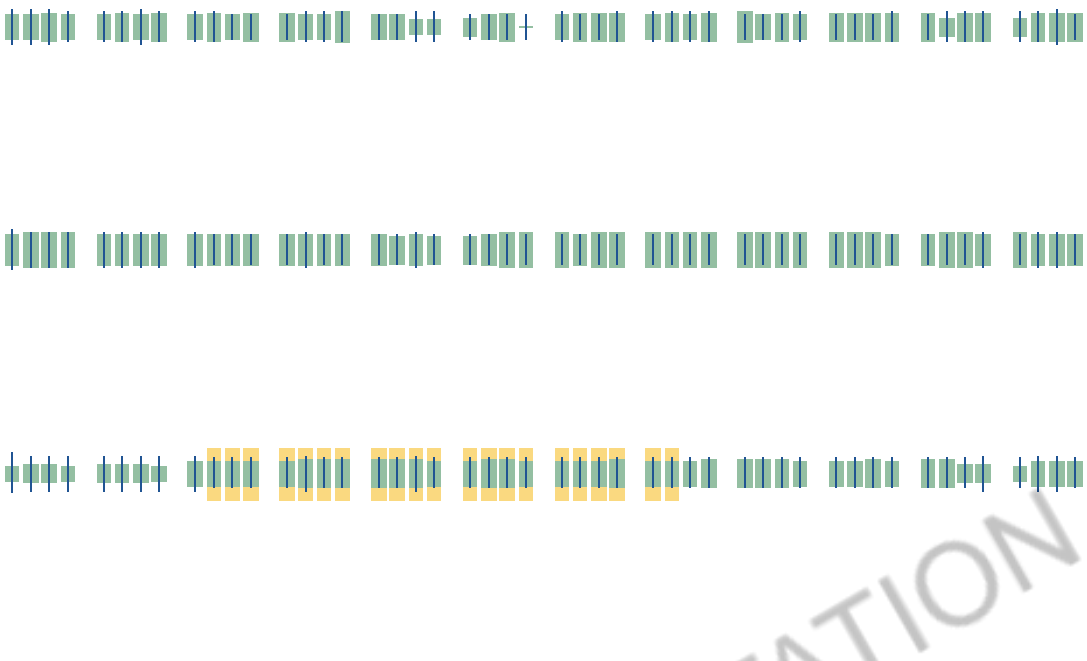
Short-billed Dowitcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Song Sparrow
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Spotted Towhee
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Tricolored Blackbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)





Whimbrel
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Willet
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Wrentit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC use to generate the migratory birds potentially occurring in my specified location”. Please be aware this report provides the “probability of presence” of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey

effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

This location overlaps the following National Wildlife Refuge lands:

LAND	ACRES
Don Edwards San Francisco Bay National Wildlife Refuge	24,718.59 acres

(510) 792-0222
(510) 792-5828

1 Marshlands Road
Fremont, CA 94555

https://www.fws.gov/refuges/profiles/index.cfm?id=81648

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

ESTUARINE AND MARINE WETLAND

- E2EM1N
- E2SBNx
- E2EM1Nh
- E2USN
- E2SBN

FRESHWATER EMERGENT WETLAND

- PEM1Ch

FRESHWATER FORESTED/SHRUB WETLAND

- PSSC
- PFOA
- PSSAh
- PSSCh
- PSSA

FRESHWATER POND

- PUSCh
- PUBFh
- PABHh
- PUBH

LAKE

- L2UBHh3

RIVERINE

- R4SBC
- R5UBF
- R4SBAx

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

APPENDIX C.4

IPaC Information for Planning and Consultation **U.S. Fish & Wildlife Service**

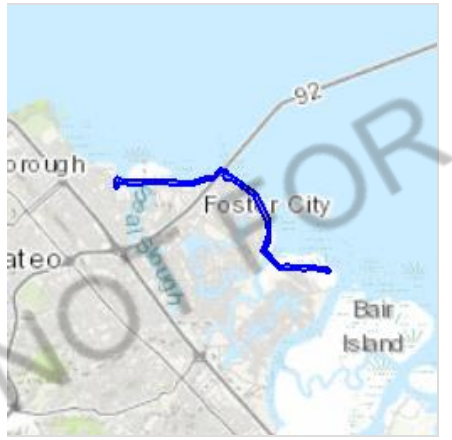
IPaC resource list OPTION A

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

San Mateo County, California



Local offices

Sacramento Fish And Wildlife Office

(916) 414-6600
(916) 414-6713

Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

San Francisco Bay-Delta Fish And Wildlife

(916) 930-5603
(916) 930-5654

650 Capitol Mall
Suite 8-300
Sacramento, CA 95814

http://kim_squires@fws.gov

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse Reithrodontomys raviventris No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/613	Endangered

Birds

NAME	STATUS
California Clapper Rail Rallus longirostris obsoletus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern Sterna antillarum browni No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
Marbled Murrelet Brachyramphus marmoratus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/4467	Threatened
Western Snowy Plover Charadrius nivosus nivosus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8035	Threatened

Reptiles

NAME	STATUS
Alameda Whipsnake (=striped Racer) Masticophis lateralis euryxanthus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/5524	Threatened
Green Sea Turtle Chelonia mydas No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6199	Threatened
San Francisco Garter Snake Thamnophis sirtalis tetrataenia No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5956	Endangered

Amphibians

NAME	STATUS
California Red-legged Frog Rana draytonii There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander Ambystoma californiense There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt Hypomesus transpacificus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/321	Threatened

Insects

NAME	STATUS
Bay Checkerspot Butterfly Euphydryas editha bayensis There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2320	Threatened
Mission Blue Butterfly Icaricia icarioides missionensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/6928	Endangered
Myrtle's Silverspot Butterfly Speyeria zerene myrtleae No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6929	Endangered
San Bruno Elfin Butterfly Callophrys mossii bayensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/3394	Endangered

Crustaceans

NAME	STATUS
Vernal Pool Fairy Shrimp Branchinecta lynchi There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/498	Threatened

Flowering Plants

NAME	STATUS
Fountain Thistle Cirsium fontinale var. fontinale No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7939	Endangered
Marin Dwarf-flax Hesperolinon congestum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5363	Threatened
San Mateo Thornmint Acanthomintha obovata ssp. duttonii No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2038	Endangered
San Mateo Woolly Sunflower Eriophyllum latilobum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7791	Endangered
White-rayed Pentachaeta Pentachaeta bellidiflora No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7782	Endangered

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act

[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Allen's Hummingbird *Selasphorus sasin* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15
Black Oystercatcher *Haematopus bachmani* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9591	Breeds Apr 15 to Oct 31
Black Scoter *Melanitta nigra* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Black Skimmer *Rynchops niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15
Black Turnstone *Arenaria melanocephala* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Bonaparte's Gull *Chroicocephalus philadelphia* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere

Brown Pelican Pelecanus occidentalis — Breeds Jan 15 to Sep 30
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/6034

Burrowing Owl Athene cunicularia — Breeds Mar 15 to Aug 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9737

Clark's Grebe Aechmophorus clarkii — Breeds Jan 1 to Dec 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Common Loon gavia immer — Breeds Apr 15 to Oct 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/4464

Common Murre Uria aalge — Breeds Apr 15 to Aug 15
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Common Tern Sterna hirundo — Breeds May 10 to Sep 10
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/4963

Common Yellowthroat Geothlypis trichas sinuosa — Breeds May 20 to Jul 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/2084

Double-crested Cormorant phalacrocorax auritus — Breeds Apr 20 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/3478

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Gull-billed Tern Gelochelidon nilotica — Breeds May 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9501

Herring Gull Larus argentatus — Breeds Apr 20 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Least Tern Sterna antillarum — Breeds Apr 20 to Sep 10
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Long-billed Curlew Numenius americanus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5511

Long-tailed Duck Clangula hyemalis — Breeds elsewhere
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/7238

Marbled Godwit Limosa fedoa — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9481

Nuttall's Woodpecker Picoides nuttallii — Breeds Apr 1 to Jul 20
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9410

Oak Titmouse Baeolophus inornatus — Breeds Mar 15 to Jul 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9656

Parasitic Jaeger Stercorarius parasiticus — Breeds elsewhere
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Red Phalarope Phalaropus fulicarius — Breeds elsewhere
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Red-breasted Merganser Mergus serrator — Breeds elsewhere
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Red-necked Phalarope Phalaropus lobatus — Breeds elsewhere
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Red-throated Loon Gavia stellata — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Ring-billed Gull Larus delawarensis — Breeds elsewhere
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Rufous Hummingbird selasphorus rufus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8002

Short-billed Dowitcher Limnodromus griseus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9480

Song Sparrow Melospiza melodia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Feb 20 to Sep 5
Spotted Towhee Pipilo maculatus clementae This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/4243	Breeds Apr 15 to Jul 20
Surf Scoter Melanitta perspicillata This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Tricolored Blackbird Agelaius tricolor This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3910	Breeds Mar 15 to Aug 10
Whimbrel Numenius phaeopus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9483	Breeds elsewhere
White-winged Scoter Melanitta fusca This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wrentit Chamaea fasciata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 10

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

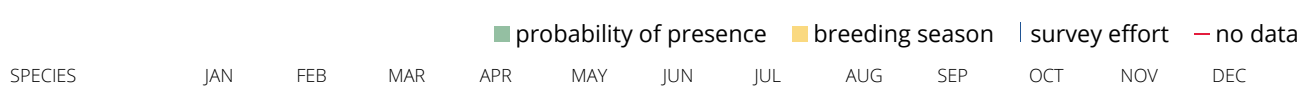
Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

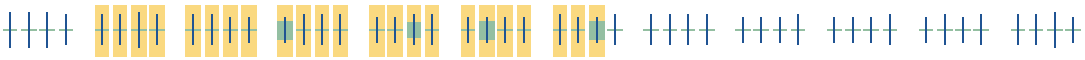
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

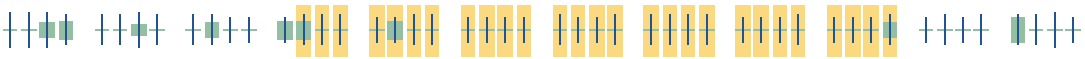
Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Allen's Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

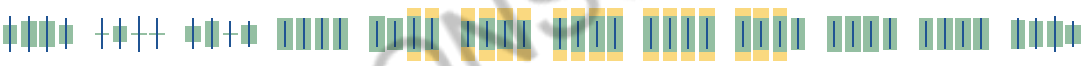


Black Oystercatcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Black Scoter
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Black Skimmer
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

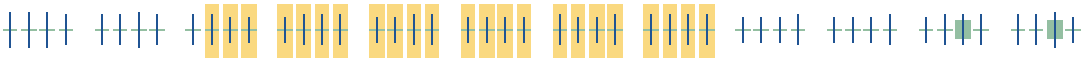


Black Turnstone
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

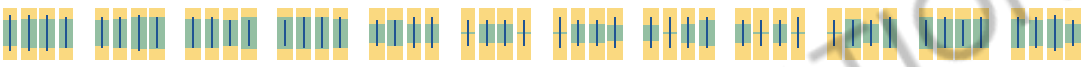
Bonaparte's Gull
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Brown Pelican
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

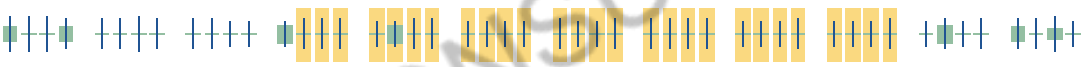
Burrowing Owl
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



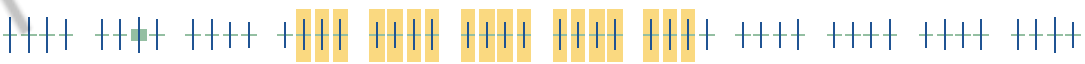
Clark's Grebe
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



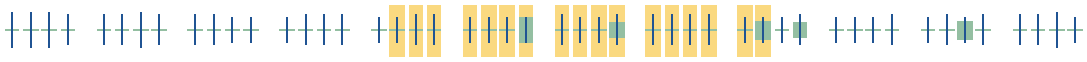
Common Loon
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



Common Murre
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



Common Tern
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



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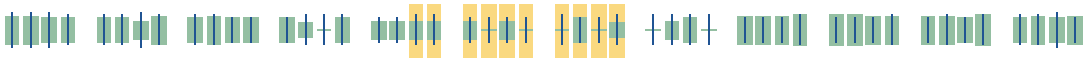
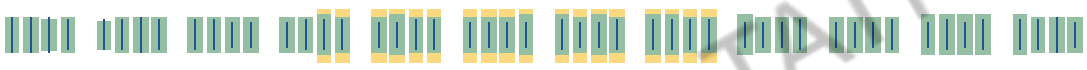
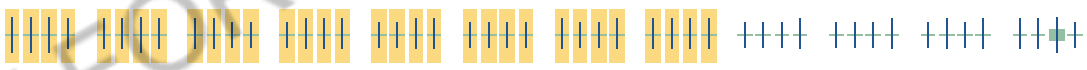
Common Yellowthroat
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



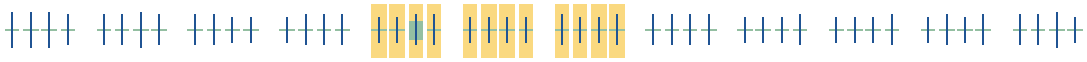
Double-crested Cormorant
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



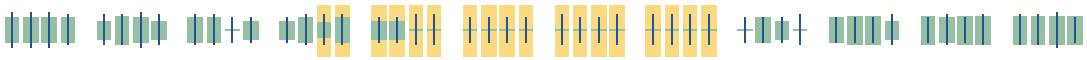
Golden Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



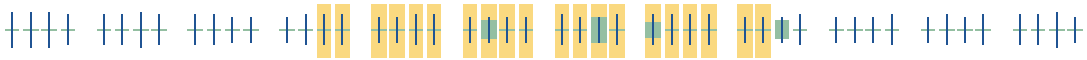
Gull-billed Tern
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Herring Gull
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



Least Tern
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

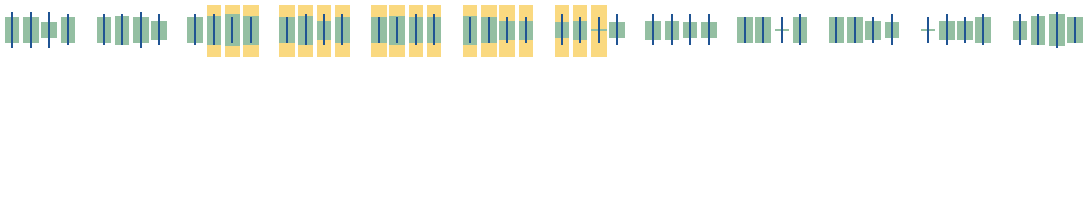


Long-billed Curlew
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Long-tailed Duck
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Marbled Godwit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Nuttall's Woodpecker
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



Oak Titmouse
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Parasitic Jaeger
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

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Red Phalarope
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Red-breasted Merganser
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Red-necked Phalarope
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Red-throated Loon
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

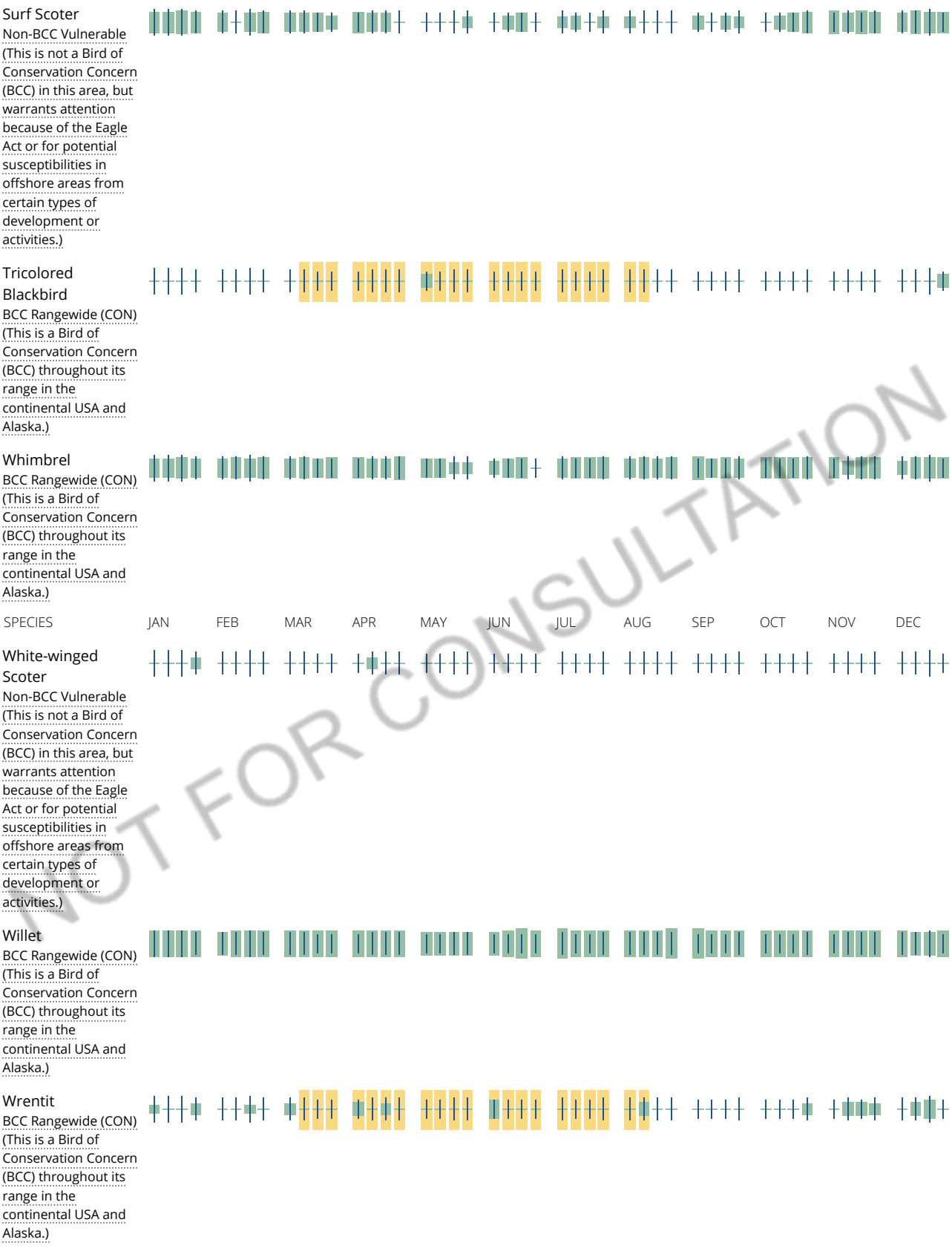
Ring-billed Gull
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Rufous Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Short-billed Dowitcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Song Sparrow
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Spotted Towhee
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

This location overlaps the following National Wildlife Refuge lands:

LAND	ACRES
Don Edwards San Francisco Bay National Wildlife Refuge	24,718.59 acres

(510) 792-0222
(510) 792-5828

1 Marshlands Road
Fremont, CA 94555

https://www.fws.gov/refuges/profiles/index.cfm?id=81648

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

ESTUARINE AND MARINE DEEPWATER
- E1UBL

ESTUARINE AND MARINE WETLAND
- E2USN
- E2USMh
- E2EM1N
- E2USM
- E2SBN
- E2EM1P

FRESHWATER EMERGENT WETLAND
- PEM1Ah
- PEM1Ch

FRESHWATER POND
- PUBHh3

PUSCh
PUBHh
PUBKx1

LAKE
L2UBHh3

RIVERINE
R3UBHx

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

APPENDIX C.5

IPaC Information for Planning and Consultation **U.S. Fish & Wildlife Service**

IPaC resource list

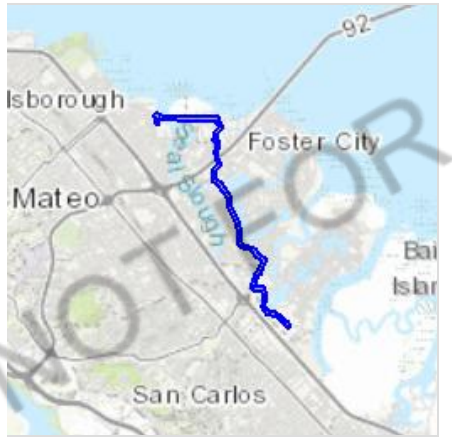
OPTION B

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

San Mateo County, California



Local offices

Sacramento Fish And Wildlife Office

(916) 414-6600
(916) 414-6713

Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

San Francisco Bay-Delta Fish And Wildlife

(916) 930-5603
(916) 930-5654

650 Capitol Mall
Suite 8-300
Sacramento, CA 95814

http://kim_squires@fws.gov

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse Reithrodontomys raviventris No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/613	Endangered

Birds

NAME	STATUS
California Clapper Rail Rallus longirostris obsoletus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern Sterna antillarum browni No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
Marbled Murrelet Brachyramphus marmoratus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/4467	Threatened
Western Snowy Plover Charadrius nivosus nivosus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8035	Threatened

Reptiles

NAME	STATUS
Green Sea Turtle Chelonia mydas No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6199	Threatened
San Francisco Garter Snake Thamnophis sirtalis tetrataenia No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5956	Endangered

Amphibians

NAME	STATUS
California Red-legged Frog Rana draytonii There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2891	Threatened

Fishes

NAME	STATUS
Delta Smelt Hypomesus transpacificus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/321	Threatened

Insects

NAME	STATUS
Bay Checkerspot Butterfly Euphydryas editha bayensis There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2320	Threatened
Mission Blue Butterfly Icaricia icarioides missionensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/6928	Endangered
Myrtle's Silverspot Butterfly Speyeria zerene myrtleae No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6929	Endangered
San Bruno Elfin Butterfly Callophrys mossii bayensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/3394	Endangered

Flowering Plants

NAME	STATUS
Fountain Thistle Cirsium fontinale var. fontinale No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7939	Endangered
Marin Dwarf-flax Hesperolinon congestum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5363	Threatened
San Mateo Thornmint Acanthomintha obovata ssp. duttonii No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2038	Endangered

San Mateo Woolly Sunflower Eriophyllum latilobum — Endangered
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7791

White-rayed Pentachaeta Pentachaeta bellidiflora — Endangered
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7782

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are

available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Allen's Hummingbird Selasphorus sasin This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15
Black Oystercatcher Haematopus bachmani This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9591	Breeds Apr 15 to Oct 31
Black Skimmer Rynchops niger This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15
Black Turnstone Arenaria melanocephala This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Burrowing Owl Athene cunicularia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9737	Breeds Mar 15 to Aug 31

Clark's Grebe Aechmophorus clarkii — Breeds Jan 1 to Dec 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Common Yellowthroat Geothlypis trichas sinuosa — Breeds May 20 to Jul 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/2084

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Gull-billed Tern Gelochelidon nilotica — Breeds May 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9501

Long-billed Curlew Numenius americanus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5511

Marbled Godwit Limosa fedoa — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9481

Nuttall's Woodpecker Picoides nuttallii — Breeds Apr 1 to Jul 20
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9410

Oak Titmouse Baeolophus inornatus — Breeds Mar 15 to Jul 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9656

Red-throated Loon Gavia stellata — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Rufous Hummingbird selasphorus rufus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8002	Breeds elsewhere
Short-billed Dowitcher Limnodromus griseus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Song Sparrow Melospiza melodia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Feb 20 to Sep 5
Spotted Towhee Pipilo maculatus clementae This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/4243	Breeds Apr 15 to Jul 20
Tricolored Blackbird Agelaius tricolor This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3910	Breeds Mar 15 to Aug 10
Whimbrel Numenius phaeopus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9483	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wrentit Chamaea fasciata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 10

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

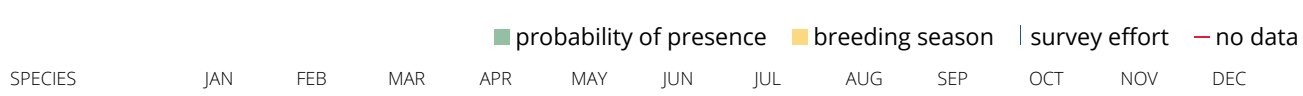
Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

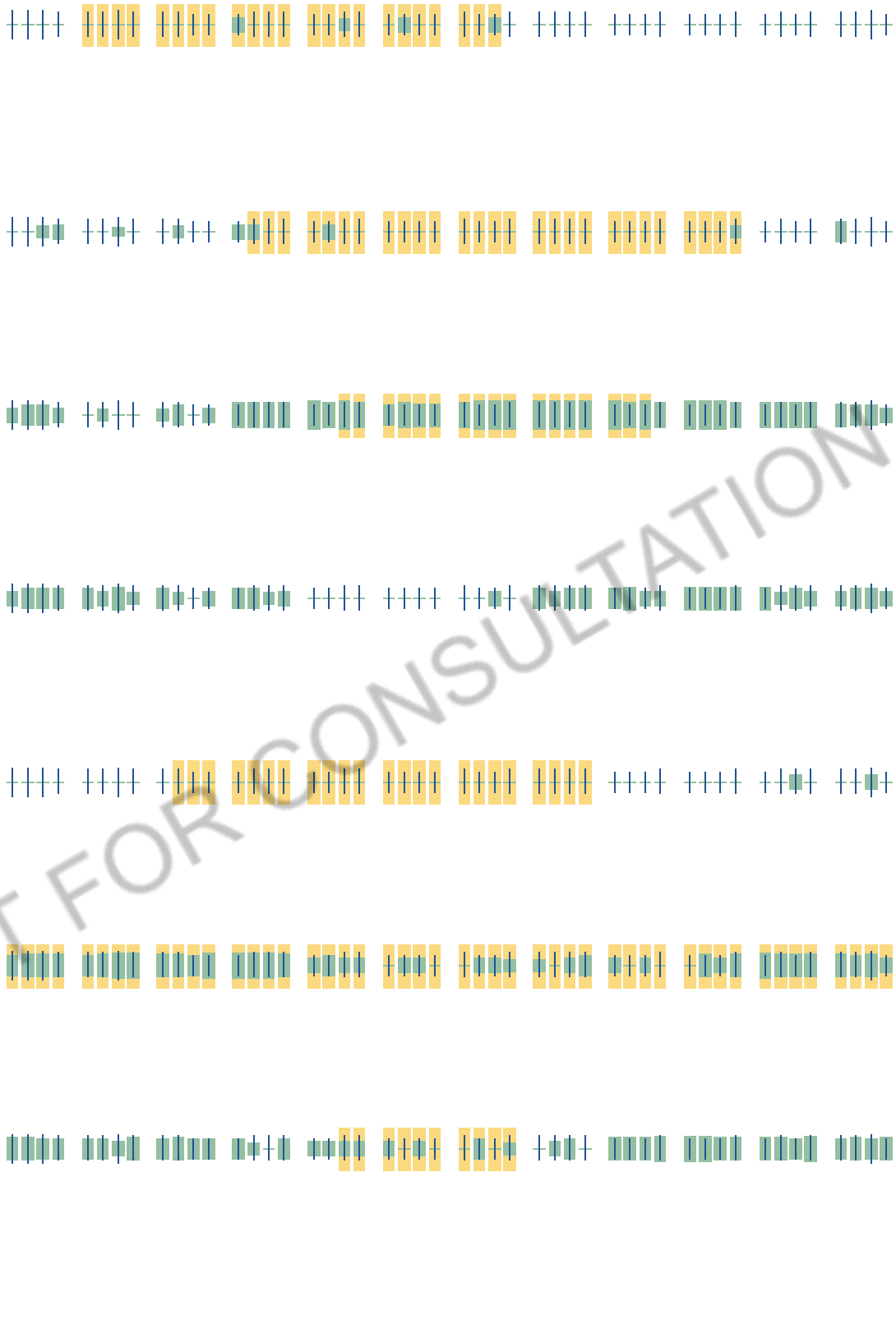
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Allen's Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Black Oystercatcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

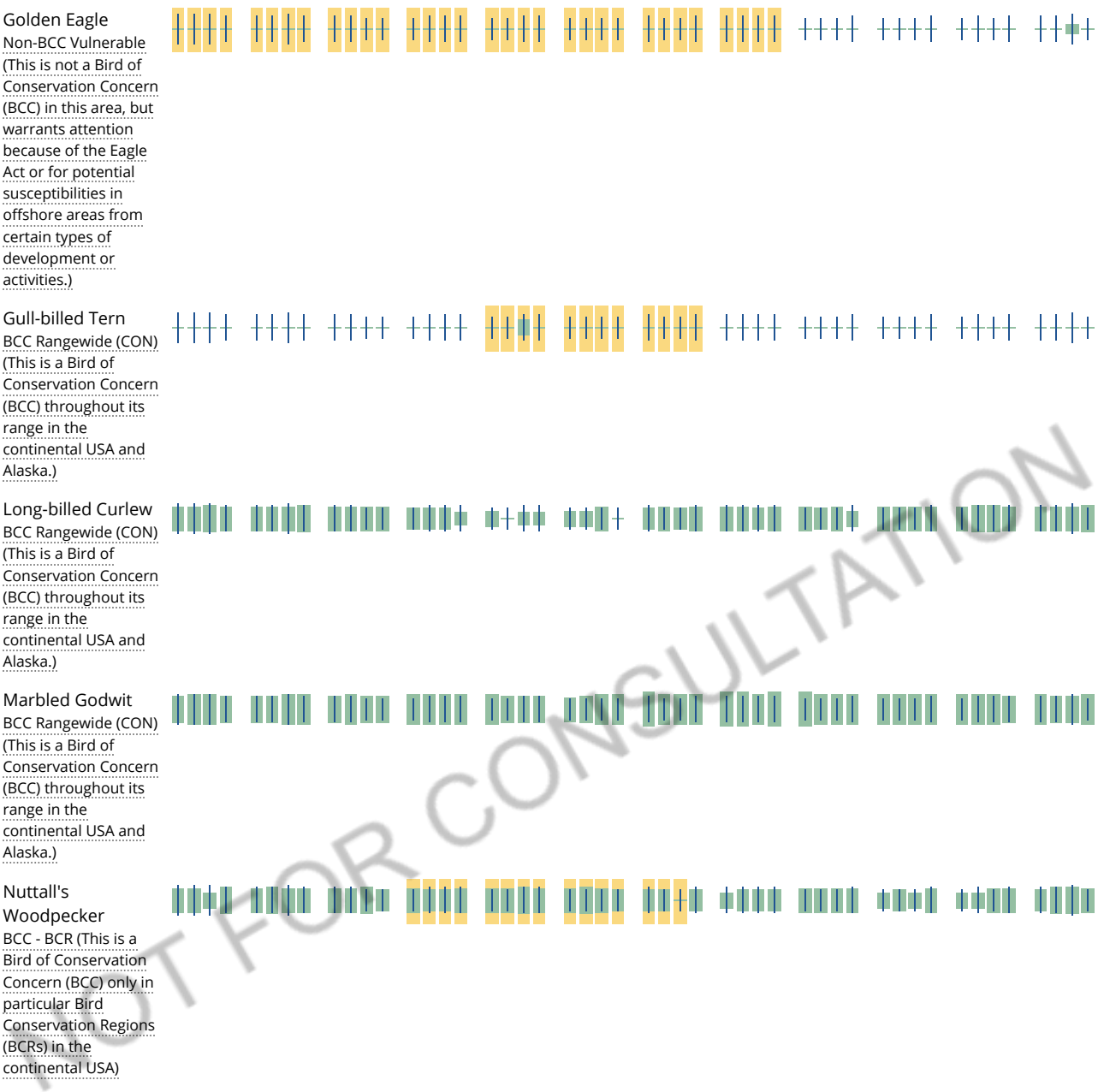
Black Skimmer
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Black Turnstone
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Burrowing Owl
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Clark's Grebe
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Common Yellowthroat
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

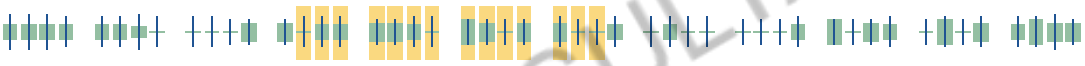


Rufous Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

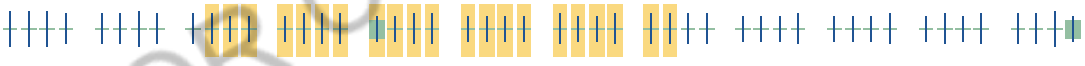
Short-billed Dowitcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Song Sparrow
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Spotted Towhee
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



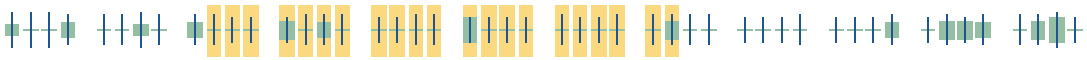
Tricolored Blackbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Whimbrel
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Willet
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Wrentit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC use to generate the migratory birds potentially occurring in my specified location”. Please be aware this report provides the “probability of presence” of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the “no data” indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ “Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds” at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

ESTUARINE AND MARINE DEEPWATER
- E1UBL

ESTUARINE AND MARINE WETLAND
- E2USN
- E2USMh
- E2EM1N
- E2SBN
- E2SBNx
- E2USM

FRESHWATER EMERGENT WETLAND
- PEM1Ch

FRESHWATER POND
- PUBHx
- PUBHh

PUSCh
PUSCx

LAKE
L2UBHh3

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

APPENDIX C.6

IPaC Information for Planning and Consultation **U.S. Fish & Wildlife Service**

IPaC resource list

Highway 101 Location

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

San Mateo County, California

Local office

Sacramento Fish And Wildlife Office

(916) 414-6600
(916) 414-6713

Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse Reithrodontomys raviventris No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/613	Endangered

Birds

NAME	STATUS
California Clapper Rail Rallus longirostris obsoletus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern Sterna antillarum browni No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
Marbled Murrelet Brachyramphus marmoratus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/4467	Threatened
Western Snowy Plover Charadrius nivosus nivosus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8035	Threatened

Reptiles

NAME	STATUS
Green Sea Turtle Chelonia mydas No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6199	Threatened
San Francisco Garter Snake Thamnophis sirtalis tetrataenia No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5956	Endangered

Amphibians

NAME	STATUS
California Red-legged Frog Rana draytonii There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2891	Threatened

Fishes

NAME	STATUS
Delta Smelt Hypomesus transpacificus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/321	Threatened

Insects

NAME	STATUS
Bay Checkerspot Butterfly Euphydryas editha bayensis There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2320	Threatened
Mission Blue Butterfly Icaricia icarioides missionensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/6928	Endangered
Myrtle's Silverspot Butterfly Speyeria zerene myrtleae No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6929	Endangered
San Bruno Elfin Butterfly Callophrys mossii bayensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/3394	Endangered

Flowering Plants

NAME	STATUS
Fountain Thistle Cirsium fontinale var. fontinale No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7939	Endangered
Marin Dwarf-flax Hesperolinon congestum No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5363	Threatened
San Mateo Thornmint Acanthomintha obovata ssp. duttonii No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2038	Endangered

San Mateo Woolly Sunflower Eriophyllum latilobum Endangered
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7791

White-rayed Pentachaeta Pentachaeta bellidiflora Endangered
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7782

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are

available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Allen's Hummingbird Selasphorus sasin This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15
Black Oystercatcher Haematopus bachmani This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9591	Breeds Apr 15 to Oct 31
Black Skimmer Rynchops niger This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15
Black Turnstone Arenaria melanocephala This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Burrowing Owl Athene cunicularia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9737	Breeds Mar 15 to Aug 31

Clark's Grebe Aechmophorus clarkii — Breeds Jan 1 to Dec 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Common Yellowthroat Geothlypis trichas sinuosa — Breeds May 20 to Jul 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/2084

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Gull-billed Tern Gelochelidon nilotica — Breeds May 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9501

Long-billed Curlew Numenius americanus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5511

Marbled Godwit Limosa fedoa — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9481

Nuttall's Woodpecker Picoides nuttallii — Breeds Apr 1 to Jul 20
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9410

Oak Titmouse Baeolophus inornatus — Breeds Mar 15 to Jul 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9656

Rufous Hummingbird selasphorus rufus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8002

Short-billed Dowitcher Limnodromus griseus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Song Sparrow Melospiza melodia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Feb 20 to Sep 5
Spotted Towhee Pipilo maculatus clementae This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/4243	Breeds Apr 15 to Jul 20
Tricolored Blackbird Agelaius tricolor This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3910	Breeds Mar 15 to Aug 10
Whimbrel Numenius phaeopus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9483	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wrentit Chamaea fasciata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 10

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

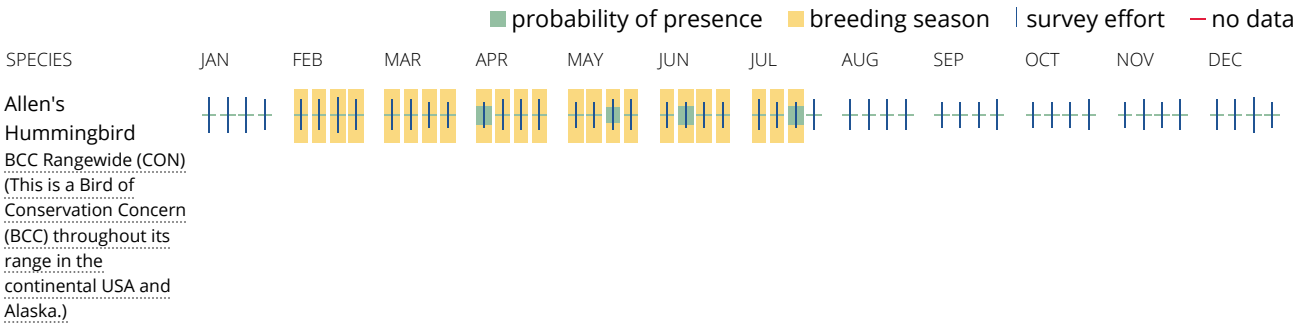
Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

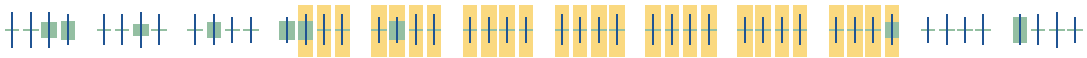
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

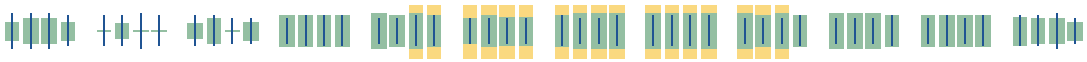
Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Black Oystercatcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



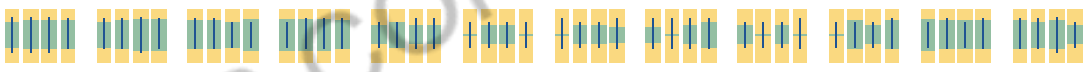
Black Skimmer
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Black Turnstone
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

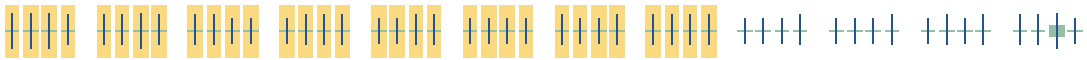
Burrowing Owl
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

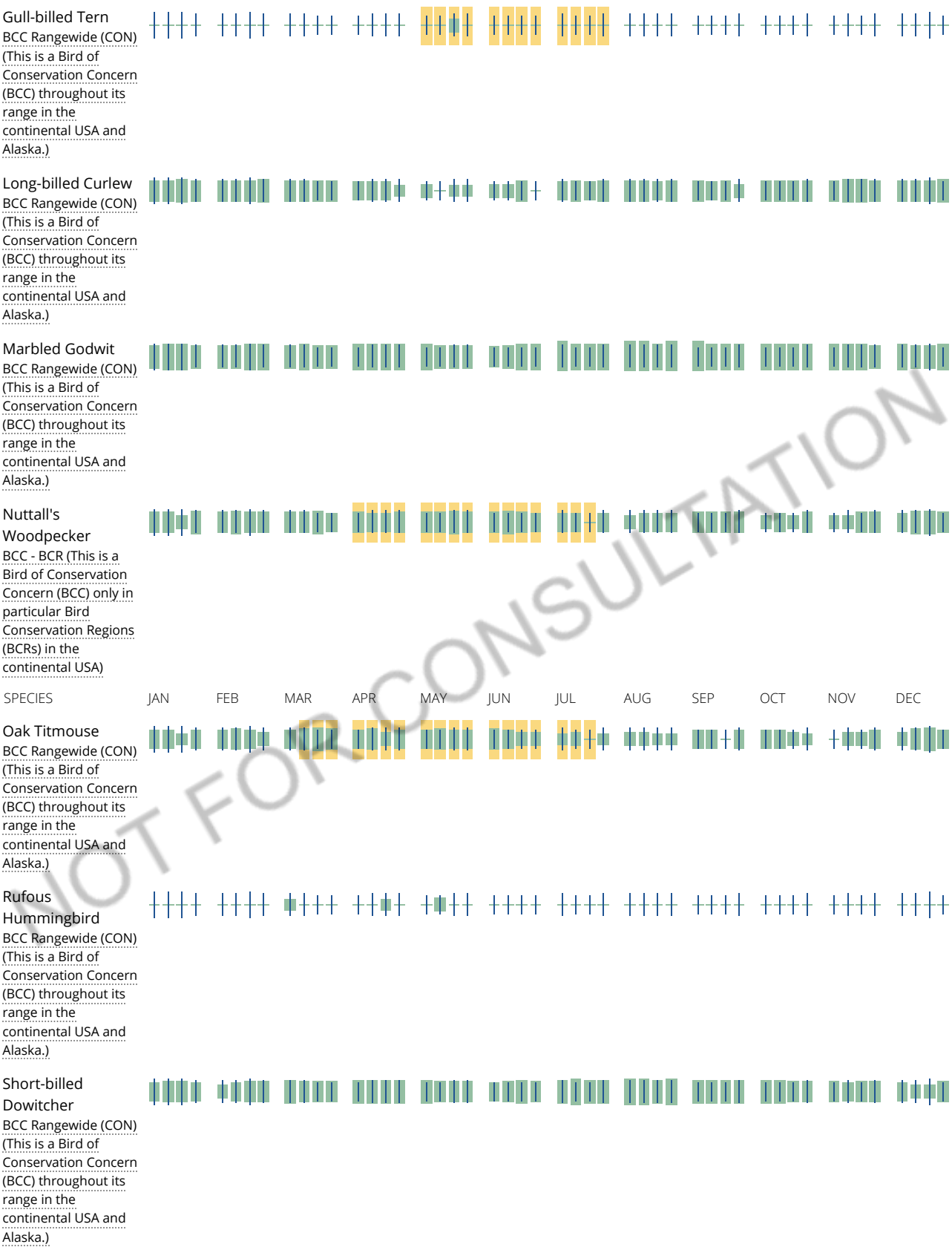
Clark's Grebe
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

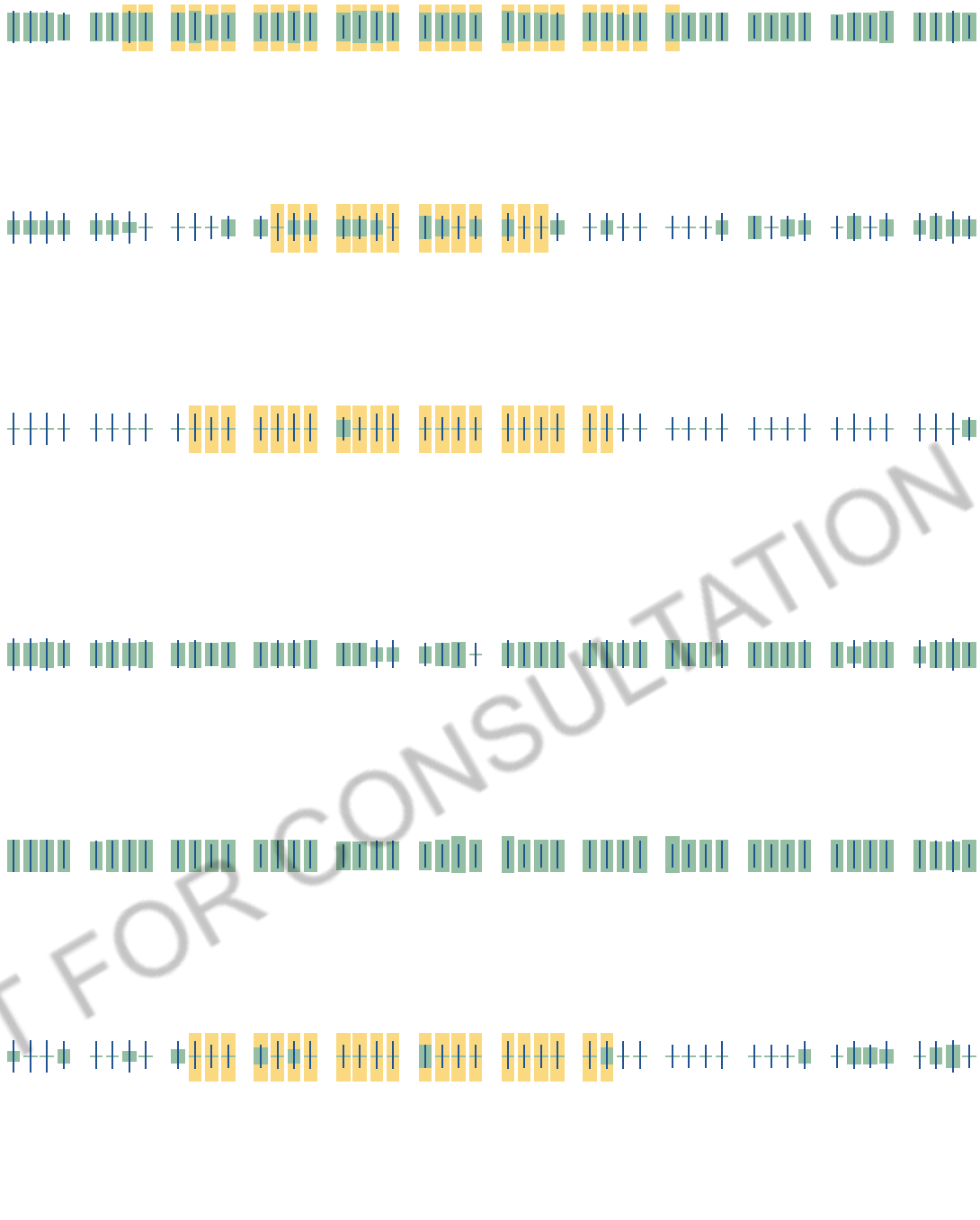


Common Yellowthroat
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Golden Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)







Song Sparrow
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Spotted Towhee
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Tricolored Blackbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Whimbrel
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Willet
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Wrentit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that

may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review.

Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

PEM1Ch

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

APPENDIX C.7

IPaC Information for Planning and Consultation **U.S. Fish & Wildlife Service**

SVCW Location

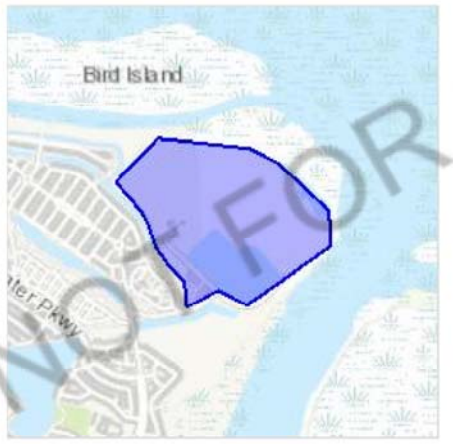
IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

San Mateo County, California



Local offices

Sacramento Fish And Wildlife Office

(916) 414-6600
(916) 414-6713

Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

San Francisco Bay-Delta Fish And Wildlife

(916) 930-5603
(916) 930-5654

650 Capitol Mall
Suite 8-300
Sacramento, CA 95814

http://kim_squires@fws.gov

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse Reithrodontomys raviventris No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/613	Endangered

Birds

NAME	STATUS
California Clapper Rail Rallus longirostris obsoletus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern Sterna antillarum browni No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
Western Snowy Plover Charadrius nivosus nivosus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8035	Threatened

Reptiles

NAME	STATUS
Alameda Whipsnake (=striped Racer) Masticophis lateralis euryxanthus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/5524	Threatened
Green Sea Turtle Chelonia mydas No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6199	Threatened
San Francisco Garter Snake Thamnophis sirtalis tetrataenia No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5956	Endangered

Amphibians

NAME	STATUS
California Red-legged Frog Rana draytonii There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander Ambystoma californiense There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt Hypomesus transpacificus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/321	Threatened

Insects

NAME	STATUS
San Bruno Elfin Butterfly Callophrys mossii bayensis There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/3394	Endangered

Crustaceans

NAME	STATUS
Vernal Pool Fairy Shrimp Branchinecta lynchi There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/498	Threatened

Flowering Plants

NAME	STATUS
San Mateo Thornmint Acanthomintha obovata ssp. duttonii No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2038	Endangered

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act [1] and the Bald and Golden Eagle Protection Act [2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY

	BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Allen's Hummingbird Selasphorus sasin This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15
Black Oystercatcher Haematopus bachmani This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9591	Breeds Apr 15 to Oct 31
Black Skimmer Rynchops niger This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15
Black Turnstone Arenaria melanocephala This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Burrowing Owl Athene cunicularia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9737	Breeds Mar 15 to Aug 31
Clark's Grebe Aechmophorus clarkii This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jan 1 to Dec 31
Common Yellowthroat Geothlypis trichas sinuosa This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/2084	Breeds May 20 to Jul 31

Golden Eagle *Aquila chrysaetos* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31
Gull-billed Tern *Gelochelidon nilotica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9501	Breeds May 1 to Jul 31
Long-billed Curlew *Numenius americanus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5511	Breeds elsewhere
Marbled Godwit *Limosa fedoa* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9481	Breeds elsewhere
Nuttall's Woodpecker *Picoides nuttallii* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9410	Breeds Apr 1 to Jul 20
Oak Titmouse *Baeolophus inornatus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9656	Breeds Mar 15 to Jul 15
Red-throated Loon *Gavia stellata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Rufous Hummingbird *selasphorus rufus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8002	Breeds elsewhere
Short-billed Dowitcher *Limnodromus griseus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere

Song Sparrow Melospiza melodia This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Feb 20 to Sep 5
Spotted Towhee Pipilo maculatus clementae This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/4243	Breeds Apr 15 to Jul 20
Tricolored Blackbird Agelaius tricolor This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA *and Alaska*. https://ecos.fws.gov/ecp/species/3910	Breeds Mar 15 to Aug 10
Whimbrel Numenius phaeopus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9483	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wrentit Chamaea fasciata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 10

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

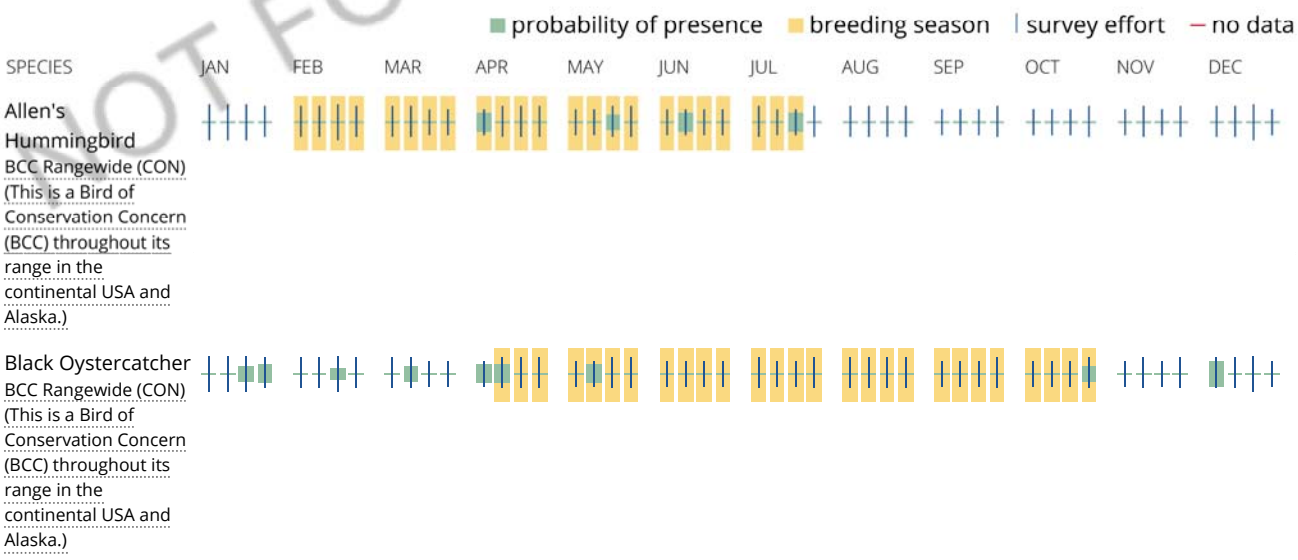
Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Black Skimmer
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

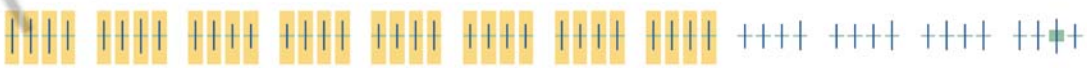
Black Turnstone
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Burrowing Owl
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

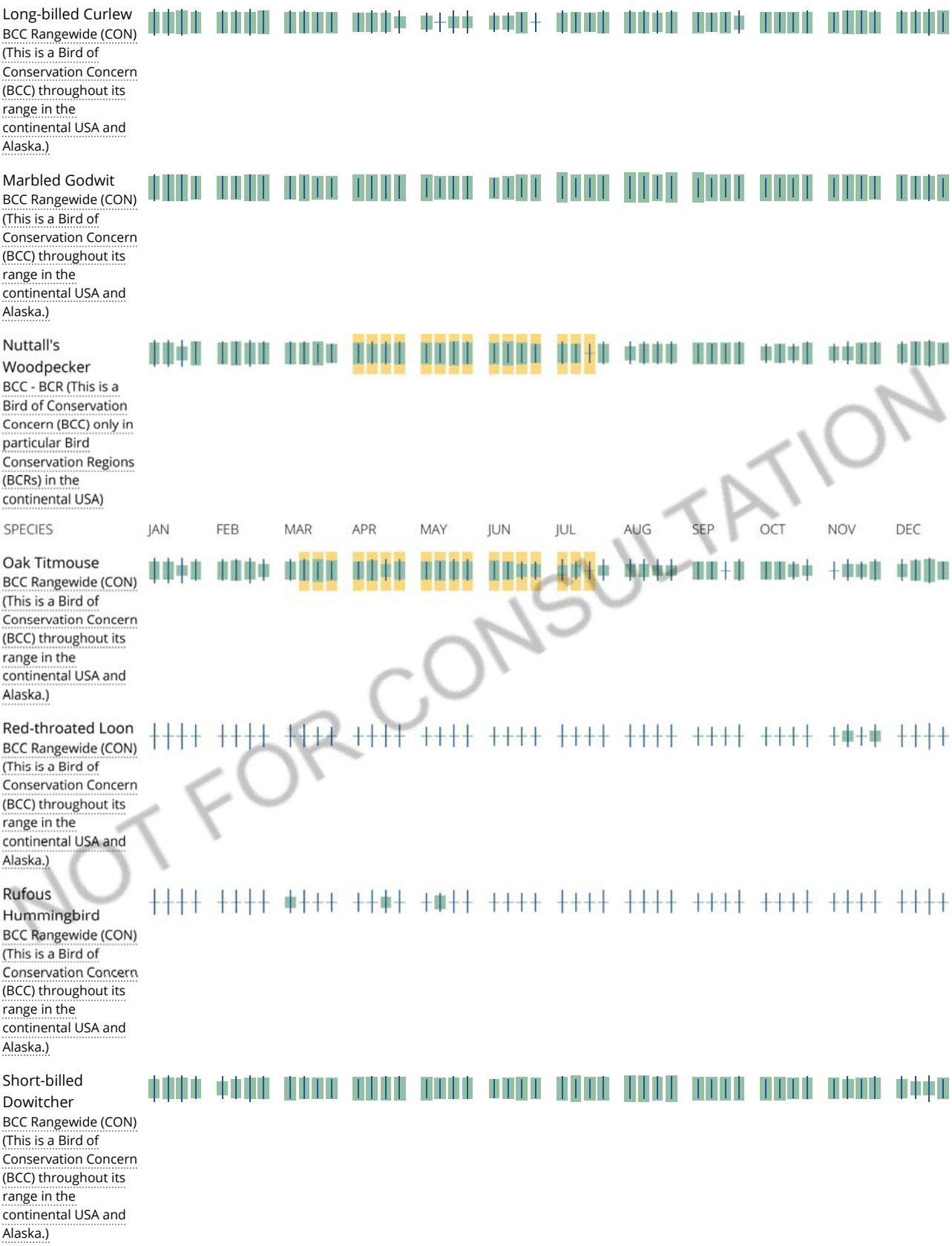
Clark's Grebe
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

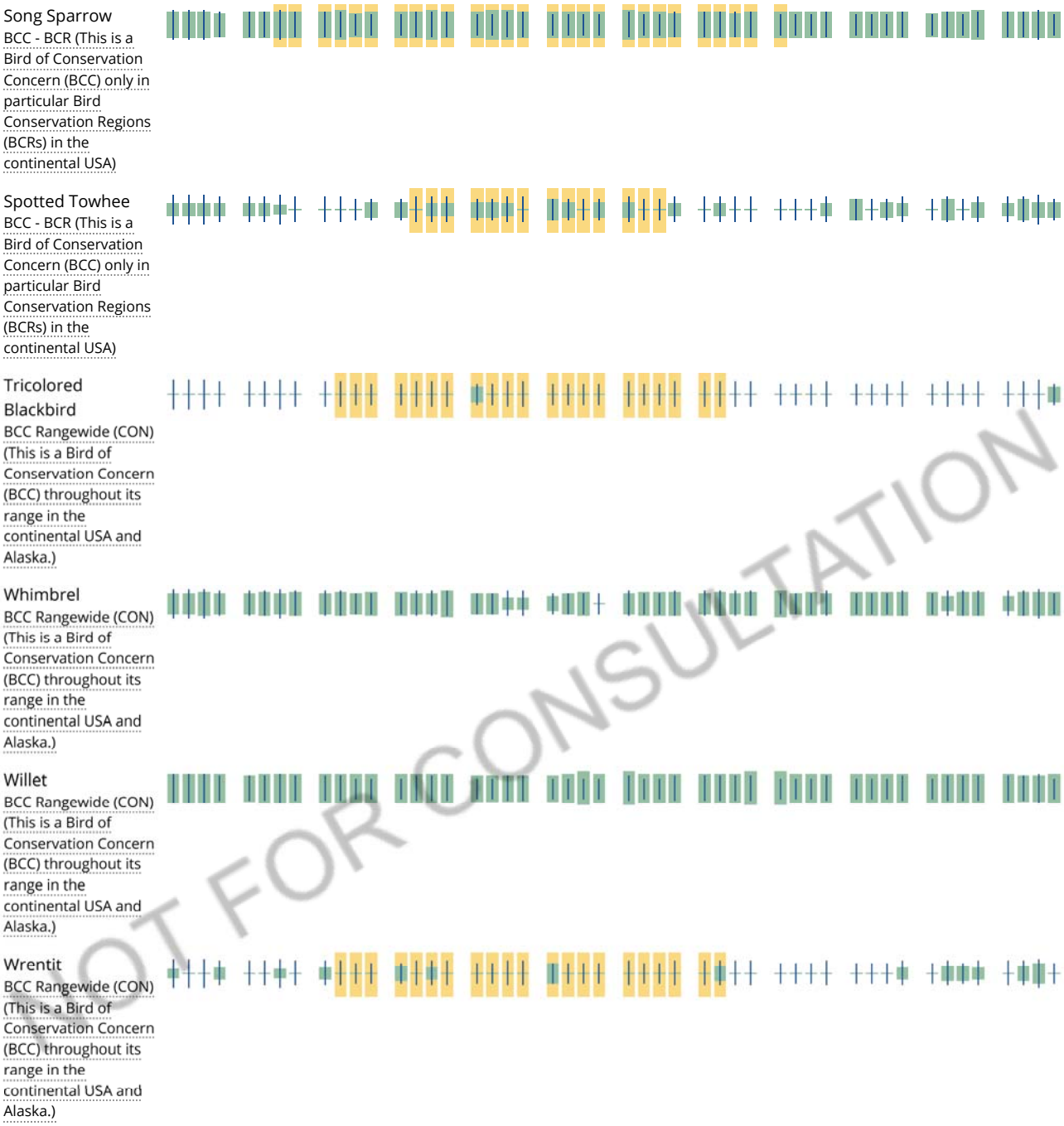
Common Yellowthroat
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Golden Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



Gull-billed Tern
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)





Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that

may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review.

Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of *Your Migratory Bird Report*

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

ESTUARINE AND MARINE WETLAND

- E2EM1N
- E2SBNx

FRESHWATER EMERGENT WETLAND

- PEM1Ah

FRESHWATER POND

- PUBKx
- PUBKx1
- PUBK1

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Appendix D: Engineers Opinion of Probable Costs

This appendix includes a summary of the cost approach and detailed cost sheets for each sub-alternative.

D.1 Capital Cost Assumptions

The following assumptions are applied to estimate facility costs:

- **Distribution Pipelines:** unit costs used for pipeline costs are listed in the table below. Cost numbers are based on recently bid projects and professional experience.

Construction Type	Unit	$/Unit	Location
Open Trench			
Regular	per inch-dia LF	$ 12-18	Unpaved roads, SFPUC ROW
Busy Areas	per inch-dia LF	$ 18-19	Heavy traffic and commercial areas
Environmental-Sensitive Areas	per inch-dia LF	$ 25	Along the bay
Micro-tunneling (<1000ft Segment, 36ft deep pit)			
Micro-tunneling	per inch-dia LF	$ 30	Under major intersections, highways, railroads
Jacking Pit (35ft deep)	EA	$ 150,000	
Receiving Pit (35ft deep)	EA	$ 100,000	
Modified Micro-tunneling (>1000ft Segment, 60ft deep pit)			
Micro-tunneling	per LF	$ 700-800	Belmont slough crossing at the end of Foster City Blvd.
Jacking Pit (60ft deep)	EA	$ 2,000,000	
Receiving Pit (60ft deep)	EA	$ 2,000,000	
Modified Micro-tunneling (>1000ft Segment, 100ft deep pit)			
Micro-tunneling	per LF	$ 700-800	Belmont slough crossing at the end of Baffin St.
Jacking Pit (100ft deep)	EA	$ 2,000,000	
Receiving Pit (100ft deep)	EA	$ 2,000,000	
Slip-lining			
Slip-lining	per inch-dia LF	$ 10	Inside existing SVCW pipelines to Shoreway Rd and to Woodside Rd
Access Pits	EA	$ 150,000	
Receiving Pits	EA	$ 60,000	
Pipe Suspension			
Slip-lining	per LF	$ 300	East 3rd St. Bridge

- **Pump Stations:** Pumping costs were estimated based on brake horsepower requirements, assuming different redundancy factors for different alternatives, pumps and motor control centers located outside and variable speed pumps. A unit cost of $5,000 per horsepower required is applied multiplied times redundancy factors for standby mumps, enclosure, drive factor, wet-well and empirical coefficients based on pump station design experience. Land acquisition costs for pump stations are not included in the cost estimate.
- **Operational Storage:** The unit cost for new storage tanks (concrete and steel) is based on cost curves from RS Means, recently constructed projects in California and from professional experience (range from $0.60 to $1.00 per gallon).
- **AWPF:** Cost estimates for tertiary, MF, RO, UV-AOP and chlorination facilities are provided based on recent project, planning studies and professional experience. Additional unit costs include post treatment and chemical handling, enclosed buildings, and off-site additional costs (e.g., as new access roads, security, lighting, admin building, ancillary facilities, landscaping, etc.). Loaded estimates of AWPF costs are within the range of similar facilities being designed or recently constructed by other California water agencies (between $8/gal to $16/gal depending on capacity and other factors).
- **Nutrient Removal:** There are a variety of established technologies and new innovative strategies that could be implemented to reduce nutrients prior to reuse, with a wide range of costs. An assumed unit cost of $3.5 gpd was applied based on cost ranges for nitrification ($1.1-$1.3/gpd) and denitrification ($1.0-$3.7/gpd). Additional studies would be needed to identify a preferred alternative (Nit/Denit filters, MBBR, DHI Energy AB technology or others) that would meet the potable reuse requirements, which would need to be further explored with the Regional Board /SBDDW as well as with SVCW to provide a nexus with their long-term nutrient management objectives. Cost benefits from an integrated water management approach could provide large cost and energy savings to the community are worth investigating.

The following allowances, contingencies and non-contract cost percentages are applied to the **Subtotal Facility Costs:**

- **Additional Facility Capital Costs:** The following percentages are applied to subtotal of treatment, pump station, storage, discharge facility and well costs: site development costs at 5%, yard piping at 5% and Electrical, Instrumentation and Controls (I&C), and Remote (low-tech) Control at 15%.
- **Taxes:** 8.75% is applied to materials (estimated at 40% of the total facility cost).

The following allowances, contingencies and non-contract cost percentages are applied to the **Facility Direct Costs**:

- **Allowance for Unlisted Items:** A markup of 5% for mobilization, bonds and permits, 10% for engineering and design, 15% for construction management, 15% for owner's administration, 5% for environmental/permitting, 15% for Contractor Overhead and Profit are applied to the facility direct costs.
- **Estimate Contingency:** A markup of 40% of the facility direct costs was added to pay contractors for overruns on quantities, changed site conditions, change orders, etc. Contingencies are considered as funds to be used after construction starts and not for design changes or changes in project planning.

The resulting **Subtotal with Contractor Markups and Contingency** is increased by 3% per year to reflect escalation to midpoint of construction based on project implementation timeline assumptions (start and end date of 2026 and 2029 respectively)

The **Project Capital Cost** includes all facility costs, allowances, markups, contingencies and the escalation to the midpoint of construction. Costs are provided in January 2019 dollars using the Engineering News-Record Construction Cost Index (ENRCCI) for San Francisco.

D.2 O&M Cost Assumptions

Operations and maintenance (O&M) costs are estimated to include the following items:

- **Energy Cost:** The cost for power varies diurnally and seasonally, thus energy costs are estimated to be $0.20/kWh for continuous treatment and pumping. A factor of 10% is applied to all energy costs.
- **Labor Costs:** Treatment-related labor is based on full time salary with benefits of $175,000 per year. Labor for other work such as work related to pipelines, pump stations and customer service is based on a full-time salary with benefits of $125,000 per year.
- **Chemical Costs:** for advanced treatment processes is estimated at approximately $100 per acre foot of purified water produced for pre-treatment to minimize fouling and post-treatment to stabilize the RO permeate and meet regulatory requirements. Chemicals may include, but not be limited to sodium hypochrlorite, sodium bisulfite, citric acid, caustic soda, sulfuric acid, scale inhibitors, lime, carbon dioxide, chlorine, etc). Dechloramination chemical costs are based on current unit costs and doses at the Pulgas Dechloramination Facility, provided by SFPUC (May 2019), which are estimated to be approximately $50/MG.
- **Maintenance Costs:** A unit cost of $170/AF is included to account for replacement and repair of AWPF facility membranes, UV lights and other AWPF process equipment. General maintenance costs for other items are estimated at 1.5% of capital costs (not including the AWPF)**.**
- **Contingency**: A contingency of 10% of the subtotal of O&M costs is also included.

D.3 Engineers Opinion of Probable Costs

This appendix includes detailed cost sheets for the sub-alternatives indicated with a "*":

Alternative	Source Water (Tertiary)	AWPF Location	Tertiary Alignment	RO Concentrate Alignment	Purified Alignment	Sub Alternative
Alt 1: 6-mgd RWA at CSR	SVCW (~6mgd)	Near SVCW	Short Alignment	Short Alignment	Option 1	1a.1*
					Option 2	1a.2*
					Option 3	1a.3*
		Hwy 101 Site	Repurpose SVCW Pipeline	Repurpose SVCW Pipeline	Option 1	1b.1*
					Option 2	1b.2
					Option 3	1b.3
Alt 2: 12-mgd RWA at CSR	SVCW + San Mateo (~12mgd)	Near SVCW	Option A + Short Alignment	Short Alignment	Option 1	2a.1*
					Option 2	2a.2
					Option 3	2a.3
			Option B + Redwood Shores Open Trench		Option 1	2b.1*
					Option 2	2b.2
					Option 3	2b.3
		Hwy 101 Site	Option B + Repurpose RWC Pipeline	Repurpose SVCW Pipeline	Option 1	2c.1*
					Option 2	2c.2
					Option 3	2c.3

Overall Cost Summary: by facility component

Treatment Cost Sheets:

A1 - Treatment + Storage + Discharge Facility - 6 MGD
A2 - Treatment + Storage + Discharge Facility - 12 MGD

Conveyance Cost Sheets:

1a.1 - Option 1 (via Woodside Rd) - AWPF near SVCW - Short Alignment
1a.2 - Option 2 (via San Carlos Rd) - AWPF near SVCW - Short Alignment
1a.3 - Option 3 (via Edgewood Rd) - AWPF near SVCW - Short Alignment
1b.1 - Option 1 (via Woodside Rd) - AWPF Near HW 101 - Repurpose SVCW Pipeline
2a.1 - Option 1 (via Woodside Rd) - AWPF near SVCW - Option A (via Beach Park) + Short Alignment
2b.1 - Option 1 (via Woodside Rd) - AWPF near SVCW - Option B (via Edgewood Blvd) + Redwood Shores Open Trench
2c.1 - Option 1 (via Woodside Rd) - AWPF Near HW 101 - Option B (via Edgewood Blvd) + Repurpose SVCW Pipeline

Engineers Opinion of Probable Cost
A1 - Treatment + Storage + Discharge Facility - 6 MGD

Kennedy Jenks

Study:	Potable Reuse Exploratory Plan (PREP) Decision Tool Phase 2	**Prepared By:**	RX	**Average Annual Influent Flow:**	7.84 mgd
Project:	SWA at Crystal Springs Reservoir	**Date Prepared:**	Jan-2019	**Average Annual Product Flow:**	6.00 mgd
AWPF Location:	AWPF at HW 101 Site/near SVCW	**K/J Proj. No.**	1668011.02	**RW Delivered:**	6720 Average Annual Reuse (AFY)
Repurpose:	RWC Tanks	**ENR**	12,115 *(2019 SF)*	**Design Capacity:**	4,167 Max Day Demand (gpm)
Estimate:	Conceptual Level Cost-Analysis				

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Costs Total Capital Cost	Est Facility Life	Annualized Capital Cost	Notes/Source
Facility Capital Costs - Part 1								
1.0	**Treatment**				**67,721,275**			
1.1	Microfiltration	7.8	MGD	$ 1,200,000	9,411,765	**20**	**632,618**	
1.2	Reverse Osmosis	7.1	MGD	$ 1,800,000	12,705,882	**20**	**854,035**	
1.3	Advanced Oxidation Process (includes UV)	6.0	MGD	$ 300,000	1,800,000	**20**	**120,988**	
1.4	Post Treatment and Chem Handling	6.0	MGD	$ 600,000	3,600,000	**50**	**139,916**	
1.5	Building	6.0	MGD	$ 1,250,000	7,500,000	**50**	**291,491**	5,000 SF/mgd 250 $/SF
1.6	Land Cost		SF	not incl				Cost of land NOT included in this analysis
1.7	Off-Site Additional Costs			15%	5,252,647			Account for new access roads, security, lighting, admin building, ancillary facilities, landscaping, etc (apply to above treatment facility costs)
1.8	Nutirent Removal	7,843,137	GPD	$ 3.50	27,450,980			Assume cost for nitrification and denitrification Cost ranges: nitrification = $1.1-$1.3/gpd; denitrification = $1.0-$3.7/gpd
1.9	Pulgas Dechlorimation Facility Upgrades			not incl				Assume the existing treatment capacity of Pulgas dechlorination facility would be sufficient
2.0	**Storage Tank**				**1,060,000**	**50**	**41,197**	**Assume equalization needed for influent and product water**
2.1	Steel Storage Tanks for EQ Tank (prior to AWPF)		MG	not incl				*Per Justin E. - additional storage in RWC tanks at SVCW could be repuproposed for equalization*
	Alternately convert RWC for use as EQ tank	1	LS	$ 200,000	200,000			*Placeholder cost provided for new connection from RWC tank to AWPF*
2.2	Steel Storage Tanks for Product Water Tank	1	MG	$ 860,000	860,000			
3.0	**Connection to Pulgas Facilities**				**1,000,000**	**50**	**38,865**	
3.1	Discharge Facility Upgrades			not incl				**Assume current discharge channel capacity of 250 mgd is sufficient** – no capital upgrades needed to support additional flow
3.2	Connection to Pulgas Facilities	1	LS	1,000,000	1,000,000			**Based on project experience for connection/turnout btw major transmission pipelines** (Assume connection to transmission or a turnout - exact location to be determined in future study)
	Subtotal				**$69,781,275**		**$2,119,111**	
Facility Capital Costs - Part 2								
4.0	Site Development Costs	@	5%		3,489,064		105,956	% of Subtotal facility costs (Includes grading, erosion control, cut/fill, etc.)
5.0	Yard Piping	@	5%		3,489,064		105,956	% of Subtotal facility costs (not inluding pipelines)
6.0	Electrical, I&C, and Remote (high-tech) Control	@	15%		10,467,191		317,867	% of Subtotal facility costs (not inluding pipelines)
	Subtotal Additional Facility Costs				**$17,445,319**		**$529,778**	
			Facility Direct Costs		**$87,226,593**		**$2,648,889**	
Markups and Contingency								
	Taxes	@	8.75%		2,442,345		74,169	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		4,361,330		132,444	% of Facility Direct Costs
	Engineering and Design	@	10%		8,722,659		264,889	% of Facility Direct Costs
	Special Studies	@	0%		0		0	Not included (note that this may be a significant future cost for the program)
	Construction Management	@	15%		13,083,989		397,333	% of Facility Direct Costs
	Owner's Administration	@	15%		13,083,989		397,333	% of Facility Direct Costs
	Environmental/Permitting	@	5%		4,361,330		132,444	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		13,083,989		397,333	% of Facility Direct Costs
	Estimate Contingency	@	40%		34,890,637		1,059,556	% of Facility Direct Costs
Subtotal with Markups and Contingency					**$181,256,861**		**$5,504,392**	
	Escalation to Midpoint of Construction	@	29%		51,772,618		1,572,226	assume 3% percent over 9 construction start = 2026 end = 2029
			Project Capital Cost Total		**$233,029,479**		**$7,076,618**	
					Annualualized Capital Costs ($/AF)		**$1,053**	project life = 50 interest rate = 3%
					Annualualized Capital Costs ($/gal)		**$0.003**	

Annual Operations and Maintenance Costs

Item No.	Description	Qty	Units	Total Annual Costs $/Unit	Total Annual Costs Total	Notes/Source
1.0	**Energy Costs**					
1.1	Energy - Treatment	6,033,655	KWh	$ 0.20	1,206,731	Treatment Operation = 24 hours per day 8760 hours operated per year 2755 KWH/MG
1.2	Energy - Other		KWh	10%	120,673	
2.0	**Chemicals**	6,720	AF	$ 100.50	675,360	
3.0	**Labor Costs**					
3.1	Labor - AWPF	8.0	staff	$ 175,000	1,400,000	full time staff at $175,000 average salary + benefits per year
4.0	**Nutirent Removal O&M**	2,863	MG	$ 1,605	4,594,706	Assume O&M cost for nitrification and denitrification Daily O&M cost ranges: nitrification = $990-$1730/MG; denitrification = $140-$350/MG
5.0	**Pulgas Dechloramination O&M (chemicals only)**					Assume chemical costs similar to current use (unit costs and loads provided by SFPUC 5.10.2019)
5.1	Carbon dioxide	2,190	MG	$ 2	4,380	Carbon dioxide - $0.0544/LB dosed at 38 lbs/MG
5.2	Sodium Hypochlorite	2,190	MG	$ 15	32,850	Sodium Hypochlorite - $0.5480/LB dosed at 3.2 mg/L
5.3	Sodium Bisulfite	2,190	MG	$ 30	65,700	Sodium Bisulfite – $802.06/dry ton dosed at 9 mg/L
6.0	**Discharge Facility O&M**			not incl		Assume no additional discharge facility O&M costs
7.0	**Maintenance:** Other					
7.1	AWPF Equipment (Replacement/Repair)	6,720	AF	$ 170	1,142,400	Estimated for MF/RO/UV-AOP equipment and pumps
7.2	Other Equipment (Replacement/Repair)	@	1.5%		2,479,623	% of capital cost not including AWPF
8.0	**Contingency**	@	10.0%		1,172,242	% of above O&M costs
			Annual O&M Costs ($/year)		**$12,894,665**	
			Annual Unit O&M Costs ($/AF)		**$1,900**	

Engineers Opinion of Probable Cost
A2 - Treatment + Storage + Discharge Facility - 12 MGD

Kennedy Jenks

Study:	Potable Reuse Exploratory Plan (PREP) Decision Tool Phase 2	**Prepared By:**	RX	**Average Annual Influent Flow:**	15.69 mgd
Project:	SWA at Crystal Springs Reservoir	**Date Prepared:**	Jan-2019	**Average Annual Product Flow:**	12.00 mgd
AWPF Location:	AWPF at HW 101 Site/near SVCW	**K/J Proj. No.**	1668011.02	**RW Delivered:**	13440 Average Annual Reuse (AFY)
Repurpose:	RWC Tanks	**ENR**	12,115 *(2019 SF)*	**Design Capacity:**	8,333 Max Day Demand (gpm)
Estimate:	Conceptual Level Cost-Analysis				

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Est Facility Life	Annualized Capital Cost	Notes/Source
Treatment Capital Costs								
1.0	**Treatment**				**119,648,088**			
1.1	Microfiltration	15.7	MGD	$ 1,000,000	15,686,275	**20**	**1,054,364**	
1.2	Reverse Osmosis	14.1	MGD	$ 1,400,000	19,764,706	**20**	**1,328,499**	
1.3	Advanced Oxidation Process (includes UV)	12.0	MGD	$ 300,000	3,600,000	**20**	**241,977**	
1.4	Post Treatment and Chem Handling	12.0	MGD	$ 500,000	6,000,000	**50**	**233,193**	
1.5	Building	12.0	MGD	$ 937,500	11,250,000	**50**	**437,237**	3,750 SF/mgd
								250 $/SF
1.6	Land Cost		SF	not incl				Cost of land NOT included in this analysis
1.7	Off-Site Additional Costs			15%	8,445,147			Account for new access roads, security, lighting, admin building, ancillary facilities, landscaping, etc (apply to above treatment facility costs)
1.8	Nutirent Removal	15,686,275	GPD	$ 3.50	54,901,961			Assume cost for nitrification and denitrification
								Cost ranges: nitrification = $1.1-$1.3/gpd; denitrification = $1.0-$3.7/gpd
1.9	Pulgas Dechlorimation Facility Upgrades			not incl				Assume the existing treatment capacity of Pulgas dechlorination facility would be sufficient
2.0	**Storage Tank**				**1,612,654**	**50**	**62,677**	**Assume equalization needed for influent and product water**
2.1	Steel Storage Tanks for EQ Tank (prior to AWPF)		MG	not incl				*Per Justin E. - additional storage in RWC tanks at SVCW could be repupropsed for equalization*
	Alternately convert RWC for use as EQ tank	1	LS	$ 200,000	200,000			*Placeholder cost provided for new connection from RWC tank to AWPF*
2.2	Steel Storage Tanks for Product Water Tank	2	MG	$ 706,327	1,412,654			
3.0	**Connection to Pulgas Facilities**				**1,300,000**	**50**	**50,525**	
3.1	Discharge Facility Upgrades			not incl				**Assume current discharge channel capacity of 250 mgd is sufficient**
								-- no capital upgrades needed to support additional flow
3.2	Connection to Pulgas Facilities	1	LS	1,300,000	1,300,000			**Based on project experience for connection/turnout btw major transmission pipelines**
								(Assume connection to transmission or a turnout - exact location to be determined in future study)
	Subtotal				**$122,560,743**		**$3,408,471**	
Additional Facility Capital Costs								
4.0	Site Development Costs	@	5%		6,128,037		170,424	% of Subtotal facility costs (Includes grading, erosion control, cut/fill, etc.)
5.0	Yard Piping	@	5%		6,128,037		170,424	% of Subtotal facility costs (not inluding pipelines)
6.0	Electrical, I&C, and Remote (high-tech) Control	@	15%		18,384,111		511,271	% of Subtotal facility costs (not inluding pipelines)
	Subtotal Additional Facility Costs				**$30,640,186**		**$852,118**	
	Facility Direct Costs				**$153,200,928**		**$4,260,589**	
	Taxes	@	8.75%		4,289,626		119,296	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		7,660,046		213,029	% of Facility Direct Costs
	Engineering and Design	@	10%		15,320,093		426,059	% of Facility Direct Costs
	Special Studies	@	0%		0		0	Not included (note that this may be a significant future cost for the program)
	Construction Management	@	15%		22,980,139		639,088	% of Facility Direct Costs
	Owner's Administration	@	15%		22,980,139		639,088	% of Facility Direct Costs
	Environmental/Permitting	@	5%		7,660,046		213,029	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		22,980,139		639,088	% of Facility Direct Costs
	Estimate Contingency	@	40%		61,280,371		1,704,235	% of Facility Direct Costs
Subtotal with Markups and Contingency					**$318,351,529**		**$8,853,503**	
	Escalation to Midpoint of Construction	@	29%		90,931,135		2,528,837	assume 3% percent over 9
								construction start = 2026 end = 2029
	Project Capital Cost Total				**$409,282,664**		**$11,382,340**	
	Annualualized Capital Costs ($/AF)						**$847**	project life = 50 interest rate = 3%
	Annualualized Capital Costs ($/gal)						**$0.003**	

Annual Operations and Maintenance Costs

Item No.	Description	Qty	Units	Total Annual Costs $/Unit	Total	Notes/Source
1.0	**Energy Costs**					
1.1	Energy - Treatment	12,067,310	KWh	$ 0.20	2,413,462	Treatment Operation = 24 hours per day
						8760 hours operated per year
						2755 KWH/MG
1.2	Energy - Other		KWh	10%	241,346	
2.0	**Chemicals**	13,440	AF	$ 101	1,350,720	
3.0	**Labor Costs**					
3.1	Labor - AWPF	11.0	staff	$ 175,000	1,925,000	full time staff at $175,000 average salary + benefits per year
4.0	**Nutirent Removal O&M**	5,725	MG	$ 1,605	9,189,412	Assume O&M cost for nitrification and denitrification
						Daily O&M cost ranges: nitrification = $990-$1730/MG; denitrification = $140-$350/MG
5.0	**Pulgas Dechloramination O&M**			not incl		Assume chemical costs similar to current use (unit costs and loads provided by SFPUC 5.10.2019)
5.1	Carbon dioxide	4,380	MG	$ 2.00	8,760	Carbon dioxide - $0.0544/LB dosed at 38 lbs/MG
5.2	Sodium Hypochlorite	4,380	MG	$ 15.00	65,700	Sodium Hypochlorite - $0.5480/LB dosed at 3.2 mg/L
5.3	Sodium Bisulfite	4,380	MG	$ 30.00	131,400	Sodium Bisulfite -- $802.06/dry ton dosed at 9 mg/L
6.0	**Discharge Facility O&M**			not incl		Assume no additional discharge facility O&M costs
7.0	**Maintenance:**					
7.1	AWPF Equipment (Replacement/Repair)	13,440	AF	$ 170	2,284,800	Estimated for MF/RO/UV-AOP equipment and pumps
7.2	Other (Replacement/Repair)	@	1.5%		4,344,519	% of capital cost not including AWPF
8.0	**Contingency**	@	10.0%		2,195,512	% of above O&M costs
	Annual O&M Costs ($/year)				**$24,150,630**	
	Annual Unit O&M Costs ($/AF)				**$1,800**	

Engineers Opinion of Probable Cost
1a.1 - Option 1 (via Woodside Rd) - AWPF near SVCW - Short Alignment

Kennedy Jenks

Study:	Potable Reuse Exploratory Plan (PREP) Decision Tool Phase 2	**Prepared By:**	RX	**Average Annual Influent Flow:**	7.84 mgd
Project:	SWA at Crystal Springs Reservoir - Pipeline & Pump Station Cost	**Date Prepared:**	Apr-2019	**Average Annual Product Flow:**	6.00 mgd
AWPF Location:	AWPF near SVCW	**K/J Proj. No.**	1668011.02	**Brine Flow:**	1.84 mgd
Repurpose:	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	**ENR**	12,115 (Jan. 2019 SF)	**RW Delivered:**	6720 Average Annual Reuse (AFY)
Estimate:	Conceptual Level Cost-Analysis			**Design Capacity:**	4,167 Max Day Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Costs Total Capital Cost	Est Facility Life	Annualized Capital Cost	Notes/Source
Facility Capital Costs								
Facility Capital Costs - Part 1								
1.0	**Pipeline**				**$ 31,319,000**	**75**	**$ 1,054,447**	
1.1	**AWPF near SVCW to SVCW Outfall (Brine - open trench)**							
	Open Cut Pipeline	2,800	LF	$ 150	$ 420,000			10 in-diameter $150 /LF
1.2	**SVCW RWC RQ Tank to AWPF near SVCW (Tertiary - open trench)**							
	Open Cut Pipeline	3,200	LF	$ 300	$ 960,000			20 in-diameter $300 /LF
1.3	**AWPF near SVCW to Hwy101 (Purified - repurpose - slip lining)**							
	Slip Lining	15,400	LF	$ 180	$ 2,772,000			18 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	11	EA	$ 150,000	$ 1,650,000			$150,000 /EA
	Slip Lining Receiving Pit	11	EA	$ 60,000	$ 660,000			$60,000 /EA
1.4	**Repurpose Alignment No.3 to Whipple Road (Purified - repurpose - slip lining)**							
	Slip Lining	12,600	LF	$ 180	$ 2,268,000			18 in-diameter $10 per inch-dia-LF
	Slip Lining Access Pit	8	EA	$ 150,000	$ 1,200,000			$150,000 /EA
	Slip Lining Receiving Pit	8	EA	$ 60,000	$ 480,000			$60,000 /EA
1.5	**Hwy101 to CSR (Purified - open trench)**							
	Open Cut Pipeline - SFPUC ROW	17,000	LF	$ 270	$ 4,590,000			18 in-diameter $270 /LF
	Open Cut pipeline - along bay	12,200	LF	$ 450	$ 5,490,000			52,500 LF of pipeline $25 per inch-dia-LF
	Open Cut pipeline - Remaning	23,300	LF	$ 330	$ 7,689,000			$330 /LF
								Assume regular unit cost for trenching along SFPUC ROW, higher unit cost in remaining
								sections (busy areas) higher unit cost for special shoring along the bay
1.6	**AWPF near SVCW to CSR (Purified - trenchless - Hwy)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	2,000	LF	$ 540	$ 1,080,000			18 in-diameter $30 per inch-dia-LF
	Microtunnelling Jacking Pit (15 ft deep)	2	EA	$ 150,000	$ 300,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	2	EA	$ 100,000	$ 200,000			$100,000 /EA
1.7	**AWPF near SVCW to CSR (Purified - trenchless - Major Intersection)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	1,500	LF	$ 540	$ 810,000			18 in-diameter $30 per inch-dia-LF
	Microtunnelling Jacking Pit (15 ft deep)	3	EA	$ 150,000	$ 450,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	3	EA	$ 100,000	$ 300,000			$100,000 /EA
2.0	**Pump Station**				**$ 6,150,000**	**50**	**$ 239,023**	
2.1	AWPF near SVCW to SVCW (Brine)	1	LS	$ 320,000	$ 320,000			1,280 total flow (gpm) 49 ft (TDH)
2.2	SVCW to AWPF near SVCW (Tertiary)	1	LS	$ 360,000	$ 360,000			5,447 total flow (gpm) 28 ft (TDH)
2.3	AWPF near SVCW to CSR (Purified)	1	LS	$ 5,470,000	$ 5,470,000			4,167 total flow (gpm) 1258 ft (TDH)
	Subtotal Facility Costs - Part 1				**$ 37,469,000**		**$ 1,293,470**	
Facility Capital Costs - Part 2								
3.0	Site Development Costs	@	5%		$ 1,873,450		$ 64,673	% of Subtotal facility costs - Part 1
								(Includes grading, erosion control, cut/fill, etc.)
4.0	Yard Piping	@	5%		$ 307,500		$ 11,951	% of Subtotal facility costs (not inluding pipelines) - Part 1
5.0	Electrical, I&C, and Remote (high-tech) Control	@	15%		$ 922,500		$ 35,853	% of Subtotal facility costs (not inluding pipelines) - Part 1
	Subtotal Facility Costs - Part 2				**$ 3,103,450**		**$ 112,478**	
				Facility Direct Costs	**$ 40,572,450**		**$ 1,405,948**	
Markups and Contingency								
	Taxes	@	8.75%		$ 1,311,415		$ 45,271	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		$ 2,028,623		$ 70,297	% of Facility Direct Costs
	Engineering and Design	@	10%		$ 4,057,245		$ 140,595	% of Facility Direct Costs
	Special Studies	@	0%		$ -		$ -	Not included (note that this may be a significant future cost for the program)
	Construction Management	@	15%		$ 6,085,868		$ 210,892	% of Facility Direct Costs
	Owner's Administration	@	15%		$ 6,085,868		$ 210,892	% of Facility Direct Costs
	Environmental/Permitting	@	5%		$ 2,028,623		$ 70,297	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		$ 6,085,868		$ 210,892	% of Facility Direct Costs
	Estimate Contingency	@	40%		$ 16,228,980		$ 562,379	% of Facility Direct Costs
				Subtotal with Markups and Contingency	**$ 84,484,938**		**$ 2,927,464**	
	Escalation to Midpoint of Construction	@	29%		$ 24,131,536		$ 836,175	% of Subtotal with Markups and Contingency
								assume 3% percent over 9
								construction start = 2026 end = 2029
								project life = 50 interest rate = 3%
				Project Capital Cost Total	**$ 108,616,473**		**$ 3,763,640**	
					Annualized Capital Costs ($/AFY)		**$ 560**	Total Annualized Captial Cost divided by AFY
					Annualualized Capital Costs ($/gal)		**$0.002**	

Annual Operations and Maintenance Costs

Item No.	Description	Qty	Units	Total Annual Costs $/Unit	Total		
1.0	**Energy Costs**						
						Pump Operation = 24	hours per day
						(applies to all pumping) 8760	hours operated per year
1.1	Egnergy - AWPF near SVCW to SVCW (Brine)	350,400	KWh	$ 0.20	$ 70,080	Pump Station Hp = 40	Total Motor HP Required
1.2	Energy - SVCW to AWPF near SVCW (Tertiary)	438,000	KWh	$ 0.20	$ 87,600	Pump Station Hp = 50	Total Motor HP Required
1.3	Energy - AWPF near SVCW to CSR (Purified)	16,644,000	KWh	$ 0.20	$ 3,328,800	Pump Station Hp = 1,900	Total Motor HP Required
1.4	Energy - Other		KWh	10%	$ 348,648	% of above energy cost	
3.0	**Labor Costs**						
3.1	Other Labor (pipeline, PS, wells)	2.0	staff	$ 125,000	$ 250,000	full time staff at $125,000	average salary + benefits per year
4.0	**Maintenance - General**	@	1.5%		$ 1,629,247	% of Project capital cost total	
5.0	**Contingency**	@	10.0%		$ 571,438	% of above O&M costs	
				Annual O&M Costs ($/year)	**$ 6,285,813**		
				Annual Unit O&M Costs ($/AF)	**$ 900**		
				Annual Unit O&M Costs ($/gal)	**$ 0.0029**		

Engineers Opinion of Probable Cost
1a.2 - Option 2 (via San Carlos Rd) - AWPF near SVCW - Short Alignment

Kennedy Jenks

Study:	Potable Reuse Exploratory Plan (PREP) Decision Tool Phase 2	**Prepared By:**	RX	**Average Annual Influent Flow:**	7.84 mgd
Project:	SWA at Crystal Springs Reservoir - Pipeline & Pump Station Cost	**Date Prepared:**	Jan-2019	**Average Annual Product Flow:**	6.00 mgd
AWPF Location:	AWPF near SVCW	**K/J Proj. No.**	1668011.02	**Brine Flow:**	1.84 mgd
Repurpose:	SVCW Pipeline along Redwood Shores Pkwy	**ENR**	12,115 (Jan. 2019 SF)	**RW Delivered:**	6720 Average Annual Reuse (AFY)
Estimate:	Conceptual Level Cost-Analysis			**Design Capacity:**	4,167 Max Day Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Costs Total Capital Cost	Est Facility Life	Annualized Capital Cost	Notes/Source
Facility Capital Costs								
Facility Capital Costs - Part 1								
1.0	**Pipeline**				**$ 21,070,000**	**75**	**$ 709,384**	
1.1	**AWPF near SVCW to SVCW Outfall (Brine - open trench)**							
	Open Cut Pipeline	2,800	LF	$ 150	$ 420,000			10 in-diameter $150 /LF
1.2	**SVCW RWC RQ Tank to AWPF near SVCW (Tertiary - open trench)**							
	Open Cut Pipeline	3,200	LF	$ 300	$ 960,000			20 in-diameter $300 /LF
1.3	**AWPF near SVCW to Hwy101 (Purified - repurpose - slip lining)**							
	Slip Lining	15,400	LF	$ 180	$ 2,772,000			18 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	11	EA	$ 150,000	$ 1,650,000			$150,000 /EA
	Slip Lining Receiving Pit	11	EA	$ 60,000	$ 660,000			$60,000 /EA
1.4	**Industrial Rd at Hwy101 to CSR (Purified - open trench)**							
	Open Cut Pipeline	31,600	LF	$ 330	$ 10,428,000			18 in-diameter $330 /LF
								Applied higher pipe unit costs to the entire alignment due to added utility challenges,
								steep hills, noval neighborhoods, etc.
1.5	**AWPF near SVCW to CSR (Purified - trenchless - Hwy & Train Path)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	2,000	LF	$ 540	$ 1,080,000			18 in-diameter $30 per inch-dia-LF
	Microtunnelling Jacking Pit (15 ft deep)	2	EA	$ 150,000	$ 300,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	2	EA	$ 100,000	$ 200,000			$100,000 /EA
1.6	**AWPF near SVCW to CSR (Purified - trenchless - Major Intersection)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	2,500	LF	$ 540	$ 1,350,000			18 in-diameter $30 per inch-dia-LF
	Microtunnelling Jacking Pit (15 ft deep)	5	EA	$ 150,000	$ 750,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	5	EA	$ 100,000	$ 500,000			$100,000 /EA
2.0	**Pump Station**				**$ 5,290,000**	**50**	**$ 205,598**	
2.1	AWPF near SVCW to SVCW (Brine)	1	LS	$ 320,000	$ 320,000			1,280 total flow (gpm) 49 ft (TDH)
2.2	SVCW to AWPF near SVCW (Tertiary)	1	LS	$ 360,000	$ 360,000			5,447 total flow (gpm) 28 ft (TDH)
2.3	AWPF near SVCW to CSR (Purified)	1	LS	$ 4,610,000	$ 4,610,000			4,167 total flow (gpm) 1033 ft (TDH)
	Subtotal Facility Costs - Part 1				**$ 26,360,000**		**$ 914,982**	
Facility Capital Costs - Part 2								
3.0	Site Development Costs	@	5%		$ 1,318,000		$ 45,749	% of Subtotal facility costs - Part 1
								(includes grading, erosion control, cut/fill, etc.)
4.0	Yard Piping	@	5%		$ 264,500		$ 10,280	% of Subtotal facility costs (not inluding pipelines) - Part 1
5.0	Electrical, I&C, and Remote (high-tech) Control	@	15%		$ 793,500		$ 30,840	% of Subtotal facility costs (not inluding pipelines) - Part 1
	Subtotal Facility Costs - Part 2				**$ 2,376,000**		**$ 86,869**	
	Facility Direct Costs				**$ 28,736,000**		**$ 1,001,851**	
Markups and Contingency								
	Taxes	@	8.75%		$ 922,600		$ 32,024	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		$ 1,436,800		$ 50,093	% of Facility Direct Costs
	Engineering and Design	@	10%		$ 2,873,600		$ 100,185	% of Facility Direct Costs
	Special Studies	@	0%		$ -		$ -	Not included (note that this may be a significant future cost for the program)
	Construction Management	@	15%		$ 4,310,400		$ 150,278	% of Facility Direct Costs
	Owner's Administration	@	15%		$ 4,310,400		$ 150,278	% of Facility Direct Costs
	Environmental/Permitting	@	5%		$ 1,436,800		$ 50,093	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		$ 4,310,400		$ 150,278	% of Facility Direct Costs
	Estimate Contingency	@	40%		$ 11,494,400		$ 400,741	% of Facility Direct Costs
	Subtotal with Markups and Contingency				**$ 59,831,400**		**$ 2,085,819**	
	Escalation to Midpoint of Construction	@	29%		$ 17,089,716		$ 595,775	% of Subtotal with Markups and Contingency
								assume 3% percent over 9
								construction start = 2026 end = 2029
								project life = 50 interest rate = 3%
	Project Capital Cost Total				**$ 76,921,116**		**$ 2,681,595**	
	Annualized Capital Costs ($/AFY)						**$ 399**	Total Annualized Captial Cost divided by AFY
	Annualualized Capital Costs ($/gal)						**$0.001**	

Item No.	Description	Qty	Units	Total Annual Costs $/Unit	Total Annual Costs Total	Notes/Source
Annual Operations and Maintenance Costs						
1.0	**Energy Costs**					Pump Operation = 24 hours per day
						(applies to all pumping) 8760 hours operated per year
1.1	Egnergy - AWPF near SVCW to SVCW (Brine)	350,400	KWh	$ 0.20	$ 70,080	Pump Station Hp = 40 Total Motor HP Required
1.2	Energy - SVCW to AWPF near SVCW (Tertiary)	438,000	KWh	$ 0.20	$ 87,600	Pump Station Hp = 50 Total Motor HP Required
1.3	Energy - AWPF near SVCW to CSR (Purified)	14,016,000	KWh	$ 0.20	$ 2,803,200	Pump Station Hp = 1,600 Total Motor HP Required
1.4	Energy - Other		KWh	10%	$ 296,088	% of above energy cost
2.0	**Labor Costs**					
2.1	Other Labor (pipeline, PS, wells)	2.0	staff	$ 125,000	$ 250,000	full time staff at $125,000 average salary + benefits per year
3.0	**Maintenance - General**	@	1.5%		$ 1,153,817	% of Project capital cost total
4.0	**Contingency**	@	10.0%		$ 466,078	% of above O&M costs
	Annual O&M Costs ($/year)				**$ 5,126,863**	
	Annual Unit O&M Costs ($/AF)				**$ 700**	
	Annual Unit O&M Costs ($/gal)				**$0.002**	

Engineers Opinion of Probable Cost
1a.3 - Option 3 (via Edgewood Rd) - AWPF near SVCW - Short Alignment

Kennedy Jenks

Study:	Potable Reuse Exploratory Plan (PREP) Decision Tool Phase 2	**Prepared By:**	RX	**Average Annual Influent Flow:**	7.84 mgd
Project:	SWA at Crystal Springs Reservoir - Pipeline & Pump Station Cost	**Date Prepared:**	Jan-2019	**Average Annual Product Flow:**	6.00 mgd
AWPF Location:	AWPF near SVCW	**K/J Proj. No.**	1668011.02	**Brine Flow:**	1.84 mgd
Repurpose:	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	**ENR**	12,115 (Jan. 2019 SF)	**RW Delivered:**	6720 Average Annual Reuse (AFY)
Estimate:	Conceptual Level Cost-Analysis			**Design Capacity:**	4,167 Max Day Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Costs Total Capital Cost	Est Facility Life	Annualized Capital Cost	Notes/Source
Facility Capital Costs								
Facility Capital Costs - Part 1								
1.0	**Pipeline**				**30,739,000**	**75**	**$ 1,034,920**	
1.1	**AWPF near SVCW to SVCW Outfall (Brine - open trench)**							
	Open Cut Pipeline	2,800	LF	$ 150	$ 420,000			10 in-diameter $150 /LF
1.2	**SVCW RWC RQ Tank to AWPF near SVCW (Tertiary - open trench)**							
	Open Cut Pipeline	3,200	LF	$ 300	$ 960,000			20 in-diameter $300 /LF
1.3	**AWPF near SVCW to Hwy101 (Purified - repurpose - slip lining)**							
	Slip Lining	15,400	LF	$ 180	$ 2,772,000			18 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	11	EA	$ 150,000	$ 1,650,000			$150,000 /EA
	Slip Lining Receiving Pit	11	EA	$ 60,000	$ 660,000			$60,000 /EA
1.4	**Repurpose Alignment No.3 to Whipple Road (Purified - repurpose - slip lining)**							
	Slip Lining	12,600	LF	$ 180	$ 2,268,000			18 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	8	EA	$ 150,000	$ 1,200,000			$150,000 /EA
	Slip Lining Receiving Pit	8	EA	$ 60,000	$ 480,000			$60,000 /EA
1.5	**Hwy101 to CSR (Purified - open trench)**							
	Open Cut pipeline - along bay	12,200	LF	$ 450	$ 5,490,000			44,500 LF of pipeline $25 per inch-dia-LF
	Open Cut Pipeline - remaninig	32,300	LF	$ 330	$ 10,659,000			18 in-diameter $330 /LF
								Applied higher pipe unit costs to the entire alignment due to added utility challenges,
								steep hills, noval neighborhoods, etc.
1.6	**AWPF near SVCW to CSR (Purified - trenchless - Hwy)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	2,000	LF	$ 540	$ 1,080,000			18 in-diameter $30 per inch-dia-LF
	Microtunnelling Jacking Pit (15 ft deep)	2	EA	$ 150,000	$ 300,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	2	EA	$ 100,000	$ 200,000			$100,000 /EA
1.7	**AWPF near SVCW to CSR (Purified - trenchless - Major Intersection)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	2,500	LF	$ 540	$ 1,350,000			18 in-diameter $30 per inch-dia-LF
	Microtunnelling Jacking Pit (15 ft deep)	5	EA	$ 150,000	$ 750,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	5	EA	$ 100,000	$ 500,000			$100,000 /EA
2.0	**Pump Station**				**$ 4,710,000**	**50**	**$ 183,056**	
2.1	AWPF near SVCW to SVCW (Brine)	1	LS	$ 320,000	$ 320,000			1,280 total flow (gpm) 49 ft (TDH)
2.2	SVCW to AWPF near SVCW (Tertiary)	1	LS	$ 360,000	$ 360,000			5,447 total flow (gpm) 28 ft (TDH)
2.3	AWPF near SVCW to CSR (Purified)	1	LS	$ 4,030,000	$ 4,030,000			4,167 total flow (gpm) 842 ft (TDH)
	Subtotal Facility Costs - Part 1				**$ 35,449,000**		**$ 1,217,976**	
Facility Capital Costs - Part 2								
3.0	Site Development Costs	@	5%		$ 1,772,450		$ 60,899	% of Subtotal facility costs - Part 1
								(Includes grading, erosion control, cut/fill, etc.)
4.0	Yard Piping	@	5%		$ 235,500		$ 9,153	% of Subtotal facility costs (not inluding pipelines) - Part 1
5.0	Electrical, I&C, and Remote (high-tech) Control	@	15%		$ 706,500		$ 27,458	% of Subtotal facility costs (not inluding pipelines) - Part 1
	Subtotal Facility Costs - Part 2				**$ 2,714,450**		**$ 97,510**	
				Facility Direct Costs	**$ 38,163,450**		**$ 1,315,486**	
Markups and Contingency								
	Taxes	@	8.75%		$ 1,240,715		$ 42,629	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		$ 1,908,173		$ 65,774	% of Facility Direct Costs
	Engineering and Design	@	10%		$ 3,816,345		$ 131,549	% of Facility Direct Costs
	Special Studies	@	0%		$ -		$ -	Not included (note that this may be a significant future cost for the program)
	Construction Management	@	15%		$ 5,724,518		$ 197,323	% of Facility Direct Costs
	Owner's Administration	@	15%		$ 5,724,518		$ 197,323	% of Facility Direct Costs
	Environmental/Permitting	@	5%		$ 1,908,173		$ 65,774	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		$ 5,724,518		$ 197,323	% of Facility Direct Costs
	Estimate Contingency	@	40%		$ 15,265,380		$ 526,194	% of Facility Direct Costs
				Subtotal with Markups and Contingency	**$ 79,475,788**		**$ 2,739,376**	
	Escalation to Midpoint of Construction	@	29%		$ 22,700,766		$ 782,451	% of Subtotal with Markups and Contingency
								assume 3% percent over 9
								construction start = 2026 end = 2029
								project life = 50 interest rate = 3%
				Project Capital Cost Total	**$ 102,176,554**		**$ 3,521,827**	
							Annualized Capital Costs ($/AFY)	**$ 524** Total Annualized Captial Cost divided by AFY
							Annualualized Capital Costs ($/gal)	**$0.002**

Annual Operations and Maintenance Costs

Item No.	Description	Qty	Units	Total Annual Costs $/Unit	Total Annual Costs Total			Notes/Source
1.0	**Energy Costs**							
								Pump Operation = 24 hours per day
								(applies to all pumping) 8760 hours operated per year
1.1	Egnergy - AWPF near SVCW to SVCW (Brine)	350,400	KWh	$ 0.20	$ 70,080			Pump Station Hp = 40 Total Motor HP Required
1.2	Energy - SVCW to AWPF near SVCW (Tertiary)	438,000	KWh	$ 0.20	$ 87,600			Pump Station Hp = 50 Total Motor HP Required
1.3	Energy - AWPF near SVCW to CSR (Purified)	12,264,000	KWh	$ 0.20	$ 2,452,800			Pump Station Hp = 1,400 Total Motor HP Required
1.4	Energy - Other		KWh	10%	$ 261,048			% of above energy cost
2.0	**Labor Costs**							
2.1	Other Labor (pipeline, PS, wells)	2.0	staff	$ 125,000	$ 250,000			full time staff at $125,000 average salary + benefits per year
3.0	**Maintenance - General**	@	1.5%		$ 1,532,648			% of Project capital cost total
4.0	**Contingency**	@	10.0%		$ 465,418			% of above O&M costs
				Annual O&M Costs ($/year)	**$ 5,119,594**			
				Annual Unit O&M Costs ($/AF)	**$ 700**			
				Annual Unit O&M Costs ($/gal)	**$0.002**			

Engineers Opinion of Probable Cost
1b.1 - Option 1 (via Woodside Rd) - AWPF Near HW 101 - Repurpose SVCW Pipeline

Kennedy Jenks

Study:	Potable Reuse Exploratory Plan (PREP) Decision Tool Phase 2	**Prepared By:**	RX	**Average Annual Influent Flow:**	7.84 mgd
Project:	SWA at Crystal Springs Reservoir - Pipeline & Pump Station Cost	**Date Prepared:**	Jan-2019	**Average Annual Product Flow:**	6.00 mgd
AWPF Location:	AWPF near HW 101	**K/J Proj. No.**	1668011.02	**Brine Flow:**	1.84 mgd
Repurpose:	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	**ENR**	12,115 (Jan. 2019 SF)	**RW Delivered:**	6720 Average Annual Reuse (AFY)
Estimate:	Conceptual Level Cost-Analysis			**Design Capacity:**	4,167 Max Day Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Costs Total Capital Cost	Est Facility Life	Annualized Capital Cost	Notes/Source
Facility Capital Costs								
Facility Capital Costs - Part 1								
	Pipeline				**$ 29,507,000**	**75**	**$ 993,441**	
1.1	**AWPF near Hwy 101 to SVCW Outfall (Brine - sliplining)**							
	Slip Lining	15,400	LF	$ 100	$ 1,540,000			10 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	11	EA	$ 150,000	$ 1,650,000			$150,000 /EA
	Slip Lining Receiving Pit	11	EA	$ 60,000	$ 660,000			$60,000 /EA
1.2	**AWPF near SVCW to Hwy101 (Purified - Repurpose - sliplining)**							
	repurpose RWC purple pipe	15,400	LF		not incl			20 in-diameter
								Assume no addition construcuion cost
	Turnout and conncet RWC purple pipe to AWPF	1	LS	$ 1,000,000	$ 1,000,000			Conservative estimate due to heavy traffic and wetlands on the NE side of the potential AWPF location
1.3	**Hwy101 to CSR (Purified - open trench)**							
	Open Cut Pipeline - SFPUC ROW	17,000	LF	$ 270	$ 4,590,000			18 in-diameter $270 /LF
	Open Cut pipeline - along bay	12,200	LF	$ 450	$ 5,490,000			52,500 LF of pipeline $25 per inch-dia-LF
	Open Cut pipeline - Remaning	23,300	LF	$ 330	$ 7,689,000			$330 /LF
								Assume regular unit cost for trenching along SFPUC ROW, higher unit cost for
								special shoring along the bay, and higher unit cost in remaining sections (busy areas)
1.4	**Repurpose Alignment No.3 to Whipple Road (Purified - repurpose - slip lining)**							
	Slip Lining	12,600	LF	$ 180	$ 2,268,000			18 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	8	EA	$ 150,000	$ 1,200,000			$150,000 /EA
	Slip Lining Receiving Pit	8	EA	$ 60,000	$ 480,000			$60,000 /EA
1.5	**AWPF near SVCW to CSR (Purified - trenchless - Hwy)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	2,000	LF	$ 540	$ 1,080,000			18 in-diameter $30 per inch-dia-LF
	Microtunnelling Jacking Pit (15 ft deep)	2	EA	$ 150,000	$ 300,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	2	EA	$ 60,000	$ 120,000			$60,000 /EA
1.6	**AWPF near SVCW to CSR (Purified - trenchless - Major Intersection)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	1,500	LF	$ 540	$ 810,000			18 in-diameter $30 per inch-dia-LF
	Microtunnelling Jacking Pit (15 ft deep)	3	EA	$ 150,000	$ 450,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	3	EA	$ 60,000	$ 180,000			$60,000 /EA
2.0	**Pump Station**				**$ 6,860,000**	**50**	**$ 266,617**	
2.1	AWPF near hwy 101 to SVCW (Brine)	1	LS	$ 480,000	$ 480,000			1,280 total flow (gpm) 194 ft (TDH)
2.2	SVCW to AWPF near Hwy101 (Tertiary)	1	LS	$ 910,000	$ 910,000			5,447 total flow (gpm) 101 ft (TDH)
2.3	AWPF near hwy101 to CSR (Purified)	1	LS	$ 5,470,000	$ 5,470,000			4,167 total flow (gpm) 1258 ft (TDH)
	Subtotal Facility Costs - Part 1				**$ 36,367,000**		**$ 1,260,058**	
Facility Capital Costs - Part 2								
3.0	Site Development Costs	@	5%		$ 1,818,350		$ 63,003	% of Subtotal facility costs - Part 1
								(Includes grading, erosion control, cut/fill, etc.)
4.0	Yard Piping	@	5%		$ 343,000		$ 13,331	% of Subtotal facility costs (not inluding pipelines) - Part 1
5.0	Electrical, I&C, and Remote (high-tech) Control	@	15%		$ 1,029,000		$ 39,993	% of Subtotal facility costs (not inluding pipelines) - Part 1
	Subtotal Facility Costs - Part 2				**$ 3,190,350**		**$ 116,326**	
	Facility Direct Costs				**$ 39,557,350**		**$ 1,376,384**	
Markups and Contingency								
	Taxes	@	8.75%		$ 1,272,845		$ 44,102	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		$ 1,977,868		$ 68,819	% of Facility Direct Costs
	Engineering and Design	@	10%		$ 3,955,735		$ 137,638	% of Facility Direct Costs
	Special Studies	@	0%		$ -		$ -	Not included (note that this may be a significant future cost for the program)
	Construction Management	@	15%		$ 5,933,603		$ 206,458	% of Facility Direct Costs
	Owner's Administration	@	15%		$ 5,933,603		$ 206,458	% of Facility Direct Costs
	Environmental/Permitting	@	5%		$ 1,977,868		$ 68,819	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		$ 5,933,603		$ 206,458	% of Facility Direct Costs
	Estimate Contingency	@	40%		$ 15,822,940		$ 550,554	% of Facility Direct Costs
	Subtotal with Markups and Contingency				**$ 82,365,413**		**$ 2,865,690**	
	Escalation to Midpoint of Construction	@	29%		$ 23,526,133		$ 818,530	% of Subtotal with Markups and Contingency
								assume 3% percent over 9
								construction start = 2026 end = 2029
								project life = 50 interest rate = 3%
	Project Capital Cost Total				**$ 105,891,546**		**$ 3,684,220**	
	Annualized Capital Costs ($/AFY)						**$ 548**	Total Annualized Captial Cost divided by AFY
	Annualualized Capital Costs ($/gal)						**$0.002**	

Item No.	Description	Qty	Units	Total Annual Costs $/Unit	Total Annual Costs Total	
Annual Operations and Maintenance Costs						
1.0	**Energy Costs**					
						Pump Operation = 24 hours per day
						(applies to all pumping) 8760 hours operated per year
1.1	Egnergy - AWPF near SVCW to SVCW (Brine)	1,752,000	KWh	$ 0.20	$ 350,400	Pump Station Hp = 200 Total Motor HP Required
1.2	Energy - SVCW to AWPF near SVCW (Tertiary)	2,628,000	KWh	$ 0.20	$ 525,600	Pump Station Hp = 300 Total Motor HP Required
1.3	Energy - AWPF near SVCW to CSR (Purified)	16,644,000	KWh	$ 0.20	$ 3,328,800	Pump Station Hp = 1,900 Total Motor HP Required
1.4	Energy - Other		KWh	10%	$ 420,480	% of above energy cost
2.0	**Labor Costs**					
2.1	Other Labor (pipeline, PS, wells)	2.0	staff	$ 125,000	$ 250,000	full time staff at $125,000 average salary + benefits per year
3.0	**Maintenance - General**	@	1.5%		$ 1,588,373	% of Project capital cost total
4.0	**Contingency**	@	10.0%		$ 646,365	% of above O&M costs
	Annual O&M Costs ($/year)				**$ 7,110,019**	
	Annual Unit O&M Costs ($/AF)				**$ 1,000**	
	Annual Unit O&M Costs ($/gal)				**$0.003**	

Engineers Opinion of Probable Cost
2a.1 - Option 1 (via Woodside Rd) - AWPF near SVCW - Option A (via Beach Park) + Short Alignment

Kennedy Jenks

Study:	Potable Reuse Exploratory Plan (PREP) Decision Tool Phase 2	**Prepared By:**	RX	**Average Annual Influent Flow:**	15.69 mgd
Project:	SWA at Crystal Springs Reservoir - Pipeline & Pump Station Cost	**Date Prepared:**	Jan-2019	**Average Annual Product Flow:**	12.00 mgd
AWPF Location:	AWPF near SVCW	**K/J Proj. No.**	1668011.02	**Brine Flow:**	3.69 mgd
Repurpose:	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	**ENR**	12,115 (Jan. 2019 SF)	**RW Delivered:**	13440 Average Annual Reuse (AFY)
Estimate:	Conceptual Level Cost-Analysis			**Design Capacity:**	8,333 Max Day Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Costs Total Capital Cost	Est Facility Life	Annualized Capital Cost	Notes/Source
Facility Capital Costs								
Facility Capital Costs - Part 1								
1.0	**Pipeline**				**$ 54,957,600**	**75**	**$ 1,850,310**	
1.1	**AWPF near SVCW to SVCW Outfall (Brine - open trench)**							
	Open Cut Pipeline	2,800	LF	$ 210	$ 588,000			14 in-diameter $210 /LF
1.2	**SVCW RWC RQ Tank to AWPF near SVCW (Tertiary - open trench)**							
	Open Cut Pipeline	3,200	LF	$ 448	$ 1,433,600			28 in-diameter $448 /LF
1.3	**AWPF near SVCW to Hwy101 (Purified - Repurpose - sliplining)**							
	Slip Lining	15,400	LF	$ 240	$ 3,696,000			24 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	11	EA	$ 150,000	$ 1,650,000			$150,000 /EA
	Slip Lining Receiving Pit	11	EA	$ 60,000	$ 660,000			$60,000 /EA
1.4	**San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo - open trench)**							
	Open Cut Pipeline	25,600	LF	$ 370	$ 9,472,000			20 in-diameter $370 /LF
1.5	**San Mateo WWTP to SVCW RWC RW Tanks (Tertirary San Mateo - trenchless - Belmont Slough)**							
	Microtunneling (Trenchless) - 100ft Pit	2,500	LF	$ 800	$ 2,000,000			20 in-diameter 40 per inch-dia-LF
	Microtunnelling Jacking Pit (100 ft deep)	1	EA	$ 2,000,000	$ 2,000,000			$2,000,000 /EA
	Microtunnelling Receiving Pit (100 ft deep)	1	EA	$ 2,000,000	$ 2,000,000			$2,000,000 /EA
1.6	**San Mateo WWTP to SVCW RWC RW Tanks (Tertiary San Mateo - pipe suspension - E 3rd Ave Bridge)**							
	Pipe Suspension	1,000	LF	$ 6,000	$ 6,000,000			20 in-diameter $300 /LF
1.5	**Hwy 101 to CSR (Purified - open trench)**							
	Open Cut Pipeline - SFPUC ROW	17,000	LF	$ 270	$ 4,590,000			24 in-diameter $270 /LF
	Open Cut pipeline - along bay	12,200	LF	$ 600	$ 7,320,000			52,500 LF of pipeline $25 per inch-dia-LF
	Open Cut pipeline - Remaning	23,300	LF	$ 330	$ 7,689,000			$330 /LF
								Assume regular unit cost for trenching along SFPUC ROW, higher unit cost for
								special shoring along the bay, and higher unit cost in remaining sections (busy areas)
1.8	**Repurpose Alignment No.3 to Whipple Road (Purified - repurpose - slip lining)**							
	Slip Lining	12,600	LF	$ 240	$ 3,024,000			24 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	8	EA	$ 150,000	$ 1,200,000			$150,000 /EA
	Slip Lining Receiving Pit	8	EA	$ 60,000	$ 480,000			$60,000 /EA
1.9	**AWPF near SVCW to CSR (Purified - trenchless - Hwy)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	2,000	LF	$ 30	$ 60,000			24 in-diameter $30 /LF
	Microtunnelling Jacking Pit (15 ft deep)	2	EA	$ 150,000	$ 300,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	2	EA	$ 60,000	$ 120,000			$60,000 /EA
1.10	**AWPF near SVCW to CSR (Purified - trenchless - Major Intersection)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	1,500	LF	$ 30	$ 45,000			24 in-diameter $30 /LF
	Microtunnelling Jacking Pit (15 ft deep)	3	EA	$ 150,000	$ 450,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	3	EA	$ 60,000	$ 180,000			$60,000 /EA
2.0	**Pump Station**				**$ 11,390,000**	**50**	**$ 442,678**	
2.1	AWPF near SVCW to SVCW (Brine)	1	LS	360,000	$ 360,000			2,560 total flow (gpm) 37 ft (TDH)
2.2	SVCW to AWPF near SVCW (Tertiary - Combined)	1	LS	480,000	$ 480,000			10,894 total flow (gpm) 22 ft (TDH)
2.3	San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo)	1	LS	1,260,000	$ 1,260,000			5,447 total flow (gpm) 158 ft (TDH)
2.4	AWPF near SVCW to CSR (Purified)	1	LS	9,290,000	$ 9,290,000			8,334 total flow (gpm) 1158 ft (TDH)
	Subtotal Facility Costs - Part 1				**$ 66,347,600**		**$ 2,292,988**	
Facility Capital Costs - Part 2								
3.0	Site Development Costs	@	5%		$ 3,317,380		$ 114,649	% of Subtotal facility costs - Part 1
								(Includes grading, erosion control, cut/fill, etc.)
4.0	Yard Piping	@	5%		$ 569,500		$ 22,134	% of Subtotal facility costs (not inluding pipelines) - Part 1
5.0	Electrical, I&C, and Remote (high-tech) Control	@	15%		$ 1,708,500		$ 66,402	% of Subtotal facility costs (not inluding pipelines) - Part 1
	Subtotal Facility Costs - Part 2				**$ 5,595,380**		**$ 203,185**	
				Facility Direct Costs	**$ 71,942,980**		**$ 2,496,173**	
Markups and Contingency								
	Taxes	@	8.75%		$ 2,322,166		$ 80,255	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		$ 3,597,149		$ 124,809	% of Facility Direct Costs
	Engineering and Design	@	10%		$ 7,194,298		$ 249,617	% of Facility Direct Costs
	Special Studies	@	0%		$ -		$ -	Not included (note that this may be a significant future cost for the program)
	Construction Management	@	15%		$ 10,791,447		$ 374,426	% of Facility Direct Costs
	Owner's Administration	@	15%		$ 10,791,447		$ 374,426	% of Facility Direct Costs
	Environmental/Permitting	@	5%		$ 3,597,149		$ 124,809	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		$ 10,791,447		$ 374,426	% of Facility Direct Costs
	Estimate Contingency	@	40%		$ 28,777,192		$ 998,469	% of Facility Direct Costs
				Subtotal with Markups and Contingency	**$ 149,805,275**		**$ 5,197,410**	
	Escalation to Midpoint of Construction	@	29%		$ 42,789,063		$ 1,484,543	% of Subtotal with Markups and Contingency
								assume 3% percent over 9
								construction start = 2026 end = 2029
								project life = 50 interest rate = 3%
				Project Capital Cost Total	**$ 192,594,338**		**$ 6,681,953**	
					Annualized Capital Costs ($/AFY)		**$ 497**	Total Annualized Captial Cost divided by AFY
					Annualualized Capital Costs ($/gal)		**$0.002**	

Annual Operations and Maintenance Costs

Item No.	Description	Qty	Units	Total Annual Costs $/Unit	Total Annual Costs Total		
1.0	**Energy Costs**						
						Pump Operation = 24 hours per day	
						(applies to all pumping) 8760 hours operated per year	
1.1	Energy - AWPF near SVCW to SVCW (Brine)	438,000	KWh	$ 0.20	$ 87,600	Pump Station Hp = 50 Total Motor HP Required	
1.2	Energy - SVCW to AWPF near SVCW (Tertiary - Combined)	700,800	KWh	$ 0.20	$ 140,160	Pump Station Hp = 80 Total Motor HP Required	
1.3	Energy - San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo)	2,628,000	KWh	$ 0.20	$ 525,600	Pump Station Hp = 300 Total Motor HP Required	
1.4	Energy - AWPF near SVCW to CSR (Purified)	28,908,000	KWh	$ 0.20	$ 5,781,600	Pump Station Hp = 3,300 Total Motor HP Required	
1.5	Energy - Other		KWh	10%	$ 653,496	% of above energy cost	
2.0	**Labor Costs**						
2.1	Other Labor (pipeline, PS, wells)	3.0	staff	$ 125,000	$ 375,000	full time staff at $125,000 average salary + benefits per year	
3.0	**Maintenance - General**	@	1.5%		$ 2,888,915	% of Project capital cost total	
4.0	**Contingency**	@	10.0%		$ 1,045,237	% of above O&M costs	
				Annual O&M Costs ($/year)	**$ 11,497,608**		
				Annual Unit O&M Costs ($/AF)	**$ 800**		
				Annual Unit O&M Costs ($/gal)	**$0.003**		

Engineers Opinion of Probable Cost

2b.1 - Option 1 (via Woodside Rd) - - Option B (via Edgewood Blvd) + Redwood Shores Open Trench

Kennedy Jenks

Study:	Potable Reuse Exploratory Plan (PREP) Decision Tool Phase 2	**Prepared By:**	RX	**Average Annual Influent Flow:**	15.69 mgd
Project:	SWA at Crystal Springs Reservoir - Pipeline & Pump Station Cost	**Date Prepared:**	Jan-2019	**Average Annual Product Flow:**	12.00 mgd
AWPF Location:	AWPF near SVCW	**K/J Proj. No.**	1668011.02	**Brine Flow:**	3.69 mgd
Repurpose:	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	**ENR**	12,115 (Jan. 2019 SF)	**RW Delivered:**	13440 Average Annual Reuse (AFY)
Estimate:	Conceptual Level Cost-Analysis			**Design Capacity:**	8,333 Max Day Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Costs Total Capital Cost	Est Facility Life	Annualized Capital Cost	Notes/Source
Facility Capital Costs								
Facility Capital Costs - Part 1								
1.0	**Pipeline**				**$ 60,337,600**	**75**	**$ 2,031,444**	
1.1	**AWPF near SVCW to SVCW Outfall (Brine - open trench)**							
	Open Cut Pipeline	2,800	LF	$ 210	$ 588,000			14 in-diameter $210 /LF
1.2	**SVCW RWC RQ Tank to AWPF near SVCW (Tertiary - open trench)**							
	Open Cut Pipeline	3,200	LF	$ 448	$ 1,433,600			28 in-diameter $448 /LF
1.3	**AWPF near SVCW to Hwy101 (Purified - Repurpose - sliplining)**							
	Slip Lining	15,400	LF	$ 240	$ 3,696,000			24 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	11	EA	$ 150,000	$ 1,650,000			$150,000 /EA
	Slip Lining Receiving Pit	11	EA	$ 60,000	$ 660,000			$60,000 /EA
1.4	**San Mateo WWTP to Hwy 101 (Tertiary - San Mateo - open trench)**							
	Open Cut Pipeline	27,600	LF	$ 370	$ 10,212,000			20 in-diameter $370 /LF
1.5	**Hwy101 to SVCW RWC RW Tanks (Tertiary - San Mateo - open trench)**							
	Open Cut Pipeline	15,400	LF	$ 500	$ 7,700,000			20 in-diameter 25.00 per inch-dia-LF
								assume higher unit cost for open trench along the bay (special shoring required)
1.6	**San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo - trenchless - Slough)**							
	Microtunneling (Trenchless) - 60ft Pit	1,000	LF	$ 700	$ 700,000			20 in-diameter 35 per inch-dia-LF
	Microtunnelling Jacking Pit (60 ft deep)	1	EA	$ 1,000,000	$ 1,000,000			$600,000 /EA
	Microtunnelling Receiving Pit (60 ft deep)	1	EA	$ 1,000,000	$ 1,000,000			$500,000 /EA
1.7	**San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo - trenchless - hwy92)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	1,000	LF	$ 30	$ 30,000			20 in-diameter $30 /LF
	Microtunnelling Jacking Pit (15 ft deep)	1	EA	$ 150,000	$ 150,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	1	EA	$ 60,000	$ 60,000			$60,000 /EA
1.8	**San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo - pipe suspension - E 3rd Ave Bridge)**							
	Pipe Suspension	1,000	LF	$ 6,000	$ 6,000,000			20 in-diameter $300 /LF
1.9	**Hwy 101 to CSR (Purified - open trench)**							
	Open Cut Pipeline - SFPUC ROW	17,000	LF	$ 270	$ 4,590,000			24 in-diameter $270 /LF
	Open Cut pipeline - along bay	12,200	LF	$ 600	$ 7,320,000			52,500 LF of pipeline $25 per inch-dia-LF
	Open Cut pipeline - Remaning	23,300	LF	$ 330	$ 7,689,000			$330 /LF
								Assume regular unit cost for trenching along SFPUC ROW, higher unit cost for
								special shoring along the bay, and higher unit cost in remaining sections (busy areas)
1.10	**Repurpose Alignment No.3 to Whipple Road (Purified - repurpose - slip lining)**							
	Slip Lining	12,600	LF	$ 240	$ 3,024,000			24 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	8	EA	$ 150,000	$ 1,200,000			$150,000 /EA
	Slip Lining Receiving Pit	8	EA	$ 60,000	$ 480,000			$60,000 /EA
1.11	**AWPF near SVCW to CSR (Purified - trenchless - Hwy)**							**Assume microtunneling under I-101 and Caltrans Path**
	Microtunneling (Trenchless) - 15ft & 35ft Pit	2,000	LF	$ 30	$ 60,000			24 in-diameter $30 /LF
	Microtunnelling Jacking Pit (15 ft deep)	2	EA	$ 150,000	$ 300,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	2	EA	$ 60,000	$ 120,000			$60,000 /EA
1.12	**AWPF near SVCW to CSR (Purified - trenchless - Major Intersection)**							**Assume microtunneling under I-101 and Caltrans Path**
	Microtunneling (Trenchless) - 15ft & 35ft Pit	1,500	LF	$ 30	$ 45,000			24 in-diameter $30 /LF
	Microtunnelling Jacking Pit (15 ft deep)	3	EA	$ 150,000	$ 450,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	3	EA	$ 60,000	$ 180,000			$60,000 /EA
2.0	**Pump Station**				**$ 11,390,000**	**50**	**$ 442,678**	
2.1	AWPF near SVCW to SVCW (Brine)	1	LS	$ 360,000	$ 360,000			2,560 total flow (gpm) 37 ft (TDH)
2.2	SVCW to AWPF near SVCW (Tertiary - Combined)	1	LS	$ 480,000	$ 480,000			10,894 total flow (gpm) 22 ft (TDH)
2.3	San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo)	1	LS	$ 1,260,000	$ 1,260,000			5,447 total flow (gpm) 172 ft (TDH)
2.4	AWPF near SVCW to CSR (Purified)	1	LS	$ 9,290,000	$ 9,290,000			8,334 total flow (gpm) 1158 ft (TDH)
	Subtotal Facility Costs - Part 1				**$ 71,727,600**		**$ 2,474,122**	
Facility Capital Costs - Part 2								
3.0	Site Development Costs	@	5%		$ 3,586,380		$ 123,706	% of Subtotal facility costs - Part 1
								(Includes grading, erosion control, cut/fill, etc.)
4.0	Yard Piping	@	5%		$ 569,500		$ 22,134	% of Subtotal facility costs (not inluding pipelines) - Part 1
5.0	Electrical, I&C, and Remote (high-tech) Control	@	15%		$ 1,708,500		$ 66,402	% of Subtotal facility costs (not inluding pipelines) - Part 1
	Subtotal Facility Costs - Part 2				**$ 5,864,380**		**$ 212,242**	
				Facility Direct Costs	**$ 77,591,980**		**$ 2,686,364**	
Markups and Contingency								
	Taxes	@	8.75%		$ 2,510,466		$ 86,594	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		$ 3,879,599		$ 134,318	% of Facility Direct Costs
	Engineering and Design	@	10%		$ 7,759,198		$ 268,636	% of Facility Direct Costs
	Special Studies	@	0%		$ -		$ -	Not included (note that this may be a significant future cost for the program)
	Construction Management	@	15%		$ 11,638,797		$ 402,955	% of Facility Direct Costs
	Owner's Administration	@	15%		$ 11,638,797		$ 402,955	% of Facility Direct Costs
	Environmental/Permitting	@	5%		$ 3,879,599		$ 134,318	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		$ 11,638,797		$ 402,955	% of Facility Direct Costs
	Estimate Contingency	@	40%		$ 31,036,792		$ 1,074,546	% of Facility Direct Costs
				Subtotal with Markups and Contingency	**$ 161,574,025**		**$ 5,593,640**	
	Escalation to Midpoint of Construction	@	29%		$ 46,150,586		$ 1,597,718	% of Subtotal with Markups and Contingency
								assume 3% percent over 9
								construction start = 2026 end = 2029
								project life = 50 interest rate = 3%
				Project Capital Cost Total	**$ 207,724,611**		**$ 7,191,358**	
					Annualized Capital Costs ($/AFY)		**$ 535**	Total Annualized Captial Cost divided by AFY
					Annualualized Capital Costs ($/gal)		**$0.002**	

Annual Operations and Maintenance Costs

Item No.	Description	Qty	Units	Total Annual Costs $/Unit	Total Annual Costs Total			
1.0	**Energy Costs**							
								Pump Operation = 24 hours per day
								(applies to all pumping) 8760 hours operated per year
1.1	Energy - AWPF near SVCW to SVCW (Brine)	438,000	KWh	$ 0.20	$ 87,600			Pump Station Hp = 50 Total Motor HP Required
1.2	Energy - SVCW to AWPF near SVCW (Tertiary - Combined)	700,800	KWh	$ 0.20	$ 140,160			Pump Station Hp = 80 Total Motor HP Required
1.3	Energy - San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo)	2,628,000	KWh	$ 0.20	$ 525,600			Pump Station Hp = 300 Total Motor HP Required
1.4	Energy - AWPF near SVCW to CSR (Purified)	28,908,000	KWh	$ 0.20	$ 5,781,600			Pump Station Hp = 3,300 Total Motor HP Required
1.5	Energy - Other		KWh	10%	$ 653,496			% of above energy cost
2.0	**Labor Costs**							
2.1	Other Labor (pipeline, PS, wells)	3.0	staff	$ 125,000	$ 375,000			full time staff at $125,000 average salary + benefits per year
3.0	**Maintenance - General**	@	1.5%		$ 3,115,869			% of Project capital cost total
4.0	**Contingency**	@	10.0%		$ 1,067,933			% of above O&M costs
				Annual O&M Costs ($/year)	**$ 11,747,258**			
				Annual Unit O&M Costs ($/AF)	**$ 800**			
				Annual Unit O&M Costs ($/gal)	**$0.003**			

Engineers Opinion of Probable Cost

2c.1 - Option 1 (via Woodside Rd) - AWPF Near HW 101 - Option B (via Edgewood Blvd) + Repurpose SVCW Pipeline

Kennedy Jenks

Study:	Potable Reuse Exploratory Plan (PREP) Decision Tool Phase 2	**Prepared By:**	RX	**Average Annual Influent Flow:**	15.69 mgd
Project:	SWA at Crystal Springs Reservoir - Pipeline & Pump Station Cost	**Date Prepared:**	Jan-2019	**Average Annual Product Flow:**	12.00 mgd
AWPF Location:	AWPF near HW 101	**KJ Proj. No.**	1668011.02	**Brine Flow:**	3.69 mgd
Repurpose:	SVCW Pipeline along Redwood Shores Pkwy & along Shoreway Rd	**ENR**	12,115 (Jan. 2019 SF)	**RW Delivered:**	13440 Average Annual Reuse (AFY)
Estimate:	Conceptual Level Cost-Analysis			**Design Capacity:**	8,333 Max Day Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Costs Total Capital Cost	Est Facility Life	Annualized Capital Cost	Notes/Source
Facility Capital Costs								
Facility Capital Costs - Part 1								
1.0	**Pipeline**				**$ 49,686,000**	**75**	**$ 1,672,826**	
1.1	**AWPF near Hwy 101 to SVCW Outfall (Brine - Slip lining)**							
	Slip Lining	15,400	LF	$ 140	$ 2,156,000			14 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	11	EA	$ 150,000	$ 1,650,000			$150,000 /EA
	Slip Lining Receiving Pit	11	EA	$ 60,000	$ 660,000			$60,000 /EA
1.2	**AWPF near SVCW to Hwy101 (Purified - Repurpose - sliplining)**							
	repurpose RWC purple pipe	15,400	LF		not incl			20 in-diameter
								Assume no addition construtuion cost
	Turnout and conncet RWC purple pipe to AWPF	1	LS	$ 1,000,000	$ 1,000,000			Conservative estimate due to heavy traffic and wetlands on the NE side of the potential AWPF location.
1.3	**San Mateo WWTP to Hwy 101 (Tertiary - San Mateo - open trench)**							
	Open Cut Pipeline	27,600	LF	$ 370	$ 10,212,000			20 in-diameter $370 /LF
1.4	**San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo - trenchless - Slough)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	1,000	LF	$ 600	$ 600,000			20 in-diameter 30 per inch-dia-LF
	Microtunnelling Jacking Pit (35 ft deep)	1	EA	$ 600,000	$ 600,000			$600,000 /EA
	Microtunnelling Receiving Pit (35 ft deep)	1	EA	$ 500,000	$ 500,000			$500,000 /EA
1.5	**San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo - trenchless - hwy92)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	1,000	LF	$ 600	$ 600,000			20 in-diameter $30 per inch-dia-LF
	Microtunnelling Jacking Pit (15 ft deep)	1	EA	$ 150,000	$ 150,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	1	EA	$ 100,000	$ 100,000			$100,000 /EA
1.6	**San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo - pipe suspension - E 3rd Ave Bridge)**							
	Pipe Suspension	1,000	LF	$ 6,000	$ 6,000,000			20 in-diameter $300 /LF
1.7	**Hwy 101 to CSR (Purified - open trench)**							
	Open Cut Pipeline - SFPUC ROW	17,000	LF	$ 270	$ 4,590,000			24 in-diameter $270 /LF
	Open Cut pipeline - along bay	12,200	LF	$ 600	$ 7,320,000			52,500 LF of pipeline $25 per inch-dia-LF
	Open Cut pipeline - Remaning	23,300	LF	$ 330	$ 7,689,000			$330 /LF
								Assume regular unit cost for trenching along SFPUC ROW, higher unit cost for special shoring along the bay, and higher unit cost in remaining sections (busy areas)
1.8	**Repurpose Alignment No.3 to Whipple Road (Purified - repurpose - slip lining)**							
	Slip Lining	12,600	LF	$ 240	$ 3,024,000			24 in-diameter 10.00 per inch-dia-LF
	Slip Lining Access Pit	8	EA	$ 150,000	$ 1,200,000			$150,000 /EA
	Slip Lining Receiving Pit	8	EA	$ 60,000	$ 480,000			$60,000 /EA
1.9	**AWPF near SVCW to CSR (Purified - trenchless - Hwy)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	2,000	LF	$ 30	$ 60,000			24 in-diameter $30 /LF
	Microtunnelling Jacking Pit (15 ft deep)	2	EA	$ 150,000	$ 300,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	2	EA	$ 60,000	$ 120,000			$60,000 /EA
1.10	**AWPF near SVCW to CSR (Purified - trenchless - Major Intersection)**							
	Microtunneling (Trenchless) - 15ft & 35ft Pit	1,500	LF	$ 30	$ 45,000			24 in-diameter $30 /LF
	Microtunnelling Jacking Pit (15 ft deep)	3	EA	$ 150,000	$ 450,000			$150,000 /EA
	Microtunnelling Receiving Pit (15 ft deep)	3	EA	$ 60,000	$ 180,000			$60,000 /EA
2.0	**Pump Station**				**$ 12,370,000**	**50**	**$ 480,766**	
2.1	AWPF near SVCW to SVCW (Brine)	1	LS	$ 910,000	$ 910,000			2,560 total flow (gpm) 128 ft (TDH)
2.2	SVCW to AWPF near SVCW (Tertiary - SVCW only)	1	LS	$ 910,000	$ 910,000			5,447 total flow (gpm) 101 ft (TDH)
2.3	San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo)	1	LS	$ 1,260,000	$ 1,260,000			5,447 total flow (gpm) 172 ft (TDH)
2.4	AWPF near SVCW to CSR (Purified)	1	LS	$ 9,290,000	$ 9,290,000			8,334 total flow (gpm) 1158 ft (TDH)
	Subtotal Facility Costs - Part 1				**$ 62,056,000**		**$ 2,153,593**	
Facility Capital Costs - Part 2								
3.0	Site Development Costs	@	5%		$ 3,102,800		$ 107,680	% of Subtotal facility costs - Part 1 (Includes grading, erosion control, cut/fill, etc.)
4.0	Yard Piping	@	5%		$ 618,500		$ 24,038	% of Subtotal facility costs (not inluding pipelines) - Part 1
5.0	Electrical, I&C, and Remote (high-tech) Control	@	15%		$ 1,855,500		$ 72,115	% of Subtotal facility costs (not inluding pipelines) - Part 1
	Subtotal Facility Costs - Part 2				**$ 5,576,800**		**$ 203,833**	
				Facility Direct Costs	**$ 67,632,800**		**$ 2,357,425**	
Markups and Contingency								
	Taxes	@	8.75%		$ 2,171,960		$ 75,376	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		$ 3,381,640		$ 117,871	% of Facility Direct Costs
	Engineering and Design	@	10%		$ 6,763,280		$ 235,743	% of Facility Direct Costs
	Special Studies	@	0%		$ -		$ -	Not included (note that this may be a significant future cost for the program)
	Construction Management	@	15%		$ 10,144,920		$ 353,614	% of Facility Direct Costs
	Owner's Administration	@	15%		$ 10,144,920		$ 353,614	% of Facility Direct Costs
	Environmental/Permitting	@	5%		$ 3,381,640		$ 117,871	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		$ 10,144,920		$ 353,614	% of Facility Direct Costs
	Estimate Contingency	@	40%		$ 27,053,120		$ 942,970	% of Facility Direct Costs
				Subtotal with Markups and Contingency	**$ 140,819,200**		**$ 4,908,098**	
	Escalation to Midpoint of Construction	@	29%		$ 40,222,360		$ 1,401,906	% of Subtotal with Markups and Contingency
								assume 3% percent over 9
								construction start = 2026 end = 2029
								project life = 50 interest rate = 3%
				Project Capital Cost Total	**$ 181,041,560**		**$ 6,310,004**	
					Annualized Capital Costs ($/AFY)		**$ 469**	Total Annualized Captial Cost divided by AFY
					Annualulalized Capital Costs ($/gal)		**$0.001**	

Annual Operations and Maintenance Costs

Item No.	Description	Qty	Units	Total Annual Costs $/Unit	Total Annual Costs Total			
1.0	**Energy Costs**							
								Pump Operation = 24 hours per day
								(applies to all pumping) 8760 hours operated per year
1.1	Energy - AWPF near SVCW to SVCW (Brine)	1,752,000	KWh	$ 0.20	$ 350,400			Pump Station Hp = 200 Total Motor HP Required
1.2	Energy - SVCW to AWPF near SVCW (Tertiary - SVCW only)	1,752,000	KWh	$ 0.20	$ 350,400			Pump Station Hp = 200 Total Motor HP Required
1.3	Energy - San Mateo WWTP to SVCW RWC RW Tanks (Tertiary - San Mateo)	2,628,000	KWh	$ 0.20	$ 525,600			Pump Station Hp = 300 Total Motor HP Required
1.4	Energy - AWPF near SVCW to CSR (Purified)	27,156,000	KWh	$ 0.20	$ 5,431,200			Pump Station Hp = 3,100 Total Motor HP Required
1.5	Energy - Other		KWh	10%	$ 665,760			% of above energy cost
2.0	**Labor Costs**							
2.1	Other Labor (pipeline, PS, wells)	3.0	staff	$ 125,000	$ 375,000			full time staff at $125,000 average salary + benefits per year
3.0	**Maintenance - General**	@	1.5%		$ 2,715,623			% of Project capital cost total
4.0	**Contingency**	@	10.0%		$ 1,041,398			% of above O&M costs
				Annual O&M Costs ($/year)	**$ 11,455,382**			
				Annual Unit O&M Costs ($/AF)	**$ 800**			
				Annual Unit O&M Costs ($/gal)	**$0.003**			

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