State of the Regional Water System

Hetch Hetchy Regional Water System

Services of the San Francisco Public Utilities Commission

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List of Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ACAMS	Alarm control and monitoring system
AF	Acre-feet
AMI	Advanced Meter Infrastructure
BAAQMD	Bay Area Air Quality Management District
BART	Bay Area Rapid Transit
BAWSCA	Bay Area Water Supply and Conservation Agency
BDPL	Bay Division Pipeline
BEM	Bureau of Environmental Management
BMP	Best Management Practices
BHR	Bioregional Habitat Restoration
CDD	City Distribution Division
CDRP	Calaveras Dam Replacement Project
CEQA	California Environmental Quality Act
Cfs	cubic feet per second
CIP	Capital Improvement Program
CM	Corrective Maintenance
CML	Cement mortar lined
CMMS	Computerized maintenance management system
CP	Cathodic Protection
CPM	Cathodic Protection Manual
CSPL	Crystal Springs Pipeline
CVRWQCB	Central Valley Regional Water Quality Control Board
DDW	Division of Drinking Water
DWR	California Department of Water Resources
DSOD	Division of Safety of Dams
EBMUD	East Bay Municipal Utility District
FAACS	Fixed Asset Accounting System
FEMA	Federal Emergency Management Agency
FY	Fiscal Year
GIS	Geographic information system
HHWP	Hetch Hetchy Water and Power
HTWTP	Harry Tracy Water Treatment Plant

I-INFO	emergency notification software (replaces RSAN)
LCA	Lower Cherry Aqueduct
LCSD	Lower Crystal Springs Dam
LOS	Levels of Service
MAXIMO	Specific CMMS software used by SFPUC (Oracle product)
mg/L	Milligram per liter
MGD	million gallons per day
NACE	National Association of Corrosion Engineers
NIPP	National Infrastructure Protection Plan
NIT	New Irvington Tunnel
NPDES	National Pollutant Discharge Elimination System
NRLMD	Natural Resources and Lands Management Division
O&M	Operations and Maintenance
PCCP	Pre-stressed concrete cylinder pipe
PG&E	Pacific Gas and Electric
PM	Preventive Maintenance
PPSU	Peninsula Pipelines Seismic Upgrades
R&R	Rehabilitation and replacement
RCM	Reliability Centered Maintenance
RCP	Reinforced concrete cylinder pipeline
RFP	Request for proposal
RMU	Remote Monitoring Units
ROW	Right-of-way
RSAN	Roam Secure Alert Network
RTU	Remote Terminal Unit
RWS	Regional Water System
SAPL	San Andreas Pipeline
SAPS	San Antonio Pump Station
SCADA	Supervisory Control and Data Acquisition
SCVWD	Santa Clara Valley Water District
SFPUC	San Francisco Public Utilities Commission
SFWD	San Francisco Water Department
SJCA	San Joaquin Valley Pipelines Condition Assessment
SJPL	San Joaquin Pipeline
SSPL	Sunset Supply Pipeline
SVCF	Sunol Valley Chloramination Facility

SVWTP	Sunol Valley Water Treatment Plant
SWRCB	State Water Resources Control Board
TTF	Tesla Treatment Facility
UPS	Uninterruptible Power Supply
UV	Ultraviolet
VMS	Video management system
WO	Work order
WQD	Water Quality Division
WSA	Water Supply Agreement
WSTD	Water Supply and Treatment Division
WSIP	Water System Improvement Program
WEIP	Watershed and Environmental Improvement Program
WSP	Welded steel pipe

1. Overview

The 2016 update of the State of the Regional Water System report primarily conveys the state of the assets comprising the regional water system including asset inventories, condition, recent performance, project status, and notable milestones. The report is made available to customers and stakeholders and is frequently used internally for a number of reference purposes and budget preparation.

The report is also used to satisfy a contractual requirement in the July 2009 Water Sales Agreement among the San Francisco Public Utilities Commission (SFPUC) and its wholesale water customers (Section 3.10B):

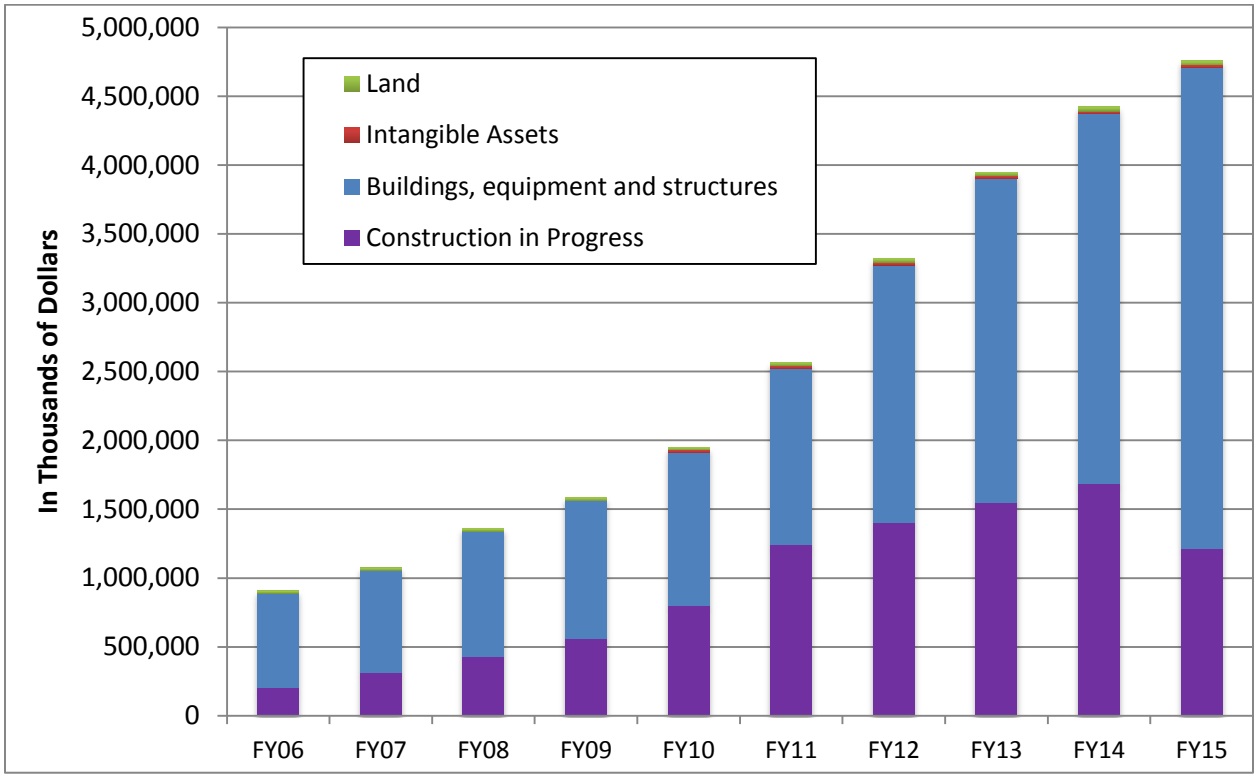
> *San Francisco will submit reports to its Retail and Wholesale Customers on the "State of the Regional Water System," including reports on completed and planned maintenance, repair or replacement projects or programs, by September of every even-numbered year, with reports to start in September 2010.*

Prior to 2014, reports focused on the regions encompassed by the SFPUC's Water System Improvement Program (WSIP), excluding assets within San Francisco. The 2014 version of the report presented the state of the entire Regional Water System (RWS) for the first time – adding upcountry assets to the ones located in the Bay Area counties. The 2016 report takes the integration further by incorporating assets throughout the system into a common structure and bringing levels of detail and asset management processes to a common standard where possible. The goal is to make the 2018 report even more seamless.

Value Added Under WSIP

As of September 2016, the $4.8 billion WSIP was over 90% complete, with the Calaveras Dam Replacement Project (CDRP) being the largest project still under construction. The program was initiated in 2002 to repair, replace, and seismically upgrade the system's pipelines, tunnels, water treatment facilities, reservoirs, pump stations, storage tanks, and dams to meet Levels of Service (LOS) goals and objectives. Accordingly, investments in capital assets have increased considerably over the last ten years. Consistent with the program's schedule, construction work declined in fiscal year 2015 (FY15) for the first time after steadily increasing for the prior ten years.

Figure 1-1: Water Investments in Capital Assets



The value of assets added to the RWS under WSIP and other capital programs requires an appropriate asset management strategy and sustainable budget to ensure performance of new and existing infrastructure into the future.

In FY16, the SFPUC began external review of its maintenance practices to ensure that critical maintenance could be objectively verified, and that its maintenance management systems were tracking completed work and uncompleted work. This effort is ongoing and is expected to take several years due to the volume of new and replaced assets in recent years. Baden Pump Station was chosen first to pilot the new maintenance review process – this facility is relatively simple, critical to operations, and was modified under WSIP. The Sunol Valley Chloramination Facility (SVCF) will benefit from a revised program after first refining maintenance practices at Baden Pump Station. Performance at the SVCF must be error-free as water immediately enters the transmission system after chemical treatment without the benefit of storage.

Looking to FY17 and beyond, integration of new conjunctive use groundwater wells into the RWS will require significant operational and maintenance efforts. About 6 million gallons per day (MGD) of dry year supply capacity should be on line by June 2017, with an additional 1 MGD following shortly thereafter once final well sites are selected. The Peninsula Pipeline Seismic Upgrade Project (Phase 3) began construction in early September 2016 and is expected to be substantially complete in the fall of 2017. Completion of this project will complete achievement of the seismic level of service objective.

Continuing To Invest

The right size matters, especially for the Capital Improvement Program (CIP). As shown in Figure 1-1, investments are now decreasing from the peak under WSIP. Based on the size of the CIP now (about $1,413M, including Hetch Hetchy water and joint assets), the SFPUC still expects to invest about $140M/year for the next 10 years. The year-to-year value of the ten-year CIP is important to monitor to ensure the right investments are made as assets age.

In practice, this rate of investment in capital projects necessitates an active planning function. Accordingly, during FY16, capital planning proceeded on two pipeline replacement projects following assessments that confirmed sub-standard condition of the assets: San Andreas Pipeline (SAPL) No. 2 (in and near the City of San Bruno) and Crystal Springs Pipeline (CSPL) No. 2 (in and around the Town of Hillsborough). Prior planning efforts over the last 15 years have been consolidated and characterized to ensure that all potential scope not addressed under WSIP or concurrent capital plans was reviewed and considered.

The recent dry hydrology greatly impacted water supplies across the state and led to state-directed water use restrictions throughout the state, including the SFPUC's service area. SFPUC staff were intensely busy in FY15 and FY16 completing drought-related projects that would help stretch water supplies. The efforts were highlighted by making emergency repairs to Lower Cherry Aqueduct (LCA) (damaged during the 2013 Rim Fire) and improving reliability of water transmission to the Sunol Valley Water Treatment Plant (SVWTP). Had the dry hydrology continued the SFPUC planned to utilize supplies from the Cherry-Eleanor system for drinking water for the first time in 30 years. Water from this part of the system can be introduced into Mountain Tunnel via LCA and must be filtered at the SVWTP, as these supplies do not have filtration avoidance approval. Fortunately, hydrology conditions improved in FY16 negating the need for the time being. However, the use of Cherry/Eleanor supplies for drinking water was fully tested in the winter of 2015 through an intensively coordinated effort among operations staff.

Another dry-year project involved equipping wholesale customer service meters with telemetry and implementing real-time water usage tracking via a customer accessible website. Usage data is updated daily and will eventually be used for billing. As of September 2016, nearly all of the meters have been converted and many customers are piloting the usage tracking on-line. This functionality helps customers, saves cost, and will greatly aid the administration of any water allocation restrictions should the SFPUC implement restrictions during drought.

Although the system's most critical conveyance vulnerabilities (in particular, seismic vulnerabilities) were addressed under WSIP, the repair of Mountain Tunnel became a SFPUC-wide priority in 2014. All Tuolumne-based supplies must be conveyed through Mountain Tunnel. Prior inspections revealed deterioration of the tunnel lining, necessitating an urgent project to either repair the existing tunnel or construct a new bypass around the damaged section. While parts of the organization focused on the necessary capital improvement, other staff focused on managing any outages of Mountain Tunnel. Unplanned outages could occur if the tunnel lining partially or totally fails prior to the improvements. Planned outages to support the improvements are expected to last 60-100 days in successive years beginning in 2017. These scheduled outages place higher stress on local supplies and operations.

Valuable inspections were performed on the Coast Range Tunnel and the original Irvington Tunnel in 2015 with favorable findings; each tunnel was found to be in good condition with little to no follow up work. Each inspection occurred under existing hazardous conditions (potential explosive gassy conditions) with a high degree of coordination between SFPUC staff and contractors – the 26-mile long Coast Range Tunnel inspection took over one year to plan and only three weeks to execute.

Measures of Performance and Improvement

Overall, regularly meeting LOS may be the most important indicator of success. Day to day reliability of the system is relatively easy to monitor while the system's response following a major seismic event is not. Success in meeting seismic LOS is tracked indirectly through infrastructure readiness and staff preparedness.

During the last two years spanning the reporting period, two incidents stand out. The first involved a major water quality incident in March 2015 after introduction of untreated water into the system at the San Antonio Pump Station (SAPS). The incident was caused by operator error during a routine operation. Although the system operators and customers worked diligently to minimize the exposure from the untreated water, ultimately 11 customers (10 wholesale plus 1 retail, NASA Ames Research Center) and the SFPUC were issued respective Tier 2 violations from the State. The citations required public notification of the "treatment technique" failure within 30 days and for the SFPUC, a multi-faceted corrective action plan.

The other incident occurred in July 2015 after a major rupture of SAPL No. 2 in the City of San Bruno. As a result water service for two wholesale customers and one retail customer was interrupted. End users were not affected as various alternative supplies and interties met demand in those service areas. Normally the SFPUC would have been able to maintain uninterrupted supply through existing redundancy, but at the time of the rupture, the parallel SAPL No. 3 was shutdown for WSIP construction. The subsequent inspection of SAPL No. 2 revealed major deterioration over hundreds of linear feet of the interior lining. This condition assessment led to a fast-tracked capital project.

In terms of water supply, the state is still in a drought, although the wetter hydrology in 2016 nearly recovered RWS-wide storage capacity. While no state-imposed rationing requirements are in effect, the SFPUC continues to call for a 10% voluntary reduction in demand from 2013 levels.

As for improvement, the SFPUC will continue to move forward by being more proactive. For example, LOS objectives are maintained by continuous evaluation of data gathered from maintenance and condition assessment reports and proactively identifying areas of risk. Redundancy is built in where practical, and risks are mitigated where feasible. When redundancy and mitigation efforts are not possible, additional monitoring is put in place to track and trend changes in performance and/or the integrity of critical assets.

2. Description of System Assets and Facility Condition

This section summarizes the general operation, inventory, and general condition of the assets comprising the RWS. Section 2.1 describes the major components of the RWS and their interconnectivity. Section 2.2 provides a brief overview of the assets contained in each of the major classes with detailed information described elsewhere in the report.

2.1 General Description of RWS

The RWS is owned and operated by the SFPUC and is comprised of two water systems, developed independently but operated as one. The first includes the local water system originally developed by the Spring Valley Water Company and purchased by the City of San Francisco in 1930. The Hetch Hetchy water system importing water from the Tuolumne River is the second; it was built by the City of San Francisco and brought on line in 1934. Today, operation of the unified system spans seven counties.

The RWS provides primary water supply for about 2.6 million people and related businesses in San Francisco, Santa Clara, Alameda, San Mateo, and Tuolumne counties. On average, 15 percent of the water delivered to SFPUC customers is derived from runoff in the Alameda and Peninsula watersheds. The remaining 85 percent comes from Sierra Nevada snowmelt and precipitation via the Tuolumne River and related facilities.

Once completed, groundwater wells located in northern San Mateo County will produce about 7.2 MGD of dry year supply as part of a SFPUC conjunctive use project with the cities of Daly City and San Bruno, and California Water Service Company. Another four MGD of groundwater will be produced from wells for retail delivery within San Francisco starting in 2017.

A schematic of the RWS is shown on Figure 2-1. O'Shaughnessy Dam impounds water along the main stem of the Tuolumne River, thereby creating Hetch Hetchy Reservoir. The watershed for Hetch Hetchy Reservoir is 459 square miles and is located entirely within Yosemite National Park. The Hetch Hetchy watershed is almost completely a federally designated wilderness area, and much of the watershed is only accessible by permit. Water collected in Hetch Hetchy Reservoir is intended for municipal use. Water can flow by gravity all the way from Hetch Hetchy Reservoir to downtown San Francisco.

The SFPUC's other two impounding reservoirs in the Tuolumne River basin, Lake Eleanor and Lake Lloyd (a.k.a. Cherry Reservoir), are used primarily to satisfy downstream flow obligations to the Turlock Irrigation District and Modesto Irrigation District (the Districts), maintain minimum instream flow releases below the reservoirs, produce hydroelectric power at Holm Powerhouse, and provide flows for recreational use (i.e., whitewater rafting).

Although Lake Eleanor and Lake Lloyd do not normally supply water directly to the Bay Area, water stored in these reservoirs is instrumental in preserving water in Hetch Hetchy Reservoir. Release of water from these reservoirs can partially fulfill the City's inflow obligations to the Districts, thereby allowing flow to be captured and retained in Hetch Hetchy Reservoir for diversion to the Bay Area.

Lake Eleanor is located approximately 3 miles above the confluence of Eleanor and Cherry Creeks. Lake Lloyd is located on Cherry Creek about 4 miles above the confluence with Eleanor Creek. Lake Eleanor and Lake Lloyd are linked by a tunnel and pump facilities that allow water to flow from Lake Eleanor to Lake Lloyd. As a result of this linkage, the two reservoirs are generally operated as a single unit.

Water that is not released to the river below Lake Eleanor and Lake Lloyd is diverted through Cherry Power Tunnel to Holm Powerhouse. Holm Powerhouse is located on Cherry Creek about 1 mile upstream of its confluence with the Tuolumne River. Up to 1,010 cubic feet per second (cfs) can be diverted through Holm Powerhouse and released into Cherry Creek which quickly combines with the Tuolumne River. These releases also support the City's inflow obligations to the Districts.

In drought conditions and with prior approval from the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW), water from Lake Lloyd and Lake Eleanor can be diverted by Lower Cherry Diversion Dam to the Early Intake Diversion Structure located on the Tuolumne River, where it would enter Mountain Tunnel to provide an alternative water source for consumption by RWS customers. When supplies from Lake Lloyd and Lake Eleanor are used, all diversions from the Tuolumne River must be filtered.

Water from Hetch Hetchy Reservoir is conveyed through the Canyon Power Tunnel to Kirkwood Powerhouse, where it can be used to generate power. Water from Kirkwood Powerhouse is discharged into Mountain Tunnel via the Early Intake Bypass Tunnel and Pipeline. Deliveries to Groveland Community Service District, in Tuolumne County, are made from waters pumped from Mountain Tunnel. Mountain Tunnel then conveys the Hetch Hetchy water to Priest Reservoir, after which it passes through Moccasin Powerhouse, again generating power. Water from Moccasin Powerhouse is discharged directly to Moccasin Reservoir. The State-operated Moccasin Fish Hatchery diverts up to 30 cfs from Moccasin Reservoir. From Moccasin Reservoir, Hetch Hetchy water travels via Foothill Tunnel to the Oakdale Portal. The Rock River Lime Plant injects hydrated lime at the Rock River shaft of Foothill Tunnel for corrosion control of the pipelines.

Local runoff that would normally flow into Priest and Moccasin Reservoirs is diverted around the reservoirs and discharged to Don Pedro Reservoir. Therefore, the water stored in Priest and Moccasin Reservoirs is primarily water from Hetch Hetchy Reservoir.

Large amounts of precipitation in the Moccasin Creek drainage area can result in an increase in Moccasin Creek elevation to the point of overtopping the upstream control point of the Moccasin Reservoir where it then mixes with water from Hetch Hetchy Reservoir. To assure uninterrupted delivery of clean Hetch Hetchy water, there are bypasses at both Priest and Moccasin Reservoirs that are used when needed to prevent unapproved water sources from entering the Foothill Tunnel and continuing through the RWS conveyance system.

The water supply enters Foothill Tunnel via the Moccasin Reservoir Bypass or the Moccasin Gate Tower. The water is treated at the Rock River Lime Plant, which is located along the Foothill Tunnel, and is used to adjust the pH of the water supply by injecting slaked lime (calcium hydroxide). The Foothill Tunnel terminates at Oakdale Portal where the San Joaquin Pipelines (SJPLs) begin.

As part of WSIP, four new assets were added: two sections of SJPL (SJPL4 East and SJPL4 West) and two crossover facilities (Emery and Pelican). Additional description is provided herein on the new assets and capability. Numerous SJPL flow rate combinations are available by using the Crossover Valves and/or the throttling stations. At the San Joaquin River Valve House, pressure-reducing valves provide pressure relief for the system and a means of drainage at the low point of the pipeline. The SJPLs terminate at the new Tesla Valve House, where the water is treated at the Tesla Treatment Facility (TTF). At the TTF, water is exposed to ultraviolet (UV) light, pH is adjusted, fluoride is added, and primary disinfection begins with the addition of chlorine.

The water then enters the Coast Range Tunnel, a 26 mile-tunnel terminating at Alameda East Portal in the Sunol Valley in Alameda County. A backup disinfection station is located at Thomas Shaft, approximately 4.5 miles downstream of Tesla Portal. Raw water entering the Coast Range Tunnel is considered appropriately disinfected upon reaching Alameda East Portal. Alameda East Portal is considered a point of entry for drinking water permit purposes.

At Alameda East Portal, water from the Tuolumne River is split among four Alameda Creek Siphons. Under normal operating conditions, ammonia is added to form chloramines at the SVCF in the mixing chamber before reaching Alameda West Portal where water enters the 3.5-mile long Irvington Tunnels. Tuolumne River water can also be diverted to San Antonio Reservoir or the SVWTP. The Calaveras and San Antonio Reservoirs collect local runoff from their surrounding watersheds to supplement Tuolumne River water. All local reservoir water in the East Bay is conveyed to SVWTP where it is treated prior to entering the Alameda Siphons.

From the Irvington Tunnels, the blend of Tuolumne River water and water treated at SVWTP is split into the five Bay Division Pipelines (BDPLs) at the Irvington Portal in Fremont. BDPL Nos. 1, 2, and 5 continue west from the Irvington, entering the new Bay Tunnel under San Francisco Bay from Newark to the Ravenswood area, then re-entering BDPL Nos. 1, 2, and 5 to the Pulgas Tunnel west of Redwood City. The Bay Tunnel was commissioned in 2014 and replaced two existing underwater pipelines. BDPL Nos. 3 and 4 travel south from the Irvington Portal and follow the south shore of San Francisco Bay through Santa Clara, Sunnyvale, Mountain View, Stanford Tunnel, and Palo Alto to the Pulgas Tunnel just west of Redwood City where all five pipelines meet. Water in the Pulgas Tunnel may be diverted into the Crystal Springs Bypass Tunnel when needed to meet demands on the Peninsula; when no demand exists, water continues to the Pulgas Temple and flows into Upper Crystal Springs Reservoir after being dechloraminated at the Pulgas Dechloramination Facility. The Palo Alto Pipeline is supplied by BDPL Nos. 1, 2 and 5, and supplies water south from Redwood City to Palo Alto, Stanford and Menlo Park.

North of the Crystal Springs bypass facilities, Hetch Hetchy/SVWTP water is transmitted north along the Peninsula into the City of San Francisco's low-pressure zone system via the Sunset Supply Pipeline (SSPL) and CSPL Nos. 1, 2 and 3. The terminal storage for low-pressure zone water consists of the University Mound Reservoir in San Francisco, which is supplied from CSPL Nos. 1 and 2. The SSPL low-pressure zone water is transmitted north along the Peninsula to the Lake Merced Pump Station in San Francisco where it is pumped into the high-pressure

zone. Water from Lake Merced Pump Station either serves demands directly or is stored in Sunset Reservoir and Sutro Reservoir in San Francisco.

The San Mateo Creek watershed on the Peninsula supplies Lower and Upper Crystal Springs Reservoirs. Pilarcitos Creek watershed supplies are also used to supply Lower Crystal Springs Reservoir. The Upper San Mateo Creek watershed supplies San Andreas Reservoir with a small amount supplemented by the Pilarcitos watershed via the San Mateo pipeline. Water from Lower Crystal Springs Reservoir is transferred to the San Andreas Reservoir through the Crystal Springs Pumps Station and Crystal Springs-San Andreas Pipeline. The Harry Tracy Water Treatment Plant (HTWTP) draws from San Andreas Reservoir for supply and produces high-pressure zone water. Treated water from HTWTP is transmitted through SAPL Nos. 2 and 3 and the Sunset Branch Pipeline. SAPL Nos. 2 and 3 reach high-pressure zone reservoirs in San Francisco. The Sunset Branch Pipeline connects high-pressure zone to low-pressure zone water in the SSPL through a pressure reducing valve at the Cappuchino Valve Lot in Millbrae. In Colma at the San Pedro Valve Lot, SAPL No. 3 is interconnected with SSPL and north of this point is utilized for low-pressure zone water transmission to Merced Manor Reservoir. (This replaces the function previously provided for by the abandoned Baden-Merced Pipeline.) Baden Pump Station allows low-pressure zone water from CSPL No. 2 to be pumped to each of the high-pressure zone pipelines. Baden Pump Station can also be used to transfer high-pressure zone water into the low-pressure zone pipelines. These inter-zone connections at San Pedro Valve Lot, Baden Pump Station, and Cappuchino accomplished through WSIP greatly increase operational flexibility, particularly during construction work and during emergencies.

The Pilarcitos watershed and reservoir to the west of San Andreas Reservoir is used to partially supply the Coastside County Water District and also supply the RWS via inter-basin transfers.

A major upgrade of the RWS facilities began in 2002[1] with the initiation of WSIP. Most of the projects were completed prior to FY16. As of September 2016, five projects remain to be completed, the largest being CDRP. WSIP has significantly increased the reliability of the water system and is discussed in detail elsewhere in this report.

2.1.1 Raker Act and Water Bank

The SFPUC constructed, operates, and maintains the Hetch Hetchy RWS and power facilities pursuant to the Raker Act. The Raker Act grants SFPUC perpetual rights-of-way on federal lands for O'Shaughnessy Dam and related facilities subject to certain terms and conditions. Pursuant to the Raker Act and State water law, the SFPUC operates the water and power facilities primarily for water supply, and secondarily for hydropower generation. The system is also operated to meet minimum streamflow requirements under agreements with the Department of Interior (DOI), and to provide for whitewater rafting when water is available to do so.

The Raker Act requires SFPUC to bypass certain flows to meet the senior water rights of the Districts, located downstream. The Raker Act also specifies sanitary regulations in the

[1] The SFPUC approved the Long-Term Strategic Plan and CIP in May 2002, followed by voter approval of revenue bond authority in November 2002. The first WSIP description (then referred to as the CIP) was submitted to the State in February 2003.

watershed, optimizes local supplies to minimize diversions from the Tuolumne River, and prohibits the sale of Hetch Hetchy water and power to private entities for resale.

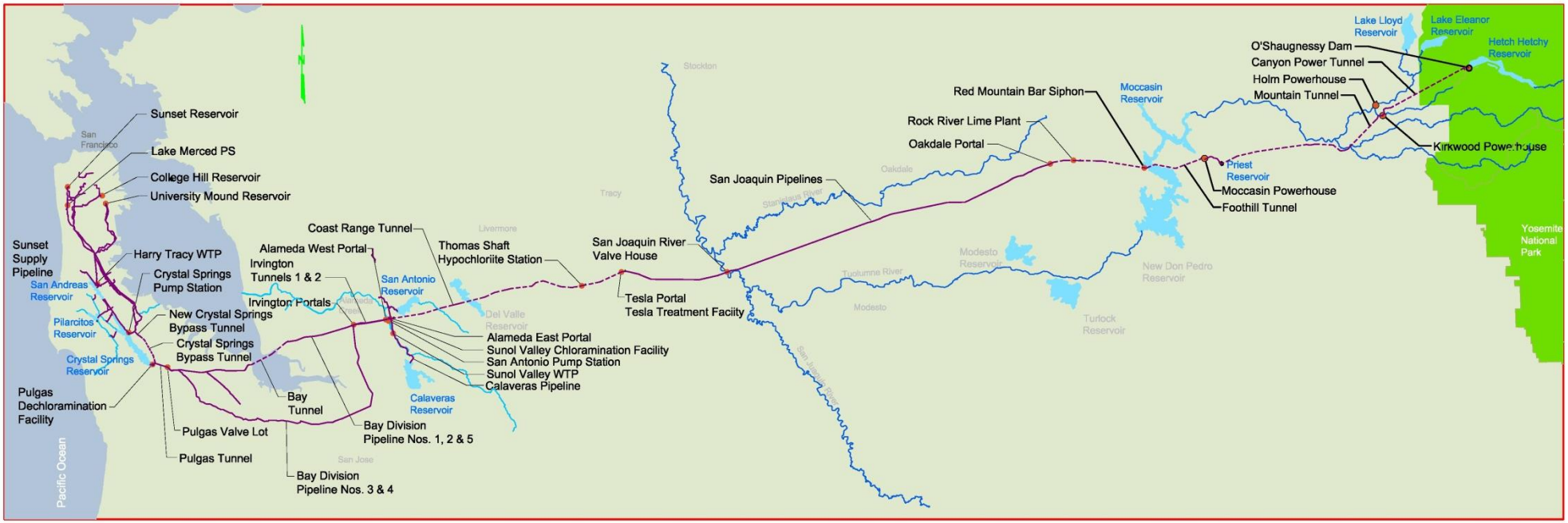
One of the agreements between the SFPUC and the Districts allocates storage space in Don Pedro Reservoir as a "Water Bank Account" for the SFPUC. The SFPUC cannot and does not directly divert water from Don Pedro Reservoir into the RWS; however, the Water Bank Account allows the SFPUC to balance the Districts' Raker Act entitlements with system operations. In essence, the Water Bank Account grows when the inflows to Don Pedro Reservoir are greater than the Districts' entitlements. Conversely, the SFPUC debits the Water Bank Account when it impounds water at its reservoirs that would otherwise be within the Raker Act entitlements of the Districts. The SFPUC has agreed not to construct means to physically remove water from Don Pedro Reservoir, and cannot, without the prior agreement of the Districts, have a negative balance in the water bank.

The Water Bank Account is limited by the maximum allocation of the Water Bank Account storage, which in turn depends upon whether the Districts are required to maintain a flood control reservation in Don Pedro Reservoir. During the months October through March, the Districts must maintain a flood control reservation of no less than 340,000 acre-feet (AF), which limits the maximum storage of the reservoir to 1,690,000 AF. Whenever the actual storage in Don Pedro Reservoir is equal to or less than 1,690,000 AF, the maximum Water Bank Account storage is limited to 570,000 AF. From the beginning of April through September, when flood control restrictions do not apply at Don Pedro Reservoir, and the Districts, at their sole discretion, allow overall storage in Don Pedro Reservoir to exceed 1,690,000 AF, the SFPUC has temporary use of up to 170,000 AF of additional storage. Because these increases in the maximum allocation of Water Bank Account storage are temporary and must be evacuated at the start of the flood control season, the SFPUC does not depend on these temporary seasonal increases for purposes of long-term water-supply planning

2.1.2 Operational Organization

The Hetch Hetchy Water & Power (HHWP) Division is responsible for the operation and maintenance of the water supply and conveyance system facilities from Hetch Hetchy Reservoir to Tesla Portal (with some duties extending to Alameda East Portal). Including the Cherry-Eleanor System, the inventory includes three impoundment reservoirs, two regulating reservoirs, four powerhouses, three switchyards, one substation, 230 miles of pipelines and tunnels, 250 miles of improved and unimproved roads, 240 miles of electric transmission/distribution lines, watershed lands and right-of-way (ROW) property. Beginning at the Telsa Treatment Facility, the Water Supply & Treatment Division (WSTD) manages all facilities downstream including Thomas Shaft and day-to-day valve operations at Alameda East Portal, extending west through the Bay Area components of the RWS up to the City and County of San Francisco. The Natural Resources and Lands Management Division (NRLMD) oversees the operation and maintenance of SFPUC-owned watershed and ROW lands, and is responsible for environmental regulatory compliance for operations and maintenance of the water supply system and watershed and ROW lands. The Water Quality Division (WQD) provides laboratory services, compliance monitoring, process engineering, regulatory reporting, and technical support for both HHWP and WSTD in operation of the RWS.

Figure 2-1: Schematic of Regional Water System



2.2 Description of Facilities

This section outlines the seven general asset categories and includes a brief condition assessment of the facilities and assets within each category. Where applicable, pending inspections and capital work are referenced.

2.2.1 Water Supply and Storage Facilities

Dams

A list of RWS dams is provided in Table A-1. Outlet piping, valves and spillways are considered to be part of each dam for asset classification purposes. All dams in the RWS are regularly monitored and surveyed independent of capital work. The state of the regular dam inspection and monitoring program is outlined in Section 4.1.1. For jurisdictional dams, annual field inspections are conducted in conjunction with the California Department of Water Resources (DWR) Division of Safety of Dams (DSOD).

O'Shaughnessy Dam

To date, regular annual inspections of O'Shaughnessy Dam has not revealed a need for capital work on the dam itself. Most capital and maintenance work at this facility is limited to the outlet works and spillway that release water from Hetch Hetchy Reservoir to Canyon Tunnel and the Tuolumne River. These projects were identified by a 2009 condition assessment and through the SFPUC dam inspection and monitoring program (as stated in Table 5-2, a detailed condition assessment was performed on the discharge facilities in 2009, not to be confused with a regular, less detailed annual inspection of the entire dam). The scope identified from the 2009 condition assessment is large and has been divided into a series of seven smaller subprojects based on priority, budget, type of construction, and location. This information was summarized into a "Planning Report" which was completed in 2015 and used as the baseline strategy for the overall project.

Four of the seven projects are identified in the 10 year capital plan and will be completed prior to year 2022. These projects are:

- Drum Gate Automation (currently in construction)
- Access & Drainage Improvements
- Drum Gate Rehabilitation
- Installation of New Bulkhead System & Butterfly Valve and Rehabilitation of Slide Gates

The SFPUC recently advertised a request for proposal (RFP) to secure the specialized professional services required to complete the remaining planning and design tasks associated with the approved subprojects; notice to proceed is anticipated by the end of 2016.

HHWP will propose the remaining three projects in the future capital plan:

- Replacement of 72" Needle Valve & Rehabilitation of 72" Butterfly Valve
- Replacement of 60" Needle Valves & Controls
- Diversion Tunnel Rehabilitation

These projects from the 2009 condition assessment will improve safety and functionality of the reservoir release system and are not deemed to be critical at this time. The release valves need to be upgraded due to their age and the safety concerns that have become apparent since their installation. Safety concerns are primarily related to the seven balance needle valves. HHWP will propose these projects in the future capital plan.

A formal condition assessment of the entire O'Shaughnessy Dam is planned to begin in FY22 and be completed by FY23. The more comprehensive condition assessment at O'Shaughnessy planned for FY 22-23 is a detailed condition assessment for all large, older assets, in order for HHWP to have a better understanding of current condition and additional investments that may be required over the next 20 year period.

Cherry Dam

To date, regular inspection of Cherry Dam has not revealed a need for capital work on the dam itself. Most capital and maintenance work at this facility is limited to the outlet works and spillway that release water from Cherry Dam to Cherry Creek. Two projects have been identified through a 2012 condition assessment and through normal operations. The first project includes replacing the 66-inch hollow jet valves with 66-inch fixed cone type energy dissipating valves and motor operators. The Cherry Valve House has two 66-inch hollow jet valves and three 84-inch butterfly valves that were installed in 1956. The existing configuration provides one butterfly at the inlet to the Cherry Power Tunnel. The other two butterfly valves serve as guard valves for the hollow jet valves. The two hollow jet valves that discharge into Cherry Creek are primarily used to regulate the Cherry Reservoir storage and prevent flow from discharging over the spillway. Both valves are currently out of service due to excessive leakage, and cost to repair the valves is more costly than replacement. This project is in construction and will be completed early 2018.

The second project is to correct deficiencies in the spillway channel leading from the dam spillway back to Cherry Creek. The Cherry spillway is designed to a capacity of about 52,000 cfs. However, the spillway channel to Cherry Creek can only accommodate about 300 cfs. To optimize the SFPUC carryover storage, the spillway channel must be improved. A formal condition assessment of Cherry Dam is planned to begin in FY21 and be completed by FY22. This assessment will include a recommended capacity for the new spillway channel. Following this condition assessment, HHWP will propose projects in the future capital plan.

Eleanor Dam

A formal condition assessment of Eleanor Dam was completed in 2016. The assessment documented the overall condition of the dam and identified multiple deficiencies that need to be corrected including:

- Strength of the bridge that spans across the dam needed to support the loads required by American Association of State Highway and Transportation Officials (AASHTO) (bridge code)
- Spillway capacity to avoid dam overtopping

- Leakage through the lift lines[2]; if not corrected, the overall life of the asset will be reduced

In short term, HHWP will limit the load on the bridge and continue to monitor the dam condition under the Dam Safety Program. HHWP will propose projects in the future capital plan to address deficiencies and extend the life of the asset.

Priest Dam

A review of monitoring data in August 2013 identified several data deficiencies in the piezometer system to that needed to be addressed to ensure that the integrity of the dam could be monitored. Additionally, the review identified the need for future geotechnical investigations and analyses to address the dam's overall stability. HHWP initiated a project to design and construct new monitoring instrumentation as well as perform an overall condition assessment of the dam, including an updated stability analysis. This project will be completed by 2020. Based on the nature of the deficiencies and risks, the timeframe is adequate and the priority of this project is not as urgent as other projects. If additional scope is identified through condition assessment, HHWP will propose new projects in the future capital plan.

Moccasin Dam

To date, regular inspection of Moccasin Dam has not revealed a need for capital work. A formal condition assessment is planned in FY24. If projects are identified through condition assessment, HHWP will propose projects in the future capital plan.

Early Intake Dam

A condition assessment of Early Intake Dam was completed in March 2014. Early Intake Dam and spillway have a long history of structural degradation and extensive seepage due to alkali-aggregate reaction[3] in the concrete. Even after repair work, seepage and structural cracks continue to develop on the dam surface, crest and gravity thrust blocks. Historical survey data indicates continuing movement of the concrete arch structure, which may lead to failure of the dam. A needs analysis of the asset is planned for FY26. Based on the outcome of this analysis, replacement or removal of this asset will be proposed in HHWP's future capital plan.

Calaveras Dam

Since 2002, Calaveras Dam has been lowered to 40 percent of design capacity (705' elevation) due to seismic safety concerns and DSOD requirements. The SFPUC is presently replacing the dam with a new structure of earth and rock fill. The dam will provide equal storage capacity and improved seismic design and is being constructed immediately downstream under WSIP as CDRP. During construction the working elevation of the reservoir is often lower than 705' to ensure construction activities are not affected. During much of 2016 the reservoir was

[2] The entire height of an arch dam is not constructed from a single concrete placement. Instead, the dam consists of multiple smaller placements of concrete, commonly referred to as "lifts", that are typically between 2 and 5 feet thick. Each lift is placed on top of each other until the desired overall dam height is achieved. The horizontal joint that forms between each lift is referred to as the "lift line" and is designed and constructed to be watertight.
[3] Alkali-silica reaction, is a reaction in concrete between the highly alkaline cement paste and the reactive silica found in aggregates. These aggregates are native to the Moccasin area.

completely off-line due to work on the new outlet piping. The reservoir and new outlet piping will be in service by December 15, 2016. The new spillway was completed in early 2016, a major safety milestone.

Upon completion (expected in 2019), Calaveras Reservoir will return to being the system's largest local reservoir and will represent more than half of the SFPUC storage capacity in the Bay Area.

Turner Dam (San Antonio Reservoir)

Turner Dam is the newest dam in the system. There are no structural issues with the dam and no known safety concerns. In the annual DSOD inspection, the adit structure valves were found to be corroded. Corrosion protection of those valves were addressed in FY15. More detail is found in Section 4.

Upper Alameda Creek Diversion Dam

The Upper Alameda Creek Diversion Dam is structurally sound but the sluicing gates have limited operational ability and significant sedimentation has accumulated upstream. The entire structure is now being modified under the CDRP and will include a new fish passage ladder and screened intake into the diversion tunnel that leads to Calaveras Reservoir. Diversions through the tunnel to Calaveras Reservoir have not been performed since the winter of 2011-2012 and may not occur until more storage is available in Calaveras Reservoir. Downstream bypass flows have been provided consistent with the construction permitting requirements.

Lower Crystal Springs Dam (LCSD)

On the Peninsula, most WSIP efforts focused on LCSD. In 1983, DSOD mandated that the maximum allowable water surface elevation of Crystal Springs Reservoir be lowered by 8 feet because of hydraulic deficiencies that render the dam's spill capacity inadequate to safely pass a Probable Maximum Flood event (the largest theoretical flood event for a given drainage area). The lower maximum operating elevation reduces the storage capacity of the reservoir by 16%, resulting in a loss of 2.6 billion gallons of water storage. Under WSIP, necessary improvements were made in 2012 allowing the dam's spillway to safely pass the Probable Maximum Flood event, and thereby restoring maximum storage capacity of the reservoir. The project widened the spillway, raised the parapet wall, and replaced the stilling basin with a new, larger facility. Native plant mitigation is required by permits before the restored maximum storage capacity can be fully utilized under the conditions of federal and state environmental permits. In FY12 the structural integrity of the original concrete was confirmed with the first borings into the dam in 40 years. A stability study was completed in FY12 using this new field data and is discussed below. A WSIP project also retrofitted the reservoir outlet facilities as part of the Crystal Springs-San Andreas Transmission Upgrade Project. As required under the conditions of federal and state environmental permits, the SFPUC has been making continual releases to San Mateo Creek since January 2015.

Upper Crystal Springs Dam

Upper Crystal Springs Dam is a non-DSOD jurisdictional dam that separates upper and lower Crystal Springs Reservoirs. Highway 92 is built on top of the structure. Although the dam

crosses the San Andreas fault, no improvements to the dam are planned. The culverts conveying water into lower Crystal Springs Reservoir were repaired and strengthened under WSIP. There is no isolation between the upper and lower reservoirs (as directed by DSOD).

San Andreas Dam

San Andreas Dam is also in close proximity to the San Andreas fault but there are no known structural problems (the San Andreas fault passes to the east side of the left dam abutment). No improvements to the dam are planned. Minor structural maintenance was performed on the spillway in 2014. WSIP upgrades to the inlet structure to HTWTP were completed in 2014.

Pilarcitos Dam

The SFPUC continues to investigate Pilarcitos Dam in conjunction with DSOD. Pilarcitos Dam is the oldest DSOD-regulated dam in the system. After an initial geotechnical investigation of the dam, the SFPUC and DSOD determined that further investigation of the dam and its foundation, as well as a structural investigation of the outlet works, was necessary. During FY14 the SFPUC completed minor restoration to the spillway gate and to the outlet access structure. Technical work related to geotechnical data review, material characterization, and seismic design criteria were completed in FY16 and are now under DSOD review. The SFPUC anticipates a capital project and other improvements will be necessary for the Pilarcitos system and has included funding in the CIP.

Stone Dam

Stone Dam, located downstream of Pilarcitos Reservoir, is in satisfactory structural condition, but structural deterioration of the spillway access structure prevents operational use of its stop logs, and the reservoir storage capacity is severely limited due to sediment deposition and lack of regular dredging. Stone Dam is a non-DSOD jurisdictional dam. Releases below Stone Dam have been made since October 2006 to support native wildlife, including steelhead, downstream in Pilarcitos Creek.

San Mateo Creek Dam No. 1

Various vegetation removal activities have recently been completed on San Mateo Creek Dam No 1. (also referred to as Mud Dam) to improve its structural integrity. San Mateo Creek Dam No. 1 is a non-DSOD jurisdictional dam and presently is not operated (overflow is conveyed to Lower Crystal Springs Reservoir via San Mateo Creek).

San Mateo Creek Dam No. 2

The impoundment behind San Mateo Creek Dam No. 2 is nearly filled with silt (approximately 600 cubic yards was removed in 2008), but the dam is structurally sound. San Mateo Creek Dam No. 2 is a non-DSOD jurisdictional dam. Long-term, this dam is useful because water can be diverted behind this dam and conveyed by gravity to San Andreas Reservoir if the connecting pipeline is repaired.

Wells

Groundwater wells represent both the newest and oldest facilities in the RWS. Table A-2 includes an inventory list of groundwater wells. The Pleasanton Well Field was constructed by the Spring Valley Water Company beginning in 1898. Water produced by the wells was conveyed to the Sunol Water Temple via a 30-inch pipeline completed in 1909. Water was then routed into the Sunol Aqueduct. Today the well field consists of two functioning wells that serve the Castlewood system without connection to the RWS. Meanwhile, on the Peninsula the Regional Groundwater Storage and Recovery Project, part of WSIP, will coordinate use of both groundwater and surface water to increase water supply reliability during dry years or during emergencies. Project wells are located in San Mateo County and will be used in coordination with California Water Service Company, the City of Daly City and the City of San Bruno who purchase wholesale surface water from the SFPUC and also independently operate groundwater production wells for their own use. Twelve wells are under construction and performance testing will begin in late 2016 and 2017. Three additional wells (for a total of 15) will be constructed in the near future, although siting of two out of those three wells is still pending.

Supply Reservoirs

Reservoirs and dams, as separate facilities, have differing maintenance programs and schedules. Maintenance, repair, and replacement activities related to supply reservoirs (listed in Appendix A, Table A-3) include limnological monitoring, application of algaecide, maintenance to aeration (or oxygenation) systems, boating facilities, and outlet structures. Hypolimnetic oxygenation systems (HOSs) were installed for Calaveras and San Antonio Reservoirs in 2006 and 2008, respectively, to improve water quality and support native fishes in the reservoirs. A system for Pilarcitos is being considered in conjunction with the other planned capital upgrades to the Pilarcitos system.

In 2009, the SFPUC began testing use of sodium percarbonate as a less environmentally harmful alternative to copper sulfate for algae management. Applications to date have been limited to Calaveras Reservoir and Moccasin Reservoir, although if algae conditions warrant it, application on any of the SFPUC's reservoirs would be considered. Sodium percarbonate is generally less effective than copper sulfate and considerably more expensive, but when used properly the product controls certain types of algae blooms. Outlet structure repairs to Crystal Springs, Calaveras, and San Andreas Reservoirs were completed under WSIP, including seismic upgrades.

Treated Water Storage

The treated water storage reservoirs listed in Appendix A, Table A-4 require regular water quality and security monitoring, extensive Supervisory Control and Data Acquisition (SCADA) instrumentation maintenance, regular removal of sediment, and structural upgrades. The north basins of University Mound and Sunset Reservoirs were seismically upgraded under WSIP. General rehabilitation to Sunset Reservoir included repair of deteriorated concrete, replacement of the reservoir liner, replacement of inlet piping, and installation of security fencing. The inlet piping to the south Sunset Reservoir basin was damaged during a pressure surge and was repaired in FY15. The roof of the Pulgas Balancing Reservoir was re-built under WSIP to improve seismic performance. The Town of Sunol treated water tanks were replaced in FY16 as

part of the fire suppression system upgrade for the town. No extensive capital work is planned for Merced Manor Reservoir following work completed as part of the 1998 A&B bond-funded seismic upgrade project (although a minor liner repair project is planned for 2018), nor is any major work planned for the much smaller Castlewood Reservoir as both of these facilities are in generally good condition.

2.2.2 Water Transmission Facilities

Pipeline Inventory and Condition

Pipelines of the RWS range greatly in terms of installation date, pipeline material, pipeline condition, and operational importance. The present inventory is shown in Table A-6. A graphical summary of pipeline and tunnel installations by material and installation date is shown in Figure 2-2. A graphical representation of pipeline and tunnel inventory by material and installation date is shown in Figure 2-3.

Bay Division and Peninsula Pipelines

Transmission projects completed by the Spring Valley Water Company between 1890 and 1930 were constructed using either cast iron or wrought steel[4]. Cast iron pipeline joints consisted of large swaged bell ends, into which a plain spigot end was inserted. Joints were sealed with leaded caulking material. The three submarine pipelines beneath Dumbarton Strait represented the last reaches of the RWS still utilizing cast iron; they were de-commissioned in the fall of 2014 after the Bay Tunnel was brought into service. The only remaining leaded content in the RWS is within limited brass appurtenances and meters which have trace amounts of lead which will be phased out over time. Additionally, an ~ 800 foot-long leaded seam was discovered in Irvington Tunnel No. 1 during the inspection in 2015. The SFPUC will cover the seam with an epoxy coating (or equivalent) during the next service opportunity. Collectively these areas are not considered to present a significant health risk to customers, particularly when coupled with the corrosion control for the RWS. Recent sampling also confirms that the RWS easily complies with concentrations outlined in the lead and copper rule (LCR).

Joints for wrought steel pipelines were riveted, as were the longitudinal seams that sealed the edges of the rolled steel plates. Active pipelines from this period are a portion of the original SAPL No. 1, the 54" portion of CSPL No. 2, and BDPL No. 1. The three submarine pipelines beneath Dumbarton Strait (now out of service) are cast iron.

A brief period during the 1920's, design for large diameter pipelines utilized a longitudinal mechanical "lockbar" that fastened the edges of rolled steel plates, thus replacing longitudinal rivet courses. Only one such pipeline remains active, the 54" SAPL No. 2, constructed in 1928; SAPL No. 2 has riveted joints (except north of Merced Manor where the pipeline is welded steel). Many sections of the lockbar pipeline are now scheduled for replacement following a major failure in July 2015 which revealed significant corrosion.

Welded steel pipe (WSP) was developed in the early 1930s, and most construction contracts for the RWS utilized WSP during this time. Longitudinal seams are welded in the shop during

[4] Original wooden flumes dating to the 1860's used to convey water to San Francisco (no longer in use) are still present in the Pilarcitos watershed.

fabrication with an automatic arc welding process. Circumferential joints are arc welded in the field by hand.

Also during the 1930s reinforced concrete cylinder pipe (RCP) was developed: a steel cylinder with high-strength concrete is cast on both sides of the cylinder. Reinforcing steel bars are embedded in the concrete outside the cylinder. Portions of BDPL Nos. 2 and 3 and the upstream portion of BDPL No. 1 are RCP.

Pre-stressed concrete cylinder pipe (PCCP) was developed in the 1950s. The design utilized less steel in pipe and relied on high-strength wire wound to high tension around a concrete core to develop compressive strength in the pipe. In the 1960s, the SFPUC began to offer PCCP as an option to bidders for pipeline construction. Two sections of BDPL No. 4, Alameda Siphon No. 3, portions of CSPL No. 3, and the Crystal Springs Bypass Pipeline were constructed with PCCP, for a total of 28 miles, all completed by 1988. Because PCCP can fail suddenly and violently, the SFPUC no longer offers PCCP as an option for new pipelines. WSP is specified instead. Steel pipes initially cost more than PCCP, but do not have the catastrophic failure consequences. The required internal inspection frequency and the cost of the inspections are also less with steel pipe. Repairing leaks on steel pipes can be done more efficiently and with less complication and cost. With proper corrosion protection, steel pipes should last longer. Therefore, the life-cycle cost of steel is likely less expensive than PCCP.

Appendix D contains a table listing the inventory and condition of RWS (active) pipelines and tunnels. The table provides information about pipeline and tunnel material, lining and coatings as well as leak history and summarized results from inspections, construction modifications, cathodic protection (CP), and maintenance. A significant part of the maintenance program is dedicated to pipeline and tunnel inspection and repair (see Section 4.1). Additionally, the RWS experiences between 3 and 5 leaks per year that require immediate repair. Most of these leaks are repaired without a pipeline shutdown or de-pressurization. Others, such as failures of pre-stressed pipeline, require complete pipeline de-watering and internal repair or replacement of individual pipeline segments.

Appendix A also provides other pipeline and tunnel specifications including length, capacity, and installation date. In addition to this report, the SFPUC's "Data Book" (updated in 2011) provides extensive detail on pipelines and tunnels.

WSIP included seven additional conveyance facilities: Alameda Siphon No. 4, San Antonio Backup Pipeline (SABPL), New Irvington Tunnel (NIT), BDPL No. 5, New Crystal Springs Bypass Tunnel, extension of SAPL No. 3, and SJPL No. 4. Additionally, 16 sections of CSPL No. 2 will be repaired. The CIP includes placeholder pipeline rehabilitation and replacement (R&R) projects that will be initiated following WSIP. To date, these projects include replacement of additional reaches of SAPL No. 2 and additional repairs to CSPL No. 2 not covered under WSIP, additional seismic upgrades to SAPL Nos. 2 and 3 not covered under WSIP, and repair or replacement of BDPL No. 4, sections A and D (PCCP sections).

Also, based on an inspection in December 2009, repairs to the interior cement mortar lining of BDPL No. 4, Section B, will be about $2 million and is included in the CIP (Water Transmission Program). Repairs will be spread throughout the full length of BDPL No. 4, Section B, about 47,400 feet with roughly 15,000 square feet of affected area.

San Joaquin Pipelines

The SJPLs convey water from the Foothill Tunnel to the TTF. SJPLs No. 1, No. 2 and No. 3 vary in age from 47 to over 80 years old. SJPL No. 4 (consisting of two, discontinuous sections) was completed in 2014. SJPL No. 3 is constructed of PCCP. All others are lined/coated WSP. SFPUC staff use eddy current technology to inspect the PCCP (last performed in 2009) and acoustic fiber optics to monitor additional wire breaks.

In 2013, the monitoring program recorded multiple failures in one PCCP section. In response, the SFPUC took this section of the system out of service in order to design and construct a repair. The repair project was constructed between December 2013 and April 2014 after which the pipeline was returned to service.

For WSP, HHWP utilizes two inspection techniques: external inspection performed through excavations and internal inspection using an in-line inspection tool. The tool identifies areas of thin wall that require repair and/or replacement of long sections of pipe with significant corrosion.

About 11 miles of SJPL No. 1 have been inspected with the in-line tool (2009 and 2010). Areas for rehabilitation have been located and corrected. The largest rehabilitation project was just completed on SJPL No. 1 just east of San Joaquin Valve House (replacement of 165 feet of pipeline). The in-line tool has demonstrated that where inspection has been performed on SJPL No. 1, the pipeline is in good condition. With areas of concern identified and corrected, the asset is expected to perform well with a reduced likelihood of unplanned outage in areas where inspection has been performed.

In-line condition assessment will be performed on about 39 miles of SJPL No. 1 in 2016. Of the 39 miles, about 7 miles will be reassessment of pipe last inspected in 2009 and 2010. The purpose if the reassessment will be to estimate the rate of growth of corrosion to determine effectiveness of the CP program and remaining life of the pipeline. The upcoming condition assessment will cost less than $5 million and if condition assessment results of this 80 year old pipe are similar to the 2009 and 2010 inspections, the majority of pipeline will still have many years of service remaining. The cost to replace 11 miles of 80 year old pipe is about $63 million. In-line inspection has proven to be an effective solution to evaluate the condition of the asset, perform cost effective rehabilitation to extend the life of the asset, ensuring maximum return on investment to the rate payer.

Over the next 10 years, HHWP plans to continue performing in-line inspections on sections of pipeline that have not been inspected over the last 10 years, including:

- SJPL No. 1: Oakdale Portal to Emery Crossover
- SJPL No 2: Emery Crossover to Tesla Portal
- SJPL No. 3: Emery Crossover to Tesla Portal

However, recent discoveries following WSIP construction have complicated safe entry to the SJPL's for maintenance/inspection/emergency repair. HHWP relies on single point isolation butterfly valves for protection. Currently the valves at Roselle, Pelican, Tesla and the Line 3/4 tie-in on the east side are undersized for static head conditions. Specifically, if either the

crossover or in-line valves were to close at Roselle, Pelican or Tesla, stopping all flow, the static head would reach the Oakdale Portal elevation. The pressure resulting from this elevation exceeds the rating on the in-line and crossover valves at these locations, exposing maintenance personnel to potential engulfment. To perform the upcoming condition assessment on SJPL No. 1, the pipeline was isolated from the SJPL network to ensure safe entry to the pipeline. The SFPUC is currently evaluating how to correct this issue. The corrective project will compete with funds allocated to perform condition assessment of the pipeline in the current 10 year CIP.

Additionally, a project is required to address releases from San Joaquin Valve House into Elliot Cut at the San Joaquin River. Construction of the UV facility at TTF was substantially completed in 2011. Historically, a surge tower located at Tesla provided protection for the SJPL's in the event of valve closure at any of the three Tesla Valve Houses. The protection that the surge tower provided was eliminated as part of the TTF construction. To reestablish protection for the lower reaches of the SJPL's following completion of the TTF facility, the pressure relief valves (PRV's) at the SJVH were upgraded. The new PRV's are electric motor actuated sleeve valves that are designed to open automatically in response to high pipeline pressure events; for example, due to a transient surge condition in the pipeline. In addition, the PRV's can be individually opened manually and used for pipeline dewatering purposes. The PRV's dissipate into Elliot Cut, part of the San Joaquin River National Wildlife Refuge owned by the US Fish & Wildlife Service, and then eventually flows into the San Joaquin River.

HHWP operates the SJVH PRV discharge systems under the authority of a Low Threat Dewatering General Order (Permit). The Permit requires that "The pH of all dewatering and other low threat discharges within the Sacramento and San Joaquin River Basins (except Goose Creek) shall at all times be within the range of 6.5 and 8.5". HHWP maintains a high pH (up to 10.3) in the SJPL's to prevent deterioration of the concrete pipe lining. During planned releases, HHWP installs temporary equipment to treat the water being released from the PRV's to stay within the Permit requirements. However, during unplanned events, a release will be in violation of this Permit. The purpose of the project is to improve the SJVH site to provide a permanent solution to mitigate the probable high pH water discharges to the San Joaquin River during planned and unplanned events.

The projects to resolve the safe entry and dewatering concerns will be evaluated as one project to determine a cost effective solution. It is likely that the final solution will be phased.

SJPL rehabilitation costs were about $3.75 million in FY15 and FY16.

Lower Cherry Aqueduct

Based on condition assessments in 2010 and 2011, numerous repair projects had already been scoped and planned. The system remained functional until the Rim Fire (August/September 2013) caused significant additional damage. Immediately following the fire, very little precipitation occurred. Repairs to the LCA then became urgent in order for the SFPUC to access the Cherry/Eleanor supplies for drinking water purposes as an emergency supply measure. Later in 2014 work was performed under a dry-year emergency project and completed in 2015. Work to correct damage caused by the Rim Fire at the diversion facility and forebay will be completed by 2018.

Figure 2-2: Linear Feet of Pipelines and Tunnels by Material and Installation Decade

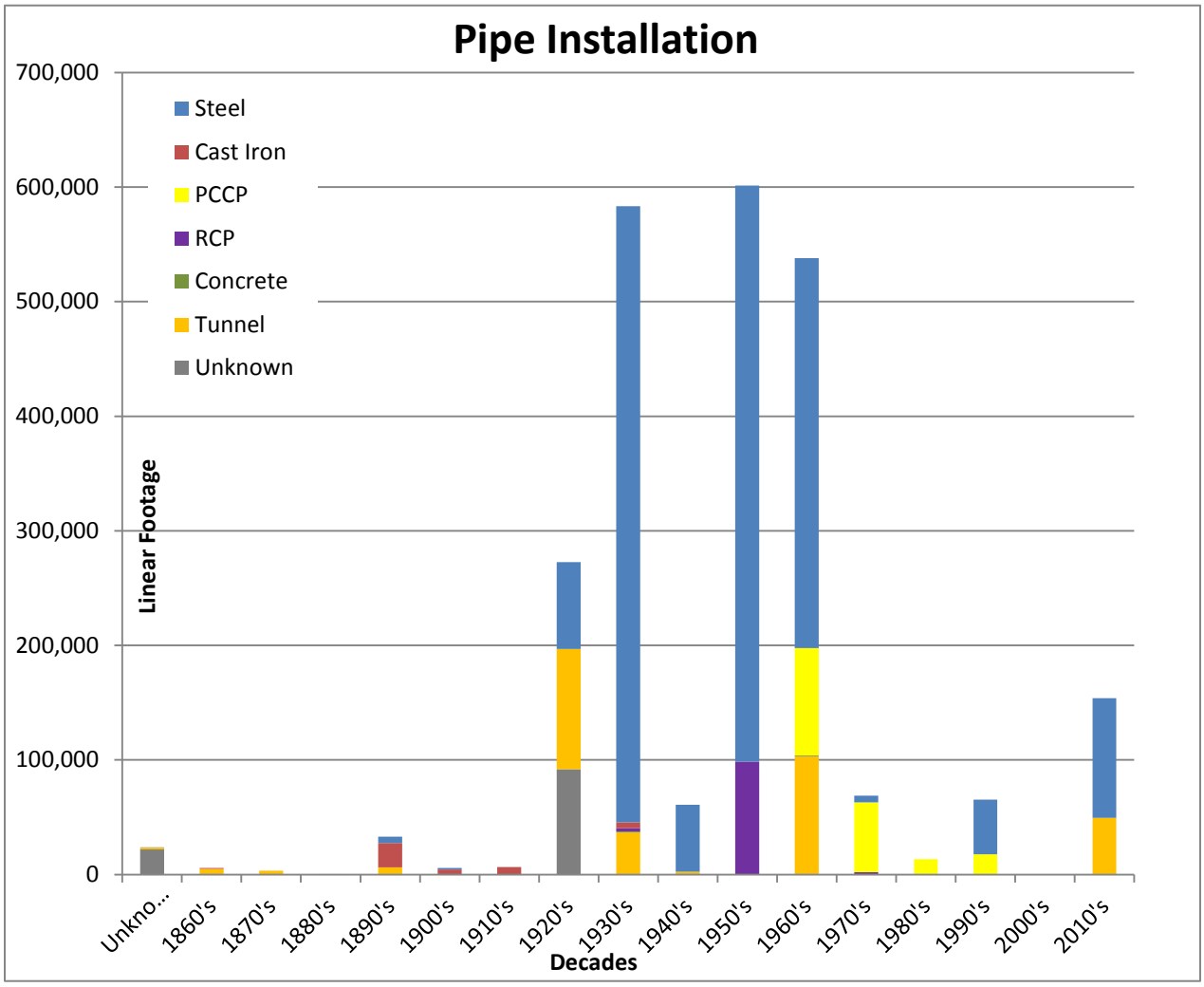
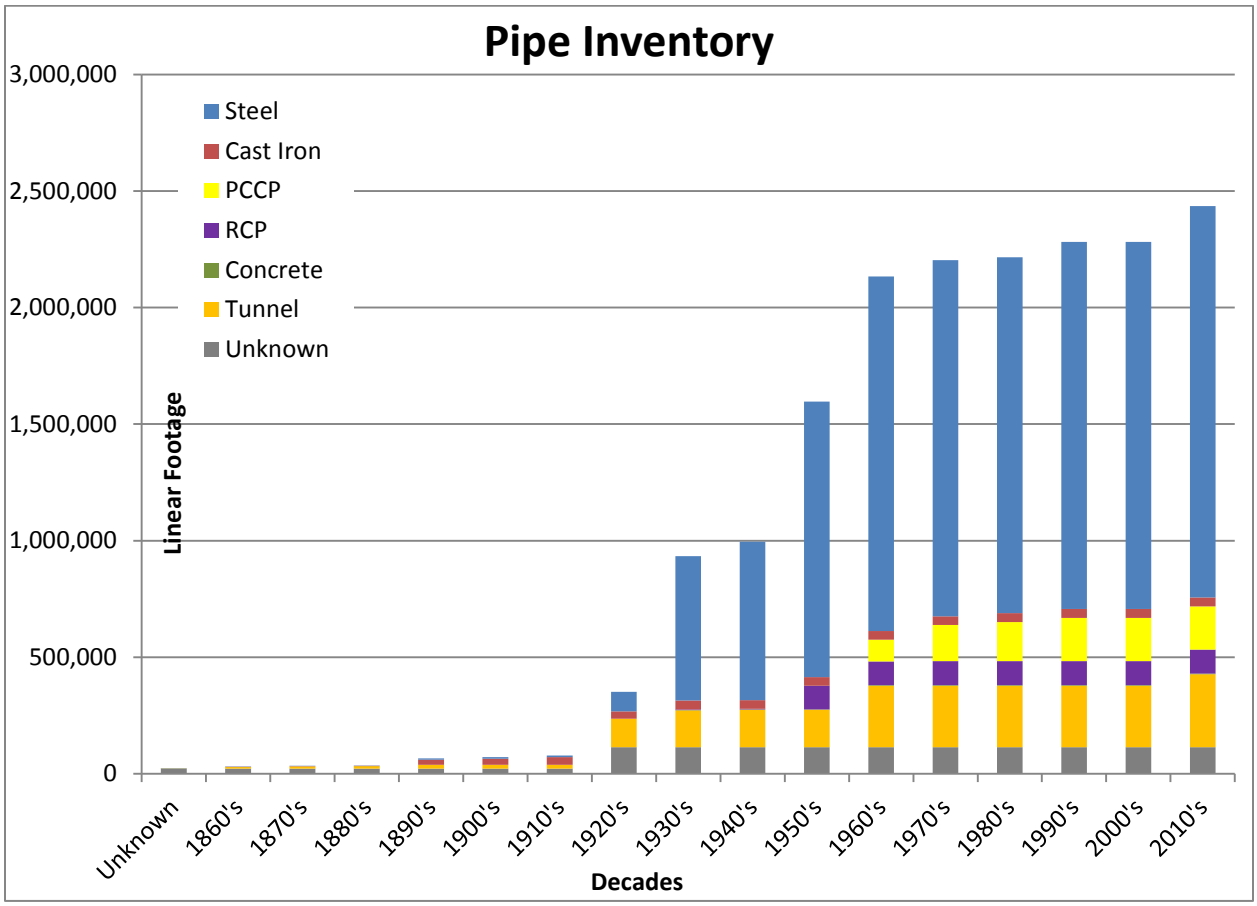


Figure 2-3: Pipelines and Tunnels Inventory



Tunnels

Canyon Power Tunnel

Canyon Power Tunnel was built over 45 years ago. The tunnel is about 10 miles long and delivers the SFPUC water supply from O'Shaughnessy Dam to Kirkwood Penstock. In 2007/2008, HHWP staff observed increased leakage at the Hetch Hetchy Adit weir. During a five-day shutdown in January 2009, temporary repairs to the concrete plug in the Hetch Hetchy Adit of the tunnel were undertaken to reduce the 200 to 300 gpm exiting from cracks and deteriorated concrete in the plug. The tunnel was last inspected the following November of 2009. The tunnel is in very good condition, but rehabilitation work is required at the Hetch Hetchy Adit where leakage has occurred. A permanent replacement of the concrete plug will be necessary in order to mitigate the future risk of developing new cracks resulting in the loss of water from the Hetch Hetchy system. This project is scheduled in the current capital plan and will be coordinated with the Mountain Tunnel shutdown in the winter of 2018-19.

Mountain Tunnel

The nineteen-mile Mountain Tunnel conveys SFPUC water supply from Kirkwood Powerhouse to Priest Reservoir. Mountain Tunnel has been in-service for over 90 years with minimal maintenance work performed. Condition assessments (2006, 2008) have identified degradation of the lining on more than 9 miles of lined sections of tunnel. An inspection is planned for 2017 that will help assess the merits of two alternatives (rehabilitate the existing tunnel or construction of a bypass).

While the final rehabilitation/replacement project is being scoped, the SFPUC began a project to improve facility access and reduce the time required to return the asset to service in the event of a failure and improve the ability to monitor changed conditions within the tunnel. The Mountain Tunnel Access and Adit Improvement Project was initiated in 2015 and is expected to be complete in 2017.

Foothill Tunnel

The Foothill Tunnel is a 16-mile-long tunnel connecting Moccasin Regulating Reservoir to the SJPLs. The tunnel was last inspected by Jacobs Associates in early 2007.

With the exception of the pipe section near the Oakdale Portal, the overall condition of the Foothill Tunnel and associated shafts is good. Minor seepage was observed. The presence of multiple short lined sections suggests that shear zones and localized rock instabilities were frequent but well-defined during construction. The poorer rock sections do not affect the tunnel's reliability because of the relatively good quality of the short, concrete-lined sections. The relatively small size and low number of rock falls in the unlined sections is a good indicator of the rock quality and overall competence. Jacobs Associates' recommended a tunnel inspection in 2017. Due to the emphasis on Mountain Tunnel, HHWP will propose a condition assessment at a later date in their future capital plan.

Coast Range Tunnel

The Coast Range Tunnel was inspected in 2015 (the last inspection was in 1995). The tunnel lining continues to be in excellent condition, and no capital work is required. Even the section of the tunnel crossing the Greenville Fault zone showed little indication of damage. Sand deposits and fragments of tunnel lining have accumulated in the shaft alcoves. Minor seepage was observed. Debris such as unused pumps, PVC tubing and cables was picked up and transported out of the tunnel. No section of the tunnel needs repair. It is recommended that the tunnel be inspected again in 2035.

Eleanor-Cherry Tunnel

An informal inspection of the Eleanor-Cherry Tunnel was performed by HHWP staff in October 2015 (the last inspection was in 1995). The tunnel is unlined and is in very good condition. No work or additional inspection is planned in the near future.

Irvington Tunnels (No. 1 and No. 2)

In 2014 the NIT was completed under WSIP, disinfected, and brought into service. The new tunnel was subsequently named Irvington Tunnel No. 2 with the original tunnel being

designated as Irvington Tunnel No. 1. In 2015 after Irvington Tunnel No. 2 had been thoroughly tested, Irvington Tunnel No. 1 was taken off line and inspected (the last inspection was in 1966). The inspection revealed only superficial deterioration which was repaired in a few weeks for less than $0.5 M. Both tunnels are typically left on line under normal operations.

Crystal Springs Bypass Tunnel

The Crystal Springs Bypass Tunnel was constructed and put into service in 1969, but due to system constraints, had not been inspected since being put into service. The CSBT was drained to accommodate the tie-in of the New Crystal Springs Bypass Tunnel with the existing pipelines. The shutdown occurred in January 2011 and provided an inspection window of opportunity.

Jacobs Associates, the consultants tasked with the cursory visual inspection of the tunnel, found the overall condition of the tunnel to be good, although there were clear indications monitoring of the steel lined sections near the downstream portal is needed. Additionally, the following observations were noted:

- G-20 gate house was structurally sound and in good operating condition
- Transition between the gate shaft and the tunnel was in excellent condition.
- Concrete-lined tunnel was in good condition
- Cement mortar lined (CML) steel lined section of tunnel included some spalled CML and extensive rust tubercles consistent with pit corrosion processes.

Jacobs Associates recommended that the steel lined section of tunnel be re-inspected within three years, and that the entire tunnel be re-inspected within 10 years.

Other Tunnels

The Hillsborough, Stanford, and Pulgas Tunnels have never been inspected but are expected to be inspected in 2020, 2023, and 2024 respectively. See 20 year pipeline inspection schedule in Appendix C-2.

Penstocks

Kirkwood Penstock

Kirkwood Penstock was built in 1964 and conveys the water from Canyon Power Tunnel to Kirkwood Powerhouse. Kirkwood Penstock experienced significant movement in 1984. Corrective actions included compaction grouting of voids in the hillside, replacement of the dresser coupling below anchor block 2 with an increased gap range of up to 6.5", and implementation of a monitoring program which is still in place today.

Movement, tracked through the monitoring program, has been within expected ranges until February 2007, when the rate of movement increased, resulting in the partial failure of one fixed saddle directly below anchor block 2. Following the movement identified in 2007, HHWP contracted with B&V to collect additional survey information and interpret/analyze available data; this effort was summarized in the Kirkwood Penstock Geo-Structural Assessment Report (December 2009). From 2010 through 2012, HHWP continued with the monitoring program. In

2012, HHWP contracted with B&V to perform a Risk Analysis to evaluate potential failure modes and associated consequences. In 2014, HHWP completed a risk analysis which established strategies for the asset. An external and internal inspection was performed in October 2015 and January 2016, respectively. The inspections establish a baseline for future monitoring and confirm the lining and coating is in adequate condition. In 2018, an improved monitoring system will be installed, saddle blocks repaired, and emergency spare components (dresser couplings) procured. The rate of movement of the penstock will continue to be monitored and evaluated as needed. The project is currently in design and a construction contract is scheduled to be advertised by January 2017 with a one year construction duration. The risks since 2007 have been minimal due to continuous monitoring.

Holm Penstock

Holm Penstock was built in the early 1960's and conveys water from Cherry Power Tunnel to Holm Powerhouse. An internal condition assessment was performed in the early 1990's, finding the penstock in very good condition. Following the Rim Fire, an external condition assessment was performed on the coating. Areas where fire damage destroyed the coating have been repaired. The condition of the remaining penstock coating is adequate. HHWP will propose a coating project in the future capital plan.

Moccasin Penstock

Moccasin Penstock was built in the early 1920's and conveys water supply from Moccasin Tunnel to Moccasin Powerhouse. HHWP performed an informal internal condition assessment of the penstock in 2006. Significant corrosion was found at the bifurcation where the penstock increases from two to four pipes. Further condition assessment has identified:

- Ability of the anchor block at the bifurcation to carry load
- Poor quality of the pipe saddles
- Concerns regarding integrity of the hammer-forged welded steel sections downstream of the bifurcation (longitudinal welds only)
- Deterioration of the concrete anchor blocks due to alkali-aggregate reaction in the concrete
- Poor condition of the coating and lining

HHWP is currently in the process of scoping a small capital project to improve penstock reliability for water transmission until sufficient funds are available to replace or further rehabilitate the penstock in future capital plans. The risk of not moving forward with a complete replacement at this time will be reduced with the completion of the current project.

Pump Stations

All major pump stations in the RWS were partially or totally re-built as part of WSIP. Crystal Springs Pump Station was completely replaced in September 2014. Scope for the project included upgraded seismic performance, modern switchgear and starters, and variable speed pumps. Collectively, the operational upgrades permit more off-peak pumping and will lower electrical costs. Baden Pump Station improvements included installation of variable speed pumps, installation of a new pressure-reducing valve to allow water from HTWTP (high-pressure zone) to supply the low-pressure zone, installation of various valve improvements,

seismic retrofit, and replacement of various piping segments, existing electrical components and transformer. At the Pulgas Pump Station, an isolation valve was replaced and stabilizing slope improvements were completed at the Pulgas Tunnel Air Shaft site.

Under WSIP, SAPS was partially re-built with work concluding in FY11. Improvements included replacement of the 1,000-horsepower electrical pumps, addition of two 1.5-megawatt emergency generators, and seismic retrofit to ensure operator safety. In preparation for the LCA test in early 2015, the Water CIP funded further upgrades at SAPS by replacing one of three diesel driven motors with an electrically driven one, along with related upgrades. These upgrades were already planned in the CIP. Preparing for the LCA test only expedited the reliability of SAPS. Seismic retrofit of the control room to ensure post-seismic life safety as well as replacement of diesel engines may be included as future CIP projects.

Lake Merced Pump Station improvements were completed in FY14, although an outstanding electrical problem has not yet been resolved. The new pump station was designed to resist fire, seismic, and other catastrophic events. Modern energy-efficient pumps and controls replaced existing equipment, and new emergency backup generators will ensure continuous station operations in case of power outage.

The Eleanor-Cherry Pump Station was built in the late 1980's to increase diversion from Lake Eleanor to Cherry Reservoir. The system was designed with ten pumps and can divert almost 500 cfs when Cherry Reservoir storage is high. Five of the ten pumps are not functioning. Cherry Reservoir must be drawn down to 140,000 AF to maintenance the pumps. Significant effort was made to have the pumps rebuilt during the recent drought but a compliant, responsive vendor was not available. Attempts were made to purchase new pumps but it was determined that the existing system should be redesigned and rebuilt. HHWP will propose a replacement project in the future capital plan. HHWP operates the system to optimize the reservoir carryover storage, regardless of whether these pumps are in service.

Valves and Valve Lots

The RWS includes over 350 valves of various sizes, types, functions, and periods of installation. A complete 2016 inventory of main-line valves of the transmission system is shown in Table A-8 (a complete description for valves west of the Coast Range Tunnel is housed in WSTD's *Valve Book Database*). Bypass valves and service connection valves are not included. Approximately 50 major valves were added under WSIP. In most cases, valves over 50 years in age have been re-built or replaced.

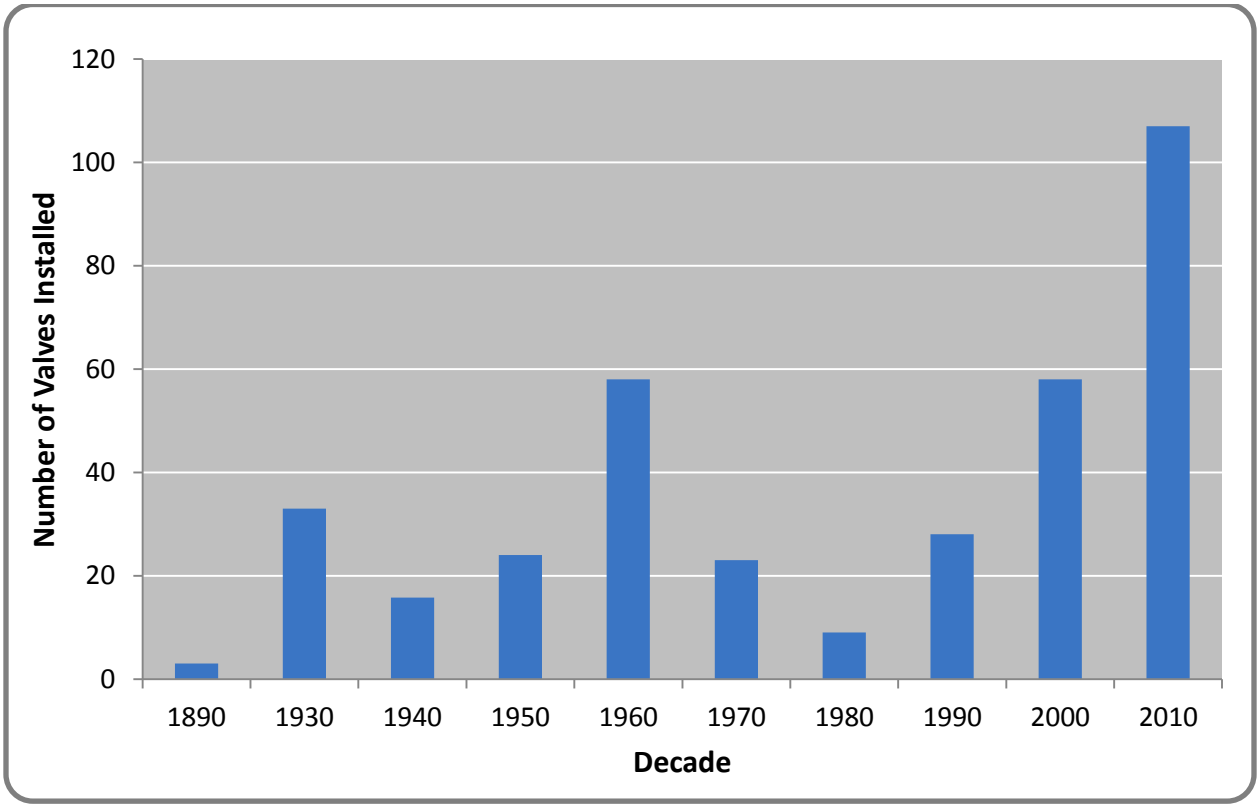
Many new valve lots have been added in the last 10 years just prior to and as part of WSIP, including the cross-over valve lots on BDPL Nos. 3 and 4 where a total of six facilities were completed, with the final two substantially completed in FY12. These valve lots significantly improve the SFPUC's ability to operate around unplanned outages of one of these pipelines. The Paseo Padre and Grimmer valve lots on BDPL Nos. 1, 2, and 5, and the Tissiack/Crawford vaults on BDPL Nos. 3 and 4 support emergency earthquake recovery by enabling the system to be isolated on either side of the Hayward Fault.

In the San Pedro Valve Lot, two valve vaults were seismically upgraded, electric valve operators were modified, a new air valve was installed, and miscellaneous site drainage

improvements were made. Elsewhere under WSIP a variety of valves (line and cross-over) are being replaced/added in SAPL Nos. 2 and 3.

The Emery and Pelican Cross-over valve vaults were added under WSIP and allow interconnection and/or isolation of the SJPL Nos. 1, 2 and 3. Potential modifications are discussed above. The valve exercising and maintenance program was enhanced in 2008 to extend the life of installed valves. These enhancements to the maintenance program were developed after the condition of several large line valves deteriorated in less than 10 years due to a combination of improper operation, poor maintenance, and improper valve material specifications. See Figure 2-4 for an inventory of valves installed by decade. [5]

Figure 2-4: Number of Valves Installed by Decade



[5] Includes only line valves west of Tesla Portal.

Interties

The SFPUC co-owns an intertie in Hayward with East Bay Municipal Utility District (EBMUD) (the facility is operated by the City of Hayward per agreement). The SFPUC also co-owns an intertie with Santa Clara Valley Water District (SCVWD) in Milpitas. Each offers the principal parties access to other regional water suppliers in emergencies or during planned maintenance. For instance, the SFPUC has requested assistance during the next Mountain Tunnel shutdown in January 2017. Each intertie has been thoroughly tested; the EBMUD intertie was completed in 2007 and the SCVWD intertie was completed in 2004. The interties were simultaneously operated in 2010. Maintenance requirements are developed each year for the interties. The City of Hayward is the designated lead for operations and maintenance at the EBMUD intertie. The SFPUC has the lead maintenance role for the SCVWD intertie (as of January 1, 2014). While WSIP was under construction, SCVWD was the lead for 5 years, but the lead role has now reverted back to the SFPUC.

DWR and SFPUC agreed in FY11 to disconnect the "temporary" raw water intertie between the South Bay Aqueduct and the SFPUC's system in the Sunol Valley, originally constructed in 1991. The intertie was characterized as a seismic vulnerability to the South Bay Aqueduct, and without expensive upgrades, DWR's preference was to disconnect it. This decision was vetted with the South Bay Aqueduct contractors first and is reversible if conditions change. Much of the utility of this intertie was replaced by the other intertie with SCVWD mentioned above. The one-way (to SFPUC) tie-in at the San Antonio Reservoir remains.

Distribution Systems

Aside from a small number of individual residential and commercial customers outside of San Francisco, RWS retail operations are limited to distribution systems in the Town of Sunol, Moccasin, Cherry Compound, O'Shaughnessy Compound, and Early Intake. In FY15 and FY16 the town of Sunol system was upgraded, adding a non-potable fire system and replacing the potable storage tanks. Since 2012 the distribution system for the Castlewood community (non-SFPUC) has been managed by the City of Pleasanton under contract with the Castlewood homeowner association.

2.2.3 Water Treatment Facilities

The RWS utilizes three major treatment facilities including two filtration plants, which treat local watershed water, and the TTF near the City of Tracy which uses UV light and sodium hypochlorite for primary disinfection of Tuolumne-based supplies. Improvements at HTWTP performed under WSIP were substantially completed in the fall of 2014. WSIP improvements at SVWTP were completed in the summer of 2013; however additional drought-related improvements needed to ensure reliable operation for potential long-term treatment of water from Cherry Lake are on-going.

Other significant treatment facilities include the Rock River Lime Plant, Thomas Shaft Chlorination Facility, SVCF, and the Pulgas Dechloramination Facility. These facilities, along with small treatment facilities which are part of the supporting utilities at remote SFPUC locations, are listed in Appendix A-5.

HTWTP, located in San Bruno, supplies the high-pressure zone customers on the Upper Peninsula and San Francisco. Local water is pumped from Crystal Springs Reservoir to San Andreas Reservoir, where it enters HTWTP. The plant is a 160 MGD direct filtration plant that uses ozone as its primary disinfectant. After the filtration process chlorine and ammonia are added to produce chloramines. Water is pH corrected and fluoridated before leaving the plant and entering the transmission system for public consumption. HTWTP has been significantly modified to meet the LOS goals established under WSIP. Five new filters were added, chemical tanks relocated and, due to seismic concerns, the contactor chamber and a new 11 million gallon treated water reservoir are located on more stable ground. The project also included improvements to the sludge handling and a new washwater tank to enhance the plant's performance. Additional improvements included a new substation, switchgear, and motor control center. The conveyance structures that bring water from San Andreas Reservoir to HTWTP were rebuilt to current seismic code.

The SVWTP is a 160 MGD conventional filtration plant. Water from Calaveras and San Antonio Reservoirs are brought to the facility by gravity where it goes through the filtration process (use of SAPS is required to convey water from San Antonio Reservoir to SVWTP when higher flow rates are needed). Although an operational rarity, Hetch Hetchy (or Cherry/Eleanor) water can be treated at the plant via SAPS to mitigate water quality issues that may arise. Water leaving the plant is chloraminated and pH corrected before entering the Alameda Creek Siphons. The plant is unique in that influent water passes through a distribution structure that channels the water to individual treatment trains. This allows a different treatment process for the differing raw water sources. This is very effective as the low alkalinity Hetch Hetchy water is difficult to treat if blended with local source waters. The WSIP project seismically strengthened all of the existing filters and added a new sedimentation basin. Additionally, a treated water reservoir was added. These upgrades greatly improved the plant's reliable capacity and corrected deficiencies associated with not having a treated water reservoir. Since WSIP project closeout at the SVWTP, WSTD has replaced existing chemical piping, valves in the sludge lagoons, drainage improvements near an existing electrical building, safety hand rails around four existing sedimentation basins, and is in the process of relocating the SCADA server room.

The TTF is located at the entrance to the Coast Range Tunnel, near the City of Tracy. The facility employs UV irradiation and disinfection for Hetch Hetchy supplies. In addition to UV treatment at this facility, the pH is adjusted, fluoride is added, and secondary disinfection begins with the addition of chlorine. The UV systems were first brought on line during the summer of 2011. The regulatory requirement for UV treatment began in April 2012. Uninterrupted chemical dosing with Sodium Hypochlorite is critical for public health protection and to maintain operating permit requirements with the SWRCB DDW. Should there be a failure of chemical feed equipment at Tesla Portal, the Thomas Shaft Chlorination Facility, located about three miles west of Tesla on the Coast Range Tunnel, will automatically start up and provide continuous disinfection. The detention time necessary for complete disinfection is obtained within the 25-mile length of the Coast Range Tunnel.

Aside from the filter plants and TTF, there are two other major treatment facilities in the Bay Area. As water passes through the Sunol Valley, further treatment is performed at SVCF. The chlorine residual is trimmed, ammonia is added to form chloramines, and water is pH-corrected and fluoridated. Last, the Pulgas Dechloramination Facility removes excess chlorine and

ammonia from water discharging into Crystal Springs Reservoir (and adjusts pH). These discharges serve to replenish supplies in Crystal Springs Reservoir and also provide necessary relief from pipeline over pressurization when system hydraulics change.

Rock River Treatment Facility

Rock River Treatment Facility was rehabilitated in 2010 and 2011. In 2010 the facility was upgraded with rotary mixers, new feeders, and safety enhancements. The upgrade to rotary mixers allows more control at very low dosage rates. In 2011 the building was rehabilitated (new windows, interior stairs, roof flashing, interior/exterior painted).

With capital upgrades to the site completed, HHWP has turned their attention to improved monitoring capability which will be completed in 2016, following completion of the San Joaquin Valley Microwave project in September 2016. Small improvement projects to replace piping in the shaft over the Foothill Tunnel, minor pump improvements, and water tanks will be performed under maintenance.

2.2.4 Building & Grounds

The inventory of buildings and grounds is listed in Table A-14 to A-16. This category includes corporation yards, administrative buildings, cottages, and other minor structures that support operations but are not otherwise part of other asset categories.

Sunol and Millbrae Yards

Most of the capital funding in this program is dedicated to re-development of the Sunol Corporation Yard and construction of the Alameda Creek Watershed Center near the Sunol Water Temple. Construction on the Sunol Yard is expected to begin in 2017, and the Alameda Creek Watershed Center in 2018. Major upgrades to the Millbrae Corporation Yard have been deferred beyond the ten-year CIP. Interim improvements at the Millbrae Yard include additional administrative space, server rooms, upgrades to the water quality laboratory and minor shop upgrades.

Moccasin Facilities

Recent upgrades to the Moccasin structures are highlighted by a new 5,000 square foot Moccasin Control Room that houses the Moccasin dispatch center, the computer server room, water operations control room and staff. This project replaced the undersized Moccasin dispatch center located in the Moccasin Powerhouse and server room located on the bottom floor of the Administration Building. The new building meets current building code and WECC/NERC security requirements. This project was completed in FY15.

Peninsula and Alameda Watershed Cottages

There are 18 cottages (2 are decommissioned, 4 are active but vacant) located throughout the Alameda and Peninsula watersheds. These serve as residences for employees, and in one case as an employee work center, that enhances the SFPUC's ability to manage the watersheds. The condition, design and size of the cottages vary greatly. Several have been completely replaced or comprehensively renovated. In recent years the SFPUC has increased the rate of investment in these structures to reduce overall life cycle costs and to satisfy tenants. Focused investments include roof and window repair, dry-rot repair, and exterior painting.

HHWP cottages are included in Appendix A-14.

2.2.5 Watershed and Right-of-Way (ROW) Lands

The SFPUC has significant land interests in the seven counties of the RWS, highlighted by the properties either owned in fee, Raker Act, easement, decree, or license in Alameda, San Mateo, San Joaquin, Stanislaus, Santa Clara, Mariposa, and Tuolumne counties. The SFPUC expends significant effort managing watershed and ROW properties and the natural resources that depend on them. The economic value associated with these lands and natural resources – natural capital – is not recognized under current accounting standards and guidelines.

The SFPUC has been working with members of the Pacific Northwest Watershed Managers and other utilities to capture these values, and to advocate for including them in required financial reporting. These efforts and ongoing expenditures will be integrated into future reports.

The inventory of watershed lands is listed in Table A-11. Detail on watershed lands and ROW asset inventories (e.g., miles of road, type, and location) and planned expenditures is limited and will be improved during the updates of this report. In general, the CIP for watershed and ROW lands includes operations and maintenance of roads, bridges, fences, vegetation management (e.g., annual fire guarding), and biological monitoring required by federal and state environmental regulatory compliance permits. Assets for the RWS also include thousands of acres of property outside of the watersheds used for various infrastructure, most notably pipelines and valve lots.

Bridges and Roadways

HHWP is responsible for 14 bridges and about 40 miles of paved roadways that provide access to facilities. Many of these bridges and roads are used by the public. Most of the roads and bridges were constructed many years ago and some are in need of repair, rehabilitation, and/or replacement. Though these roads and bridges fall under the purview of the Stanislaus Forest or the Yosemite National Park, it has been determined that SFPUC is the legal entity responsible for maintaining and rehabilitating these assets.

Condition assessments were performed on HHWP bridges between 2013 and 2014. The condition assessment included visual inspections and review of load ratings for all bridges. Hydraulic/scour and seismic capacity assessments were performed for a subset of bridges, based mainly on public access. No bridge improvement projects are known to be needed in response to any specific federal or state regulatory mandates.

The Moccasin Debris Deflector Bridge and the Maintenance Bridges over the California Aqueduct occasionally serve as work platforms for maintenance crews but lack safety railings that conform with current OSHA standards. Due to regulatory and safety concerns, these improvements are a high priority. Replacement of the substandard railings at O'Shaughnessy Adit Access Bridge and improvement of the guardrail system and signage for Holm Access Bridge are also high priority for reasons of safety. Replacement of the Turkey Ranch Bridge and Oakdale Irrigation District Bridge 1 are also a high priority as these bridges are significantly deteriorated and provide critical access to HHWP facilities. Some specific improvements at Oakdale Irrigation District Bridge 2 are high priority, such as placement of approach markers. These high priority projects will be completed under the R&R program.

Replacement of the Cherry Lake Road Bridge at Early Intake is a medium priority due to the various structural and safety deficiencies, the limited remaining service life expected for this bridge, and its importance to HHWP's operational access. The recommended approach rail and safety improvements for the Cherry Lake Road Bridge over the Middle Fork Tuolumne River and the South Fork Siphon Adit Access Bridge are a medium priority. The replacement projects recommended for the O'Shaughnessy Adit Access, Holm, and Cherry Creek bridges are a relatively low priority. This is mainly because the deficiencies identified in these bridges are primarily associated with their capacity for resisting seismic (lateral) loads, which represent a relatively severe but unusual load case.

Many of these bridge improvements will be addressed. HHWP will propose rehabilitation/replacement of the following "medium/low priority" bridges in future capital plans:

- Cherry Lake Road Bridge over Tuolumne River at Early Intake
- Holm Access Bridge over Cherry Creek
- Cherry Lake Road Bridge over Cherry Creek
- O'Shaughnessy Adit Access Bridge over Tuolumne River

A condition assessment was performed on Cherry Lake Road and Hetch Hetchy Road in 2013. Many maintenance projects were identified. Capital projects currently included in HHWP's capital plan include:

- Guardrails: Install new guardrails at locations where the potential hazard is the greatest, such as locations with steep drop-offs and sharp curves and at existing bridge approaches with substandard rails. Replace existing railroad-rail guardrails with standard metal-beam guardrails.
- Pavement rehabilitation: Perform structural pavement section rehabilitation or full section replacement annually at areas of severe potholes, alligator cracking, and pavement distortions, rutting and depressions.

2.2.6 Communication Systems

This category includes assets related to radio/phone, SCADA, computer, and security systems. These systems are usually independent and installed on many different platforms.

Radio/Communication System Upgrades

In 2012 the SFPUC initiated a thorough review of the radio communication needs for the operating divisions, which span seven counties and multiple jurisdictions related to radio communication. The review led to the microwave backbone project which is a multi-phased project that will ultimately connect the entire RWS with a redundant system, and provide seamless communications among all SFPUC divisions throughout the service area. Additionally, video surveillance, remote gate locks, audio monitoring, and SCADA data traffic will be added to the system's bandwidth capacity to protect critical infrastructure. In the first phase the project will link the expanded microwave backbone installed upcountry to the City's backbone. Once a linked microwave system is created that follows the City's ROW and easements, the SFPUC can create a networked voice radio system that will significantly enhance day-to-day and emergency operations.

SCADA

The WSTD SCADA systems continued to responsively and reliably meet the operational needs of the RWS with an overall availability of better than 99.95%. Following last year's major hardware and software infrastructure upgrades to the Bay Area SCADA system, additional upgrades in the areas of security and data storage and network reliability were completed. Primary remote site and wide area network communications were migrated from the Frame Relay technology being retired by AT&T to AT&T's next generation offering, AVPN, which utilizes Ethernet and MPLS technologies. Several WSIP projects were recently integrated into SCADA including HTWTP, BDPL No. 5 – East Bay Reaches, NIT, and the San Antonio Backup Pipeline.

In 2016, HHWP separated its Water and Power SCADA system into two systems; the SCADA system for water operations remained on the Wonderware platform but the Power system was ported to the OSI platform, a software platform designed to be compliant with the new North American Electric Reliability Corporation (NERC) power regulatory standards. HHWP cannot sustain supporting two SCADA systems and will transport the water system to the OSI platform over the next five years.

Facility Security

Security review and site-specific upgrades continue at many facilities within the RWS. These upgrades include improved fencing, conversion to electronic card access, implementation of a re-keying plan, and expansion of video monitoring systems to minimize the risk of intrusion at facilities. A 10-year Security CIP has been prepared to identify security upgrades to facilities in the RWS. Appropriate details are presented later in this report.

2.2.7 Rolling Stock and Equipment

The operating divisions that maintain the RWS have an extensive inventory of rolling (and floating) stock summarized in Table A-17, including passenger cars, light trucks, heavy equipment (dump trucks, front loaders, bull dozers, flat beds, large cranes, etc.), trailer equipment (generator sets, light poles, wood chippers, etc.), boats, and other equipment. This fleet of rolling stock provides a major mutual aid resource to the region and statewide, and allows the SFPUC to be self-sufficient in most emergencies. There are no aircraft owned by the SFPUC but some assistance can be provided by local law enforcement agencies, Cal Fire, and the East Bay Regional Park District in emergencies.

3. Asset Management Program Overview

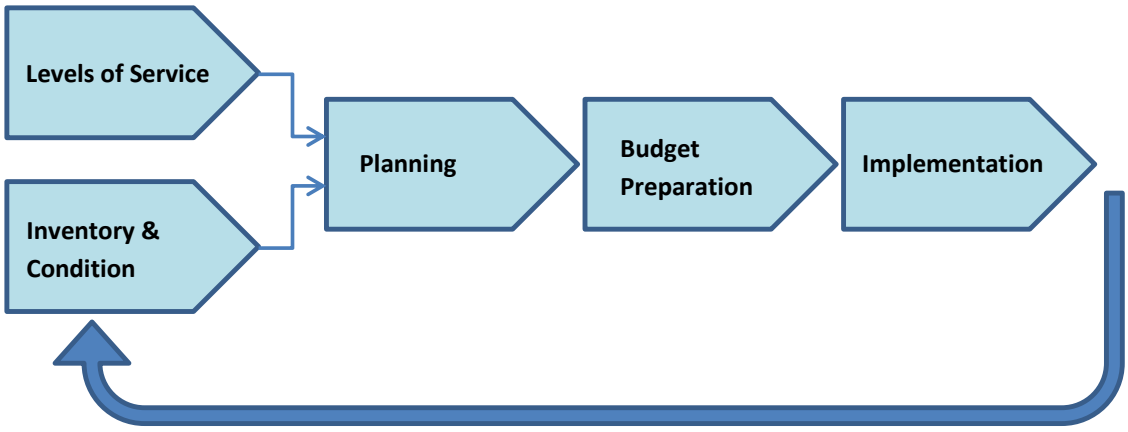
An ideal asset management program allows a utility to minimize the total cost of owning and operating assets while delivering specified levels of service at an acceptable level of risk. Implementing the program requires a regular practice of acquiring data on assets, an evaluation of that data to determine any shortcomings in maintenance or need for capital projects, implementation of modified maintenance practices or completion of capital upgrades, and a practice of documenting the resulting performance for later use.

These functions are integrated to collectively create an asset management program and are discussed in the sections of this chapter:

- **Define Levels of Service:** Establish, publish and regularly review Levels of Service and related performance objectives;
- **Document Asset Inventory and Condition:** Perform periodic condition assessment of assets and determine actual performance as related to the LOS;
- **Plan/Analyze:** Perform planning tasks that help identify performance shortcomings and where needed, modify maintenance practices and/or generate capital project scope that eliminate the performance gaps (and inherently, prioritize work);
- **Develop Budget:** Review cost estimates of new or modified work, compare to the existing budget and prepare revised budgets for Commission review. In parallel SFPUC Finance staff help prioritize and structure the budget (including the CIP) by providing financing options (and limitations) and implications to fund balances and rate projections;
- **Implement/Operate:** Carry out maintenance programs, as adjusted and complete any capital projects; and,
- **Obtain/Apply Feedback:** Record available data and use it to inform planning and budgeting.

Figure 3-1 diagrams how these programs work together.

Figure 3-1: Asset Management Program Processes



3.1 Performance Objectives

As a general matter, a utility's levels of service represent broad, system-wide performance objectives that guide the management of the utility and that can be communicated and understood by ratepayers. LOS can evolve over time reflecting changes to regulatory requirements, system demands, adoption of new reliability standards, and ratepayer willingness to pay.

Overall, the performance of the system is the collective performance of the system's individual assets. The challenge then becomes creating an asset management program for individual assets that ensures broad system-wide performance is achieved – and doing this in a cost effective manner. Below, the broader policy level objectives are discussed first, followed by the objectives of the asset management program that are designed to achieve them.

3.1.1 Levels of Service for the RWS

The present LOS goals and objectives of the RWS were developed during the WSIP and generally refer to the completion of various capital projects with defined scope and time-certain delivery. The WSIP LOS goals (outlined in bold text below) and accompanying objectives (bullets) address six areas for improvement: water quality, seismic reliability, delivery reliability, water supply, sustainability, and cost- effectiveness. These goals are not anticipated to change.

Water Quality – ***maintain high water quality***

- Design improvements to meet current and foreseeable future federal and state water quality requirements.
- Provide clean, unfiltered water originating from Hetch Hetchy Reservoir and filtered water from local watersheds.
- Continue to implement watershed protection measures.

Seismic Reliability – ***reduce vulnerability to earthquakes***

- Design improvements to meet current seismic standards.
- Deliver basic service to the three regions in the service area (East/South Bay, Peninsula, and San Francisco) within 24 hours after a major earthquake. Basic service is defined as average winter-month usage, and the performance objective for design of the regional system is 229 MGD. The performance objective is to provide delivery to at least 70 percent of the turnouts in each region, with 104, 44, and 81 MGD delivered to the East/South Bay, Peninsula, and San Francisco, respectively.
- Restore facilities to meet average-day demand of up to 300 MGD within 30 days after a major earthquake.

Delivery Reliability – ***increase delivery reliability and improve ability to maintain the system***

- Provide operational flexibility to allow planned maintenance shutdown of individual facilities without interrupting customer service.
- Provide operational flexibility to minimize the risk of service interruption due to unplanned facility upsets or outages.
- Provide operational flexibility and system capacity to replenish local reservoirs as needed.
- Meet the estimated average annual demand of up to 300 MGD under the conditions of one planned shutdown of a major facility for maintenance concurrent with one unplanned facility outage due to a natural disaster, emergency, or facility failure/upset.

Water Supply – ***meet customer water needs in non-drought and drought periods***

- Meet average annual water demand of 265 MGD from the SFPUC watersheds for retail and wholesale customers during non –drought years for system demands through 2018.
- Meet dry-year delivery needs through 2018 while limiting rationing to a maximum 20 percent system-wide reduction in water service during extended droughts.
- Diversify water supply options during non-drought and drought periods.
- Improve use of new water sources and drought management, including groundwater, recycled water, conservation, and transfers.

Sustainability – ***enhance sustainability in all system activities***

- Manage natural resources and physical systems to protect watershed ecosystems.
- Meet, at a minimum, all current and anticipated legal requirements for protection of fish and wildlife habitat.
- Manage natural resources and physical systems to protect public health and safety.

Cost-effectiveness – ***achieve a cost-effective, fully operational system***

- Ensure cost-effective use of funds.
- Maintain gravity-driven system.
- Implement regular inspection and maintenance program for all facilities.

3.1.2 Asset Management Objectives

As mentioned above, a more specific set of objectives is used to guide capital and maintenance planning and is referred to collectively as asset management objectives. The asset management objectives provide the necessary detail to connect daily workforce priorities with the broader ratepayer service expectations (i.e., LOS).

These objectives are to:

- Develop and maintain a detailed asset inventory;
- Regularly complete asset condition assessments;
- Use a computerized maintenance management system (CMMS) to centralize all asset data;
- Perform preventive or predictive maintenance only where cost-effective (minimize life-cycle cost) or when system risks to unplanned outages warrant increased maintenance costs;
- Prioritize corrective maintenance (CM) to increase system reliability;
- Complete peer-review of maintenance programs to ensure scope of maintenance is consistent with industry standards;
- Develop expenditure reports that compile costs for facilities, assets and maintenance programs – a quick way to tell where money is going and what it is accomplishing.
- Update the 10-year CIP and annual operating budget by integrating data from condition assessments, estimates of remaining useful life, failure analyses, replacement costs, maintenance programs and LOS;
- Investigate asset failures and document the root cause of failure;
- Plan facility maintenance to minimize risk to customers; and,
- Maintain emergency response plans (listed in Appendix B).

These asset management objectives become even more critical for the RWS now that most of the WSIP assets are complete and in need of an appropriate maintenance programs.

3.2 Condition Assessments

The assets in the RWS are periodically inspected through three separate assessment programs, each essentially using a risk-based approach. The first program addresses fixed assets or facilities. Facility inspections are prioritized and repeated every three to ten years depending

on each facility's importance in meeting LOS[6]. Although inspections are performed at the facility level, condition data in the CMMS is housed at the asset level.

At HHWP, condition assessments on critical assets with a life expectancy of greater than 25 to 30 years are performed on a case by case basis. Early in the asset's life cycle inspections and limited assessments coincide with scheduled maintenance activities. As assets move through their lifecycle the information gathered from previous preventative maintenance reports as well as performance deviations identified by operators are used to schedule more comprehensive condition assessments. On critical assets with a lessor life expectancy assessments are built into the routine preventative maintenance program for that specific asset.

Linear assets (e.g., pipelines and roads) are assessed with a second program. Inspection frequency is dictated by pipeline conditions, availability of pipeline (usually the pipelines must be drained), operational problems associated with pipeline failures, potential liabilities, and the rate of degradation observed in prior inspections.

Dams use a third inspection and monitoring program usually performed with regulatory oversight. The program is conservative in light of the high liability associated with dams and the importance to the region's water supply. The major components of the program consist of: regular inspection and monitoring, maintenance, repairs, planning studies (stability studies, inundation map updates and other), and emergency planning.

For all of the condition assessment programs a risk-based approach recognizes two key risk criteria: severity and probability.

- **Consequence/Severity**: impact of the failure on the utility of each identified risk.
- **Probability:** likelihood that failure arising from any deficiencies will actually occur.

There are many types of risk for the RWS that are considered when quantifying overall risk:

- **Public Health Risk (Water Supply)** - Risk of insufficient water quantity and loss of fire suppression capabilities.
- **Public Health Risk (Water Quality)** - Risk of an interruption in water supply or degradation of water quality, which could result in loss of life and detrimental effects on human health.
- **Environmental Risk** - Risk of a harmful discharge to air, land or water caused by human or mechanical failure.
- **Reputation Risk** - Risk of damage to the SFPUC's reputation and the loss of consumer confidence in the SFPUC's ability to provide reliable and safe drinking water.
- **Financial Risk** – Loss of revenue if supplies cannot be made, increased expenses if regulatory fines are levied.

[6] WSTD uses three tiers of assets for assets in the Bay Area, with Tier 1 representing the most important classification. There are about 100 facilities within the three tiers. HHWP uses two tiers for facilities; critical and non-critical.

In general, facilities are deemed high risk when there is a relatively high probability of failure and failure would lead to major operational consequences – i.e., loss of water supply and/or failure to meet water quality objectives. For the purpose of condition assessment priority, it is important to note that this assignment of risk occurs at the facility level (such as HTWTP). Actual maintenance, which is performed on the individual assets within a facility, is prioritized using a similar method as discussed below. Inspection schedules for WSTD facilities in Tiers 1, 2 and 3, in addition to dams, linear assets, and new assets are listed in Appendix C.

3.2.1 Facility Assessment

Formal assessment of most facilities began about 10 years ago as the scoping process for WSIP began. Most WSTD Tier 1 facilities were re-visited in 2009 with assessments of Tier 2 facilities following in 2010. After these first rounds were completed, subsequent inspections were scheduled on a repeatable cycle. Many tier 1/critical facilities were significantly modified by capital projects which created challenges for capturing an accurate asset inventory. Although improving every year, many facilities still have less than 95% of the assets documented. Appendix C details the existing non-linear and linear asset inspection schedule. Over the next two FYs, inventories will be reconciled.

All assets within a facility, such as a pump station or treatment plant, are assessed at the same time for consistency and efficiency. Facilities completed under WSIP have been be added to the appropriate condition assessment schedules. In some circumstances (e.g., specialized coatings and liners), assets must be inspected within the applicable warranty period, often one to two years after substantial completion. Tunnel inspection is particularly difficult and hazardous due to the presence of natural gas in many SFPUC tunnels. Despite these challenges, the SFPUC has been able to inspect four major tunnels in recent years (Crystal Springs By-Pass Tunnel, 2011; Mountain Tunnel, 2008; Coast Range Tunnel, 2015; and Irvington Tunnel No. 1, 2015) with an additional inspection of Mountain Tunnel planned for 2017.

Pre-Assessment Planning

Prior to conducting condition assessments, all records of maintenance performed since the previous assessment are reviewed by Maintenance Engineering staff. This includes, but is not limited to: CM logs, preventative maintenance logs, O&M manuals, standard equipment templates, relevant installation or as-built drawings, and relevant equipment specifications or technical data sheets. Capital project deliverables (equipment lists, data sheets and O&M manuals) are verified with existing CMMS data and on-site conditions.

If equipment has an unusually high level of maintenance required or unusually poor performance (compared to manufacturer's specifications and recommendations), Maintenance Engineering staff determines if equipment is properly specified, if engineering processes are appropriately designed, and if equipment is installed properly. Maintenance Engineering then makes recommendations for improvements to the facility manager as appropriate.

Field Assessment

Assets are assessed in the field using standard asset condition assessment documentation unique to the asset category (e.g. mechanical, electrical, structural, or linear). The facility

assessment team consists of an operator, facility manager[7], a maintenance planner, a maintenance engineer, and any specialty tradesperson. For each assessed facility asset, the assessment team verifies that all asset details have been recorded on the standard equipment template. For each asset, the asset name, location, brief description, CMMS identification code and date placed in service is recorded on the standard asset condition assessment form. Any missing information is recorded on the template.

Each assessed asset is visually inspected to observe its general condition. This observation is categorized using a numerical scale and described on standard asset condition assessment forms. Equipment is also observed in operation, to the extent possible, with additional observations recorded. Field observations or observed failures are recorded on standard asset condition assessment forms. Corrective actions or remedies are identified and recorded.

Other recorded details include inspection date, assessment team, date of next inspection, time to complete the assessment and estimated useful life remaining. If recent digital photos of the equipment are not already included in the CMMS database, then digital photos are taken of the asset.

Post-Assessment Analysis

Following completion of all assets within a tier, Maintenance Engineering reviews data collected during the assessments, design records, and maintenance history records, and then completes a condition assessment report. Maintenance Engineering determines if the process engineering is adequately designed and if the equipment was properly specified and installed. The report also recommends improvements to maintenance or equipment upgrades/re-specification, new process engineering if warranted, and parts/materials list for essential spare parts. The goal of the report is provide actionable recommendations to management that will lower life-cycle costs and reduce unplanned outages.

3.2.2 Linear Asset Program

The linear assets of the RWS include pipelines, tunnels, and penstocks as well as watershed roads. This section primarily addresses pipeline inspections which are usually performed inside a de-watered pipeline. The SFPUC continues to perform pipeline inspections to proactively find potential problems with transmission pipelines before major problems occur, and similar to facility condition assessments, pipeline inspections are also risk-based.

Pipeline inspections are scheduled through a four-step process. First, a long-range recurrence inspection schedule is created based on date of last inspection and pipeline material. Second, criticality of the pipeline is considered, particularly if a segment of pipe will be relied upon with no redundancy during other outages. Third, the condition of the pipe found on the previous inspection is considered. Last, schedules are adjusted by up to two years (sooner or later) to accommodate construction and other system outages that can affect the cost of performing the shutdown and inspection. If a pipeline is particularly critical, cost is a minor factor.

[7] Staff leads for facilities vary; chief stationary engineers typically manage treatment facilities and pump stations, plumber supervisors manage pipelines and vaults, and building superintendents typically manage buildings and corporation yards.

The pipeline inspection program in the Bay Area began in 1990 with the dedication of two engineers to the task. During the early 1990s, utility plumbing crews were expanded to prepare pipelines for interior inspections, support inspections, and replace any inoperable appurtenances.

There are a variety of pipeline types and sizes that require specific inspection techniques to detect flaws and assess conditions particular to each pipeline. Each type of flaw requires unique repair methods to restore the pipeline. Some flaws are significant enough, or expansive enough to warrant replacement or slip-lining.

Most inspections of pipelines use visual methods to detect flaws. The most common category of pipeline is WSP, representing more than half of the total distance of transmission pipelines. Riveted pipelines, the oldest in the transmission system, also make up a significant portion of the total. RCP is also inspected visually, but has flexible joints, a unique feature. Steel "lockbar" pipeline develops flaws similar to that of WSP. A combination of acoustic sounding (with ball peen hammer) and visual inspections are performed for all pipelines.

Steel pipe sections of the SJPL are performed with a HHWP inspection device[8]. The device identifies areas of thin wall that require repair and/or replacement of long sections of pipe with significant corrosion. Spot repairs guided by this inspection data are the best option to extend the life of the asset at the least cost.

Due to the liabilities associated with PCCP and the prevalence of this pipe in other water systems across the world, special technologies have been developed to inspect and detect the unique flaws that can develop in PCCP. An electromagnetic device is towed through a dewatered pipeline section with a specialized contractor to determine the number of broken pre-stressed wires that surround the pipeline (when intact these wires provide most of the hoop strength). A baseline of current wire breaks is typically established for each piece section using prior inspection data or a calibration section of pipeline of known condition (if available). Then additional wire breaks can be detected/monitored through real time monitoring using acoustic fiber optic cable inserted into the pipeline (while it is in service) or by additional inspections.

These proven methods have been used throughout the industry for well over 10 years and are considered reliable methods. Details of linear asset condition and inspection techniques are included in Appendix D and Appendix E.

3.3 Planning

Identifying any shortcomings between desired performance and actual performance, and then determining how to close the gaps with capital projects, modified maintenance, or enhanced staff training is the primary function of the planning process. A well designed planning process involves thorough research, broad involvement by staff and stakeholders, and documentation of assumptions and decisions. As discussed above, knowledge of asset condition is paramount to this process.

[8] More information on the HHWP inspection tool is available at this link: Advanced Method of Condition Assessment for Large-Diameter Mortar-Lined Steel Pipelines

3.3.1 Develop and Review Maintenance Programs

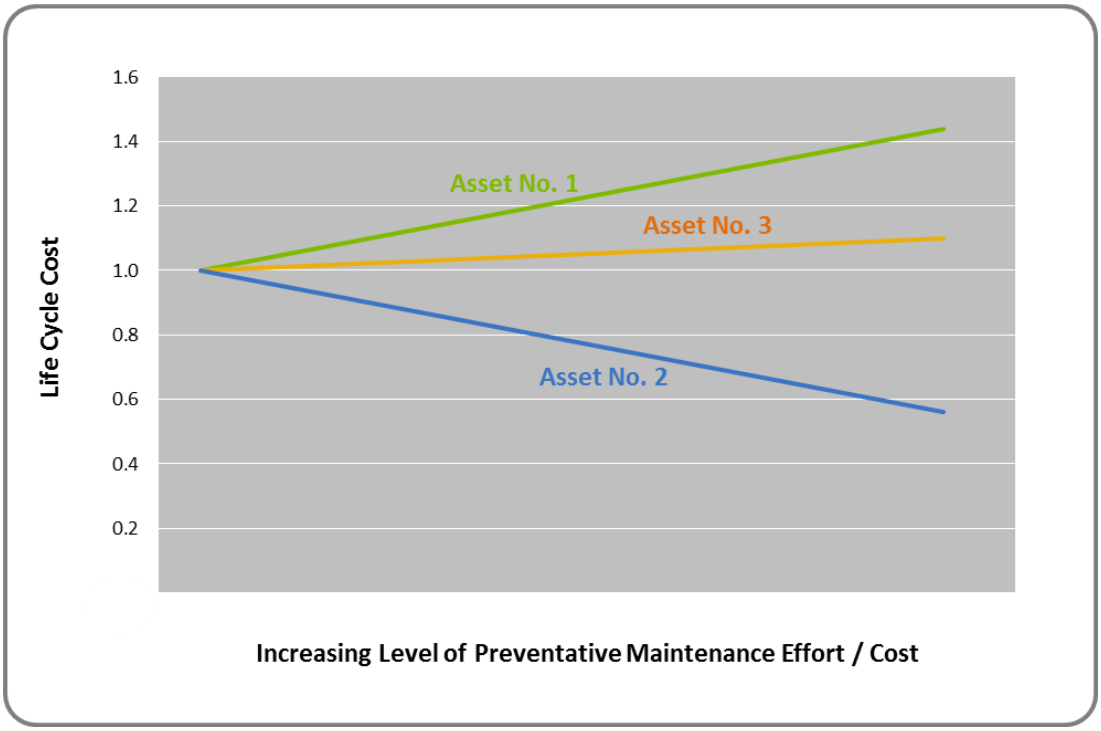
Maintenance procedures for assets originate from manufacturer documentation that is usually delivered at the time of asset acceptance (either delivery sign-off or during project close out). A capital project can typically generate hundreds of new assets and procedures. Ensuring delivery of this information is tracked through a separate effort and is discussed below.

These procedures must be translated into "job plans" that outline the specific sequence of maintenance tasks, the frequency and timing of the procedures, and which work crews must work together to complete the tasks. These translation and set up functions are performed by maintenance planners while a maintenance engineer confirms the technical aspects of the maintenance tasks.

Earlier in 2015, WSTD began using external maintenance experts to review the job plans for a given facility to ensure that appropriate maintenance was being performed and documented. This peer review ensures that the scope of maintenance is understood and appropriately prioritized. Reports are also getting re-formatted into easier to read summaries that can be quickly generated from the work order database. These reports allow managers to track how often and how thoroughly maintenance is being performed at a facility as compared to objective industry standards. The review effort was initiated at the Baden Pump Station and is now focused on the SVCF. HHWP is currently not using these tools, but will consider them in the near future.

The decision on whether and/or when to perform preventive maintenance is based on two objectives: minimize unplanned outages (reliability) and minimize life-cycle costs. For a given level of reliability, higher levels of preventive maintenance can result in different life-cycle cost scenarios depending on the particular asset as the three hypothetical examples in Figure 3-2 illustrate.

Figure 3-2: Preventive Maintenance Prioritization Methodology



For hypothetical Asset No. 1, increasing preventive maintenance activities increasingly adds to the overall life-cycle cost due to its low replacement value. The maintenance strategy employed in this case should appropriately be "run to fail" (assuming reliability is unaffected). Examples include off-the-shelf electronics and sensors, as well as inexpensive pumps or motors which require little or no preventive maintenance.

For Asset No. 2, increasing preventive maintenance activities continues to lower the overall life-cycle cost, a typical result for large-value assets. Investment in corrosion protection is an excellent example of how to justify higher expenses on preventive maintenance to reduce overall life-cycle costs. A $100 million pipeline can have its useful life reduced by 50% without proper corrosion protection costing as little as $10,000 a year.

For Asset No. 3, increasing preventive maintenance activities slightly increases overall life-cycle costs. Although the goal of any preventive maintenance program is to lower overall life-cycle costs, the role of certain assets in water system reliability (or any part of LOS) may warrant deviation from this goal. If an unplanned outage of a chlorine injection pump having little redundancy leads to high operational consequences, the higher life-cycle costs attributed to maintenance (assuming that the maintenance is effective at increasing useable life and/or reliability) may be warranted to reduce system risk. Also note that in general, when maintenance is not cost-effective, system reliability can still be addressed by adopting a maintenance plan that essentially consists of predicting the component's remaining useful life and then replacing it when it reaches 85% to 95% of that value. Many systems in the RWS in contact with corrosive chemicals fall into this category.

3.3.2 Maintain and QA/QC Asset Management Databases

Database management is a key function of the planning group as the databases house the asset inventory, condition, performance history, and location. Three primary databases support asset management processes: the CMMS (MAXIMO), the Fixed Asset Accounting System (FAACS), and the geographic information system (GIS).

CMMS (MAXIMO)

The CMMS is primarily a work order system that records and schedules maintenance and operations support by trades staff and engineers. Increasingly though, the CMMS is being used to support asset management and capital planning as it contains asset condition, performance history, and cost of maintenance. Improving the linkage between capital projects and the CMMS is on-going. Ideally, engineering drawings showing equipment and assets would be automatically added to the CMMS once project close-out is complete and installed equipment is verified.

The CMMS allows thousands of pieces of equipment over seven counties to be compiled in a simple, searchable inventory. The CMMS includes complete descriptions of each asset along with installation dates and performance histories; most assets are also geo-located in CMMS and GIS.

Along with regular standardized assessments, asset condition is also supplemented by maintenance reports and operator observations. Collectively, this information provides management with actual performance of individual assets and larger facilities and remaining useful life. The CMMS contains labor and materials expenditure data that permits accurate estimation of asset value and replacement costs. A process to ensure quality assurance of CMMS data is still under development.

Geographic Information System

Locations of assets can be recorded in various GIS libraries including pipeline alignments, property rights and boundaries, appurtenance locations (valves, vaults, manholes, service connections, etc.), as well as peripheral data such as leak history, geotechnical data including liquefaction soil potential, corrosion potential, and locations of known earthquake faults. Links in the GIS data also reference engineering drawings (plans and profile as-builts).

WSTD is currently working towards integrating our CMMS with our GIS system. This will allow geographic data for assets to be directly available within the CMMS. There are also numerous GIS-based displays that allow work orders to be viewed geographically in the office or on mobile devices in the field.

In order to integrate these systems, both must have data which accurately reflects the assets on ground and is named according to the asset classification index used in the CMMS. WSTD is in the process of creating GIS data from engineering as-builts and verifying the accuracy of the data using aerial photographs and field staff. The CMMS database administrator will need to update the data in the CMMS using the GIS. Once the two systems have accurate data which follows a uniform naming convention, the two systems can be linked.

FAACS

The FAACS is used to compute the value of a facility or fixed asset net of depreciation. This is the primary database used for the SFPUC's financial statements. When capital projects are completed project managers communicate facility and asset details to SFPUC accounting staff.

Depreciation begins at substantial completion with value decreasing linearly over time to zero after a set period, usually 50 to 100 years. While the SFPUC converts financial systems (Oracle's F$P is expected to be online at the beginning of FY18), a concerted effort is being made to better link the information from capital projects, FAACS and the CMMS. This will create much greater resolution in asset value among classes of assets (such as treatment or transmission) and asset location (San Joaquin Valley or Peninsula, etc.), and will link maintenance and capital expenditures within a given facility. The net result will be a more comprehensive characterization of expenditures by asset.

3.3.3 Compile Performance and Failure Reports

After an unplanned failure of an asset or facility is reported by operations or detected by SCADA, the SFPUC completes a simple, streamlined *Incident Report* that records description, chronology, possible root cause, and suggested corrective action. An "incident" is defined as an unplanned outage that takes an asset/facility partially or fully offline, an unplanned discharge, or a regulatory violation. Near-misses also count as incidents even though no realizable operations impacts occur. For example, when a redundant chemical feed pump fails and results in use of a back-up or another re-operation, no significant operational impact has occurred, but the failure is still significant. Other opportunities to gather and trend asset/facility failures (even when they do not reach the level of seriousness of an "incident") come from SFPUC's internal notification system, i-INFO (SFPUC's emergency notification software), weekly operations meetings, and CM work orders generated by MAXIMO.

The relevant incident details are recorded into the CMMS. Typical root cause of common failures include: inadequate preventive maintenance, inadequate design, poor specifications, inadequate training for staff, poor procedures, poor communications, and operator error. Sometimes failures fall outside of these categories or the reason for a failure is unknown. Typical remedies include: replacement in kind, modified maintenance, modified operations, revised equipment specifications, and/or enhanced monitoring. Recording the performance histories in the CMMS allows long-term review for a piece of equipment or facility (all pieces of equipment are parts of larger facilities). Most importantly, a corrective action plan is developed for each incident. Details for FY15 and FY16 incidents for WSTD are shown in Appendix F.

3.3.4 Complete Master Plans

Investment decisions on many assets and facilities are developed within various master plan updates. Master plans are unique to a facility class (such as valve vaults or pre-stressed pipelines) or function (such as corrosion protection). A master plan will broadly review LOS objectives and asset condition, and then refine maintenance programs and/or create new capital projects as necessary. This review process is typically documented in a *Needs Assessment Report*. Individual master plans are updated every 5 to 7 years, with 1 or 2 updated each year. WSIP and other recent capital projects have documented current asset conditions in many cases,

making several master planning updates relatively easy (or unnecessary). Capital scope for the CIP can also be identified through vulnerability assessments, regulatory action, and failure reports.

3.4 Budgeting

Since FY15, the City and County of San Francisco has adopted a two-year budget (both operating and capital). The two-year budget is prepared and adopted during even-numbered FYs and becomes effective for the two succeeding years. The SFPUC's CIP is updated each year to coincide with the annual updates of the City & County of San Francisco's CIP. Mid-budget cycle adjustments are minimized.

During budget preparation, managers must forecast operating expenses for the next two fiscal years. The task requires anticipation of asset completion and the necessary staff and resources needed to maintain them. This is particularly challenging with new groundwater wells coming on line in FY17 and FY18 which involves phased testing, operation and specialized staff. On the capital side more iteration is required between finance staff and operations staff as they work together to complete the CIP. Rate projections, reserve balances, and financing options each affect the size of the CIP, particularly in the first two years.

Following internal review by senior management, various Commission workshops are held to discuss the budget with staff in January and February. Rate hearings are held later in the spring. The Mayor's office reviews the SFPUC's budget before presenting the city-wide budget to the Board of Supervisors. Finally the Board of Supervisors reviews and ultimately passes the budget, usually in late June. Each of these reviews can modify aspects of the SFPUC's budget.

3.5 Implementation

The planning process refines and guides maintenance programs and scoping of capital projects. The major maintenance programs are outlined in detail in Section 4 along with their corresponding accomplishments from FY15 and FY16, as well as plans for future work. Maintenance prioritization within a program, and across programs, is discussed above.

3.5.1 Types of Maintenance Performed

All maintenance programs consist of different type of work orders, although most are comprised of either preventive or corrective ones. A full list of work order type is shown below for reference.

- Preventive Maintenance (PM) - Work on a specific asset that is interval- or condition-based. Besides traditional preventive maintenance, PM work orders in the CMMS include diagnostic testing, servicing and overhauls, compliance/regulatory items, and scheduled inspections. Only assets have associated PMs.
- CM - Unplanned failure or reduced performance on a specific asset that is discovered by field observation, condition assessment, reported by an operator, SCADA alarm, or customer.

- System Operations (OPS) – Work directly supporting operations, but not including maintenance-related work.
- Capital Support (i.e., WSIP) – Maintenance work in direct support of a capital or R&R project. This includes activities such as de-watering/disinfecting pipelines to support construction, performance testing, and attending project meetings.
- Administration (AD) - This work type is for operations and maintenance staff performing indirect work due to administrative activities such as completion of timecards (eTime), training, safety tailgate meetings, etc.
- Other – Miscellaneous operational or maintenance work that does not fit the categories indicated above. Examples include corporation yard maintenance.

In practice, the fundamental Reliability Centered Maintenance (RCM) concept is reflected in maintenance efforts within the RWS-West that are focused on maintaining reliability of critical assets and strive to be conditions based. Work is screened through the maintenance planning group (as described below) and reviewed by the Operations and Maintenance Manager to ensure work on critical assets is prioritized prior to being scheduled and disseminated to maintenance staff.

As described above, work orders are labeled in the CMMS by type, but the planning/prioritization process uses an additional term to delineate CM work: planned or unplanned. (PM and other work order types are usually categorized as planned).

- **Planned work.** Whether corrective, preventative or another type, a work order is considered to be planned if a job plan is written and reviewed in the CMMS, the normal approval process is followed, all permits are secured, and appropriate notifications occur. Even after an unplanned failure of asset occurs, the corresponding corrective work order could still be planned. Most planned work is routine and regular.
- **Unplanned work.** Work that skips one or more planned steps due to urgency is characterized as unplanned work. Approvals for work scope, timing, use of overtime, and job parameters can be verbal as directed by management. Work orders in this category are created after or during the work.

3.5.2 Work Order Prioritization

The following describes the general process used to prioritize work orders for the RWS with some differences in actual practice between WSTD and HHWD acknowledged. Prioritization by mid-level managers is required due to the volume of work, and the higher level of perspective needed to gauge the importance of potential tasks – including determining when work orders should never be performed because it is not cost-effective or required to maintain system reliability.

WO Approval and Scheduling

Once a work order (WO) is deemed complete and has been appropriately cataloged, the WO enters the approval and scheduling phase where it is reviewed and approved by the Planning Manager. Once approved, WOs are available for staff to charge labor and materials against

until the WO has been closed, cancelled, or completed. Blanket WOs are usually approved at the beginning of the FY.

- **Blanket work orders** cover only three types of work: 1) general tasks to be completed at a treatment facility by operations staff only; 2) indirect administrative work for supervisors; and 3) staff training. This type of WO is entered into the CMMS through the work request or the WO tracking screens. All blanket WOs follow the same general principles as other WOs and can appear as either child or parent WOs. However, blanket WOs are established at the beginning of each FY and after preliminary review, are immediately approved. All blanket WOs remain open throughout the FY but are closed at the end of each FY.

For all non-blanket WOs, maintenance planning staff schedule the WO depending on the priority level assigned, nature of the work, and availability of staff and materials.

Work order approval and scheduling decisions are made based on the same methodology as the condition assessment program in that work is prioritized based on the operational consequences of reduced performance level or total failure of a piece of equipment. A CM work order may involve in-kind replacement, upgrade, repair, or demolition and site remediation when the asset is no longer needed.

WO Priority System

After preventive maintenance activities are determined to be appropriate, completion priority generally uses the same logic. That is, the first preventive maintenance activities to be scheduled are those that reduce the most life-cycle cost and those that most increase system reliability. Predictive maintenance is not presently performed but a method utilizing the SCADA system is being explored.

As work orders of all types are generated on a daily basis, a standardized system is used to prioritize work based on the urgency of completion. In the CMMS each approved work order receives a priority ranking:

> **(9) Emergency –** The existence of an imminent threat to life or limb, an imminent catastrophic threat to the environment, or an imminent threat of catastrophic equipment failure exists, **(usually declared by management)**.
>
> **(8) Operational Failure –** A personal injury, unscheduled shutdown of critical equipment, harm to the environment, or sustained breach of water quality resulting in a RWQB or CDPH violation has occurred, and immediate action must be taken.
>
> **(7) Urgent Work** - High Probability of Failure. Urgent action needed to prevent Priority 8 or 9 occurrences. These situations are usually found during PM inspections, but may result from general observations while in an area.
>
> **(6) Regulatory Compliance PM** - Regulated Testing, Maintenance, and Inspection Activities, these work orders will typically emanate from a regulating body such as DOT, DMV, OSHA, WECC, CPUC, Regional Water Quality Board, SWRCB, etc. Examples of this type of work might include DOT Vehicle inspections, DMV Smog

testing, Protective Relay testing and maintenance, ROW Vegetation Management inspections, etc.

(5) High Criticality Asset PM – Preventive/Predictive Maintenance against critical assets, support of HSIP construction projects, or a limited window of opportunity (such as a shutdown).

(4) Standard PM – Preventive/Predictive Maintenance/Safety/Code Corrections.

(3) Routine Work– Schedulable maintenance repairs, as a result of PM or general observation, regular/routine work, and cottage remodel work.

(2) Low Priority Work – Work that enhances system or mission performance.

(1) Desirable Work – No direct effect on system or mission performance if not done.

Maintenance Backlog Management

The maintenance backlog is defined simply as combination of work orders that have been submitted and approved, but are awaiting work initiation and work that has been identified but not yet approved to proceed. Most of the backlog tends to be low priority work orders that continually fail to get scheduled due to the presence of higher priority work. Backlog work orders can also consist of deferred preventive maintenance. Planning staff monitor outstanding work orders and re-initiate priority ones with trades supervisors.

On a weekly basis, all work within the backlog is reviewed for potential scheduling. At WS&T, priority of the work is used first to screen the work that gets scheduled. Within each priority group, assuming all things equal, the "oldest" work order is scheduled first. The remaining work is scheduled according to "age" in descending order until either the schedule is full or there are no more remaining work orders among that priority group. Any work order older than one fiscal year is cancelled. Meetings among mid-level managers and trades supervisors ensure that priority work remains in the system.

HHWP staff place work requests into a backlog where managers responsible for their specific work groups approve and commit resources to jobs that are to be performed within the upcoming 30 to 45 days. The HHWP's Asset Management Services group plans and schedules maintenance activities for crafts 7 to 14 days in advance to allow for sufficient notification and coordination to occur.

Performance is tracked using metrics that evaluate:

- Labor availability
- Actual work performed on Scheduled vs. Unscheduled work (1 week in advance)
- Actual work performed on Forecasted work (2 week look-ahead)

As schedule success increases, reactive work decreases, demonstrating an improvement in the maintenance and management of HHWP assets.

Hetch Hetchy is always striving for continual improvement in its maintenance program which is demonstrated by the implementation of a comprehensive work order life cycle. The work order life cycle begins with initiation and continues through review, approval, execution,

feedback, closeout and updating job plans and asset information as appropriate, all of which are documented by Standard Operating Procedures. This process assures a standardized approach across all work groups that is measurable and encourages staff participation at all levels.

3.5.3 Capital Project Completion and Close-Out Reporting

This section includes a discussion of all RWS WSIP projects. One of the major responsibilities of the SFPUC during the WSIP is to ensure appropriate asset management deliverables are received by operations staff and archived by project teams and contractors prior to project close-out. These deliverables include complete sets of equipment manuals (also called Operations and Maintenance Manuals, or O&Ms), warranty information, record and as-built drawings, equipment inventory sheets, and in some cases specialized trainings, operating permits/agreements, and service agreements. These deliverables are audited each quarter and reported to the WSIP and Water Enterprise management with formal reports beginning in FY12. The most recent tracking sheet is included in Appendix G.

WSIP Construction Management Procedures 32 and 33 describe the Contract Close-out and "Record Documents" submittals, respectively. The Contract Close-out procedure outlines the process by which verifications are made for satisfactory completion of contract work. The Record Documents procedure specifies the process by which record information is collected and documented in construction drawings and at completion of projects, and by which final project record documents are produced, certified, and archived. Projects designated as completed (meaning Final Completion) have three to six months before the project is closed out. During that time, O&M manuals, Equipment Data Sheets, and Record Drawings are collected and compiled.

As shown in Appendix G, outstanding deliverables exist. Accordingly, Water Enterprise staff are still actively pursuing them with the various WSIP project teams. Obtaining deliverables from the earliest WSIP projects can be costly (and often un-budgeted) - and difficult, as the earliest projects worked off of less-complete specifications in this area. Still, comparing Appendix G from the 2012 version of this report (when the data was first tracked) shows the task to be nearly complete after years of effort.

Warranty periods are also tracked so that operations staff can thoroughly test components and/or inspect them prior to the expiration of contractor or supplier warranties. Advanced planning is required for inspections of interior pipeline linings because these actions require additional facility shutdowns at the same time as construction-driven shutdowns.

3.6 Vision for Maintenance Program

The vision for the maintenance program is to shift focus from CM to PM and predictive maintenance – a change made considerably easier when WSIP construction ends. As more preventive maintenance is implemented, more costly CM should be avoided. Predictive maintenance will be implemented in situations where it can be shown to be cost effective.

With WSIP construction winding down in FY17, a big initiative in the coming years will be to ensure asset inventory is accurate (adding new, deleting obsolete or replaced, and maintaining

existing assets). Rehabilitation and upgrade projects occurring at the same facility make this a challenge.

Implementing this vision requires acceptance of ownership and associated responsibilities of all new assets constructed and/or installed within the RWS as part of WSIP. Once these new assets are put into service, they cannot be neglected or subjected to deferred maintenance. Doing so significantly reduces their overall usable life and significantly increases their life-cycle costs. Preventive maintenance on these new assets will be integrated into the existing maintenance program and proper maintenance work will be scheduled accordingly.

Additionally, more work is needed to accurately record total maintenance and R&R costs of assets within the RWS. At present, maintenance functions are performed by multiple divisions and groups within the SFPUC, city departments outside the SFPUC, and outside specialists. Accounting for these different costs is difficult.

Finally, significant maintenance is performed within treatment facilities as part of the daily work routines of assigned WTP staff. This work can be better integrated into the CMMS for a more complete picture of asset management at these facilities.

4. FY15 and FY16 Maintenance Programs

The sections below document the major accomplishments in maintenance and R&R. Capital projects are discussed in Chapter 5. For management and budgeting purposes, the largest maintenance programs are separated into general functional areas. The categories also resemble those used in the CIP. Each program is discussed below along with major accomplishments in FY15 and FY16, and planned work for future years.

Most activities within maintenance programs are generated from maintenance-related work orders either as scheduled preventive maintenance activities, or as reactive corrective-related ones. These activities are usually labor-intensive (typically utilizing in-house labor), and also require materials and supplies. These work orders are charged to operating budgets.

When equipment or assets fail and require renewal or replacement, activities are expensed to the R&R budget housed within the capital budget. Regardless of whether or not work orders involve R&R funding, work orders in excess of $10,000 are above the approval authority of lower-level supervisors and management. When this occurs, the work order is considered to be a project and requires division manager approval once scope and budget are reviewed.

Most work within a program is executed by WSTD staff but support is often provided by other groups within the SFPUC, other city departments (e.g., many IT functions), or outside consultants and contractors. Staff provide environmental review and compliance for operations and maintenance projects, in close coordination with maintenance planning staff.

Underlying all of the activities of the maintenance program is the work by the Maintenance Planning Section, which continuously manages the asset inventory, asset condition assessments, and maintenance status. Without accurate information on assets (Appendices A, C and D) the planning staff cannot appropriately schedule and prioritize work orders. This section also closely works with the Maintenance Engineering Section in reviewing the specifics of job plans to ensure proper maintenance procedures are outlined.

When equipment or assets fail and require R&R at HHWP, the activity is funded either through HHWP programmatic funds or through the capital fund budget (depending on the project costs and whether the improvement qualifies for bond funding). All projects in excess of $5,000 must go through a management approval process. Larger R&R projects, or projects that cannot be performed by staff, are managed by HHWP's R&R group. Common to all projects is the following support structure:

- Environmental support is provided by NRLMD and BEM
- HHWP's Asset Management group provides coordination of HHWP resources and asset inventory changes
- Maintenance Engineering supports the project as-requested by the R&R group
- A Job Manager will be assigned to the project and will be accountable for project delivery and budget

4.1 Water Supply and Storage

This program includes maintenance work on existing dams. The RWS includes fourteen dams under DSOD jurisdiction. There is a multitude of activities related to the inspection and the monitoring of these dams. The RWS is up to date and in good standing in all aspects. Both HHWP and WSTD work closely with DSOD and in many cases have gone above and beyond minimum requirements.

Groundwater wells constructed under WSIP are expected to be on line in FY17 and FY18 and will be added to the program. It will eventually encompass alternative supply projects such as additional groundwater, desalination, and/or recycled water facilities as they become active in the RWS.

4.1.1 Dam Monitoring Program

The RWS includes the fourteen dams under DSOD jurisdiction; six in Tuolumne County: Early Intake Dam, Lake Eleanor Dam, Moccasin Dam (aka Moccasin Lower Dam), O'Shaughnessy Dam, Priest Dam, and Cherry Valley Dam; two in Alameda County: Calaveras Dam and Turner Dam; three in San Mateo County: San Andreas, Pilarcitos and Lower Crystal Springs; and three in San Francisco County: University Mound, Sunset Reservoir, and Merced Manor Reservoir.

Of the five jurisdictional dams in the Bay Area, Lower Crystal Springs is a gravity dam while the other four (Calaveras, Turner, San Andreas and Pilarcitos) are earth filled dams. See Appendix A for additional detail.

The system also includes several other smaller, non-jurisdictional dams. Upper Crystal Springs Reservoir is relatively large in terms of storage volume by comparison to the others, but only impounds water three to ten feet above the adjacent Lower Crystal Springs Reservoir.

The SFPUC established a comprehensive monitoring program to maintain the dams and ensure public safety downstream. This WSTD program extends beyond the minimum requirements of the DSOD outlined in the California Water Code, Division 3 – Dams and Reservoirs. This report does not cover the dams in San Francisco County.

The major components of the program consist of regular inspection and monitoring, maintenance, repairs, planning studies (stability studies, inundation map updates and other), and emergency planning. Peer review is added through participation in the Bay Area Dam Owners Group (a local collaborative effort with SCVWD, Contra Costa Water District, and EBMUD). This Group shares information on topics such as dam safety and monitoring, environmental permits for dam maintenance, emergency preparedness, seismic stability analyses, and operational restrictions. Specialized technical assistance is provided by AECOM.

Field Inspections & Monitoring

Field inspections consist of routine inspections, formal annual inspections, and episodic inspections accompanied with engineering surveys following seismic events of specified magnitude.

Routine inspections are conducted by SFPUC staff including engineering survey crews. Staff record monthly readings on piezometers and seepage drains and also perform a bi-monthly visual inspection on spillways and appurtenances. The survey crew conducts a bi-annual dam displacement survey on monuments for vertical and horizontal movements.

Table 4-1: Dam Displacement Survey and Inspection Dates

Tasks	FY15 & FY16 Status Update	FY17 & FY18 Projection
O'Shaughnessy	• Weekly Seepage and Inspection • Dam Displacement Surveys June 30, 2015 August 20, 2015 October 5, 2015 November 17,2015 December 16, 2015 May 12, 2016 June 2,2016 June 29, 2016 July 7, 2016 August 23, 2016	Continue
Early Intake	• Weekly Seepage and Inspection • Dam Displacement Surveys June 29, 2015 November 23, 2015 April 29, 2016 June 21, 2016 July 19, 2016 August 31, 2016	Continue
Priest	• Weekly Seepage and Inspection • Bi-weekly Piezometers • Dam Displacement Surveys June 29, 2015 October 7, 2015 October 9, 2015 October 13, 2015 October 22, 2015 November 12, 2015 January 12, 2016 April 27, 2016 July 7, 2016 August 3, 2016	Continue

Tasks	FY15 & FY16 Status Update	FY17 & FY18 Projection
Moccasin	• Weekly Seepage and Inspection • Bi-weekly Piezometers • Dam Displacement Surveys June 29, 2015 September 16, 2015 January 14, 2016 January 28, 2016 February 4, 2016 March 18, 2016 June 2, 2016 July 20, 2016 August 16, 2016	Continue
Lake Eleanor	• Weekly Seepage and Inspection • Dam Displacement Surveys June 29, 2015 September 25, 2015 September 28, 2015 October 7, 2015 October 22, 2015 March 18, 2016 May 3, 2016 August 25, 2016 October 21, 2016	Continue
Cherry	• Weekly Seepage and Inspection • Dam Displacement Surveys June 25, 2015 June 29, 2015 September 28, 2015 October 23, 2015 March 18, 2016 April 26, 2016 June 21, 2016 September 1, 2016 October 21, 2016	Continue

Tasks	FY15 & FY16 Status Update	FY17 & FY18 Projection
Lower Crystal Springs	• Dam Displacement Survey, instrumentation readings, and inspection dates July 22, 2015 August 19, 2015 September 18, 2015 October 16, 2015 November 18, 2015 December 15, 2015 January 25, 2016 February 18, 2016 March 15, 2016 April 12, 2016 May 16, 2016 June 10, 2016 October 23, 2015 April 28, 2016	Continue
Pilarcitos	• Dam Displacement Survey, instrumentation readings, and inspection dates July 24, 2015 August 18, 2015 September 16, 2015 October 4, 2015 November 17, 2015 December 23, 2016 January 21, 2016 February 17, 2016 March 24, 2016 April 18, 2016 May 23, 2016 June 23, 2016 October 27, 2015 April 26, 2016	Continue

Tasks	FY15 & FY16 Status Update	FY17 & FY18 Projection
San Andreas	• Dam Displacement Survey, instrumentation readings, and inspection dates July 23, 2015 August 14, 2015 September 15, 2015 October 13, 2015 November 16, 2015 December 16, 2015 January 20, 2016 February 16, 2016 March 18, 2016 April 19, 2016 May 18, 2016 June 20, 2016 October 26, 2015 April 25, 2016	Continue
Turner	• Dam Displacement Survey, instrumentation readings, and inspection dates July 21, 2015 August 20, 2016 September 17, 2015 October 15, 2015 November 19, 2015 December 17, 2015 January 27, 2016 February 22, 2016 March 23, 2016 April 20, 2016 May 19, 2016 June 22, 2016 November 9, 2015 April 20, 2016	Continue
Calaveras	Dam replacement construction started on August 2011 and anticipated completion is in 2018.	No inspection until WSIP dam replacement project is complete in 2018.

Annual inspections are conducted by the DSOD inspector together with the SFPUC inspection team. DSOD inspects the following: piezometers, upstream and downstream face of the dam, crest and toes areas of the dam, groins, seepage points, spillways, spillway basins, outlet structures, tunnels, valves, piping, and metalwork. The DSOD inspector observes the outlet valve exercise once every three to five years. SFPUC exercises outlet valves annually. DSOD

issues a written report to the SFPUC after each annual inspection to summarize their findings and recommendations. Annual Inspections by DSOD were performed as summarized in Table 4-2.

Table 4-2: DSOD Annual Dam Inspection Dates

Tasks Annual Inspection by DSOD	FY15 & FY16 Status Update	FY17 & FY18 Projection
O'Shaughnessy	June 1, 2015 June 2, 2016 2014 and 2015 annual reports filed with DSOD in September 2016. HHWP findings indicate facilities deemed safe for continued use.	Next inspection is expected to occur in 2017 and 2018
Early Intake	June 29, 2015 April 29, 2016 2014 and 2015 annual reports filed with DSOD in September 2016. HHWP findings indicate facilities deemed safe for continued use.	Next inspection is expected to occur in 2017 and 2018
Priest	June 29, 2015 April 27, 2016 2014 and 2015 annual reports filed with DSOD in September 2016. HHWP findings indicate facilities deemed safe for continued use.	Next inspection is expected to occur in 2017 and 2018
Moccasin	June 29, 2015 June 2, 2016 2014 and 2015 annual reports filed with DSOD in September 2016. HHWP findings indicate facilities deemed safe for continued use.	Next inspection is expected to occur in 2017 and 2018
Lake Eleanor	June 29, 2015 October 23, 2015 2014 and 2015 annual reports filed with DSOD in September 2016. HHWP findings indicate facilities deemed safe for continued use.	Next inspection is expected to occur in 2017 and 2018
Cherry	June 29, 2015 October 23, 2015 April 29, 2016 2014 and 2015 annual reports filed with DSOD in September 2016. HHWP findings indicate facilities deemed safe for continued use.	Next inspection is expected to occur in 2017 and 2018

Tasks Annual Inspection by DSOD	FY15 & FY16 Status Update	FY17 & FY18 Projection
Lower Crystal Springs	March 14, 2016	Next inspection is expected to occur in 2017 and 2018.
Pilarcitos and San Andreas	November 5, 2015	Next inspection is expected to occur in the Fall or Winter of 2016 and 2017.
Turner	June 16, 2016	Next inspection is expected to occur in 2017 and 2018
Calaveras	The dam is monitored under the WSIP dam replacement contract until completion in 2018.	The dam will be monitored under the WSIP dam replacement contract until completion in 2018.

Inspections and engineering surveys are required following an earthquake depending on the magnitude and proximity of the earthquake to the dam. For WSTD, the criteria are specified in the Emergency Action Plans (EAPs) for each dam. These surveys are conducted immediately or during the next available daylight period. On July 20, 2015 an earthquake centered about one mile east of Fremont was strong enough to trigger surveying at Turner Dam. No abnormal readings were detected. For HHWP, criteria are specified in HHWP's Earthquake Notification Procedure. No earthquakes triggering surveying have been experienced on the HHWP project recently.

At HHWP, monitoring data are collected manually during the routine monthly inspection and the bi-annual engineering survey. The monitoring data include piezometer readings, seepage flows, survey readings, reservoir levels, and rainfall information. Piezometer readings, reservoir levels, and rainfall data are plotted over a 10-year period to identify trends. Piezometer readings, which represent water pressure, are labeled on each dam cross section to illustrate the internal phreatic surface. The survey readings that show horizontal and vertical movement are summarized in a tabular format with a 10-year history. The monitoring data are a central element in the reports submitted to DSOD each year. HHWP's dam monitoring and inspection program will be updated over the next 10 years for each HHWP dam. As these changes are made, the dam facility reports will be modified to reflect these improvements to the program.

Maintenance and repair consists of annual flushing of piezometer piping and DSOD annual inspection recommendation follow-ups. The flushing of hydraulic piezometer piping is required in order to maintain proper operation. DSOD annual inspection recommendation follow-ups generally consist of vegetation clearing, rodent control, minor spillway repair, and repair of seepage measuring devices. These activities are included in the operating budget.

Maintenance – Valve Exercising

SFPUC exercises dam outlet valves annually. Valve movements in FY15 and FY16 are summarized in Table 4-3.

Table 4-3: Summary of Valve Movements in FY15 & FY16

Tasks Valve Exercise	FY15 & FY16 Status Update	FY17 & FY18 Projection
O'Shaughnessy	2015 • Valves 1-8 not exercised due to drought • Valve 12 exercised 2/18/15 • Valve 13 exercised 2/18/15 • Valve 15 not exercised • Valve 16 exercised 6/11/15 • Slide Gates A,B,C exercised 3/24/15 • Slide Gates 9, 10, 11 exercised 3/24/15 • Slide Gates 12, 13, 14 exercised 1/5/2015 • Drum Gates exercised 3/31/15 2016 • Valve 1-8 exercised May 19, 2016 • Valve 12, 13 & 16 not exercised • Valve 15 exercised 9/23/2015 • Slide Gates A,B,C exercised 7/8/2015 • Slide Gates 9, 10, 11 exercised 7/8/15 • Slide Gates 12, 13, and 14 not exercised • Drum Gates exercised 7/17/2015	Continue
Early Intake	2015 • Gates 1 &2 and Guard Gates 1 & 2 operated throughout year. Exercised 3/10/2015 and 6/10/2015 2016 • Gates 1 &2 and Guard Gates 1 & 2 operated throughout year. Exercised 9/1/2015 and 12/23/2015	Continue

Tasks Valve Exercise	FY15 & FY16 Status Update	FY17 & FY18 Projection
Priest	2015 • Ball Valve and Butterfly Valves (BFV) 1&2 exercised 3/3/15 • Slide Gates 1, 2 and Bypass BFV exercised 1/2015, 2/2015, 4/2015, 6/2015 2016 • Ball Valve and BFV 1&2, Slide Gates 1, 2 and Bypass BFV exercised 7/2015 and 9/2015	Continue
Moccasin	2015 • Normal operation of Gates 1, 1a, 2, & 2a. Gate 3 not operated 2016 • Normal operation of Gates 1, 1a, 2, & 2a all exercised 7/9/2015. Gate 2 exercised 9/8/2015 and Gate 3 exercised on 7/29/2015.	Continue
Lake Eleanor	2015 • Valves 1, 2, 3 & 4 operated over full range during runoff. 2016 • Valves 1, 2, 3 & 4 operated over full range during runoff. Valves 3a & 4a refurbished and operated on 9/11/2015 & 10/2/2015	Continue
Cherry	2015 • Hollow Jet Valves 1 & 2 not exercised. BFV 1, 2 & 3 along with 12" needle, BFV and 6" fish release valve all exercised almost every month 2016 • Hollow Jet Valves 1 & 2 not exercised. BFV 1, 2 & 3 along with 12" needle, BFV and 6" fish release valves all exercised almost every month	Continue
Lower Crystal Springs	New emergency release valves H91 and H92 were exercised in January 15, 2015. Adit valves H10, H11, H12, H20, H21 & H22 were exercised in June 22, 2016.	Test of line valves and emergency valves in later part of 2016. Repeat test of adit, line and emergency valves in 2017

Tasks Valve Exercise	FY15 & FY16 Status Update	FY17 & FY18 Projection
Pilarcitos	S10, S11, and S12 were exercised in November 5, 2015.	Continue
San Andreas	DSOD acknowledges that SFPUC has plan to add blow-off valves on SA2 and SA3 raw water lines in HTWTP that will satisfy DSOD's draw down criteria. Inlet valves were exercised on May 20, 2015.	Continue
Turner	No valve movement occurred during this period due to a critical operation on the San Antonio pipeline. The exercise took place instead on August 28, 2016.	Valve exercise is projected when San Antonio pipeline can be taken out of service, in the summer of FY17.
Calaveras	WSIP construction – no activities.	WSIP construction – no Activities

Maintenance – Vegetation Management

SFPUC and DSOD inspections regularly trigger vegetation and rodent clearance work along dams and spillways. This work is transmitted to the maintenance crews for completion via memorandum from the engineering section. Table 4-4 shows work from FY15 and FY16.

Table 4-4: Summary of Vegetation Management for FY15 and FY16

Tasks Vegetation & Rodent Management	FY15 & FY16 Status Update	FY17 & FY18 Projection
O'Shaughnessy	No activities required	Continue
Early Intake	2015: Vegetation removal completed May 21, 2015. Rodent abatement completed November 24, 2015 2016: Vegetation removal completed May 2, 2016. Rodent abatement completed March 23, 2016	Continue
Priest	2015: Vegetation removal completed June 9, 2015. Rodent abatement completed November 24, 2015 2016: Vegetation removal completed February 25, 2016. Rodent abatement completed March 23, 2016	Continue
Moccasin	2015: Vegetation removal completed May 20, 2015. Rodent abatement completed November 24, 2015 2016: Vegetation removal completed May 26, 2016. Rodent abatement completed March 23, 2016	Continue
Lake Eleanor	Vegetation removal completed October 26, 2015.	Continue
Cherry	Vegetation removal completed March 3, 2016. Tree removal completed May 5, 2016	Continue
Lower Crystal Springs	Completed on August 2015. Vegetation was removed on downstream groins of the dam.	Continue
San Andreas	Completed on July 2015. Pest Control Specialist set up traps to catch moles and gophers and checked the traps on a weekly basis.	Continue

Tasks Vegetation & Rodent Management	FY15 & FY16 Status Update	FY17 & FY18 Projection
Pilarcitos	Completed on July 2015	Continue
Turner	Some bushes and trees were removed in November 2015. Areas around water ponds require environmental review and biological survey. Rodent control procedure is being evaluated in coordination with NRLMD. Work is ongoing.	Continue the process of securing environmental permits to trim or remove tulles on the downstream face and the toe of the dam.
Calaveras	WSIP construction - no activities.	WSIP construction – no activities.

Repairs

Repairs include work that cannot be capitalized and refer to maintenance and small R&R projects. Table 4-5 below shows work from FY15 and FY16 and projected work for FY17 and FY18. Similar information for HHWP is provided under the previous section on Monitoring and Inspection.

Table 4-5: Dam Repair Tasks

Tasks	FY15& FY16 Status Update	FY17 & – FY18 Projection
Lower Crystal Springs		
Monthly instrument reading collection and data evaluation	Completed	Continue
Annual report for DSOD	July 31, 2015, July 8, 2016	Continue
Install anchor hold-downs over emergency dissipation structure gratings	Completed on June 2015	----------
Add riprap around emergency dissipation structure	New Item	Continue
Pilarcitos		
Monthly instrument reading collection and data evaluation	Completed	Continue
Annual report for DSOD	July 31, 2015, July 8, 2016	Continue
San Andreas		
Monthly instrument reading collection and data evaluation	Completed	Continue
Annual report for DSOD	July 31, 2015, July 8, 2016	Continue
Repair of piezometers #12 & #19 casing is needed again @ San Andreas Dam after log boom knocked off the piezometer casings. Piezometer #20 also needs repair.	Ongoing	Continue

Tasks	FY15& FY16 Status Update	FY17 & – FY18 Projection
Install rip-rap for erosion protection at the outlet of the stilling basin.	Ongoing	Continue
Turner		
Monthly instrument reading collection and data evaluation	Completed	Continue
Annual report for DSOD	July 31, 2015, July 8, 2016	Continue
Flush piezometers	September to October 2015	Continue
Provide corrosion protection for adit valves in outlet structure	Completed on October 2015	--------
Calaveras		
--------	WSIP construction - no activities.	WSIP construction - no activities.

Planning Studies

Seismic stability studies and analyses were conducted for LCSD, San Andreas Dam, Pilarcitos Dam, and Calaveras Dam in the 1970s and 1980s as required by DSOD. Extensive studies were conducted based on regional and dam site-specific geology, seismicity of two active fault systems (Calaveras and San Andreas), subsurface exploration and soil sampling, and characterization of the embankments and foundations. Although updates to these stability studies are not generally required by DSOD, the SFPUC plans to update them approximately every 15 years in conjunction with outside experts to incorporate any new findings on subsurface materials or new seismic criteria. This frequency allows review of approximately one DSOD-jurisdictional dam per year in the SFPUC system.

The inundation maps for all of the dams were last updated in the 1970s as required by the State Office of Emergency Services. The maps show areas of potential flooding in the event of catastrophic and total failure of the dam. The maps are updated as needed to incorporatedownstream land use changes.

In FY12, URS provided guidelines for the SFPUC to better interpret piezometer data for LCSD, Pilarcitos, San Andreas, and San Antonio Dams. These guidelines allow staff to more rapidly identify problems with dam stability. URS reviewed all relevant studies and examined historical reservoir, rainfall, and instrument data to determine a matrix of response actions to guide safe operations of the four regional reservoirs.

At HHWP, seismic stability studies and analyses are conducted with each condition assessment. Refer to Section 2 regarding studies performed to date and timing of upcoming condition assessments. As stated in the previous State of the Regional Water System report, HHWP's dam monitoring and inspection program will be updated over the next 10 years for each HHWP dam. As these changes are made, the dam facility reports will be modified to reflect these improvements to the program. Changes in monitoring systems are already scheduled into the 10 year capital plans.

San Antonio Dam

During FY12, the inundation map was updated for San Antonio Dam. Over the last 20 years there have been major changes to downstream land use making an update essential. Upgrades to the piezometers were completed in FY11. A stability analysis for San Antonio Dam will be initiated in the near term.

LCSD

An updated inundation map was completed for LCSD in FY11. This study also included a review of the most recently available hydrology data in the San Mateo Creek watershed to ensure that the 100-year flood assumption used by Federal Emergency Management Agency (FEMA) were appropriately conservative. The SFPUC completed an investigation on the concrete strength of the dam. The objective of the investigation was to verify and confirm the physical properties of the concrete. Results published in 2012 confirmed the concrete strength with no signs of deterioration. In FY12, the SFPUC also initiated a stability analysis of the dam. The purpose of this study was to reconfirm the safety and stability of the dam and fulfill a

commitment from the SFPUC to downstream stakeholders to perform an in-depth reevaluation of the dam's stability using the most appropriate analytical techniques and seismic standards. This study was completed in October 2013. The SFPUC initiated the retrofitting of two piezometers located at the toe of the dam. The project is estimated to complete in 2017.

San Andreas

An updated inundation map was completed for the San Andreas Dam in December 2015. Upon a hypothetical failure of San Andreas Dam, San Andreas Reservoir will flow into Lower Crystal Springs Reservoir and ultimately spill into San Mateo Creek. A stability analysis for San Andreas Dam will be initiated in the near term.

Pilarcitos

In FY15, the SFPUC awarded a Professional Service Contract titled Pilarcitos Dam and Reservoir Improvement Project to AECOM to assist in the areas of: dam upgrades, geotechnical investigation and engineering, structural and seismic engineering, hydraulic and hydrologic engineering, engineering planning, engineering design, and engineering support during construction for the dam and outlet structure. The contract is for $3 million with a duration of up to 9 years. Three tasks orders have been issued: Task Order 1—Project Management and Data Review/Materials Characterization (April 2015), Task Order 2—Outlet Structure Data Review and Visual Inspection (October 2015), and Task Order 3—Seismic Criteria and Ground Motions (October 2015). The dam Materials Characterization report was finalized and sent to DSOD for review on September 2015. A Forebay Data Review report and Seismic Hazard Technical Memorandum were submitted to DSOD in June 2016.

Calaveras

Construction of a replacement dam began in early FY12. The new dam will have state-of-the-art piezometers. An inundation map was revised in FY10. Construction will continue through FY19.

Emergency Action Plans

Emergency Action Plans (EAPs) are prepared for each dam. Each EAP includes roles and responsibilities, notification flowchart with notification procedure, mitigation activities and inundation map. These documents are updated annually and are up to date as indicated in Appendix B. Table top exercises are scheduled annually, rotating through each HHWP reservoir once every five years (to accommodate the six reservoirs, a table top exercise will be performed for two reservoirs once every five years). For the larger reservoirs, the National Park Service, Tuolumne County Sheriff, US Forest Service and Turlock Irrigation District will participate in future table top exercises. Dam EAPs contain information on critical assets. These EAPs are provided to the US Army Corp of Engineers, Modesto and Turlock Irrigation Districts, DWR, Tuolumne County Office of Emergency Services and Tuolumne County Sheriff's Office. At this time, there are no planned EAP table top exercises for Bay Area dams.

HHWP personnel also participate in Turlock Irrigation District's EAP table top exercises for Don Pedro Reservoir annually.

FY17 and FY18 Planned Work

The Dam Monitoring Program is intended to be a continuous maintenance program. During FY17 and FY18 work will continue in a variety of areas.

At LCSD, the toe piezometer retrofit work is ongoing and will be carried into 2017. The scope will include drilling out existing piezometers, piezometer automation by installing vibrating wiring sensors and telemetry units. As part of this project, there will be additional riprap added around the emergency dissipation structure to augment the existing ripraps.

At the San Andreas Dam, work is planned for retrofitting existing open well piezometers and existing adit structures.

Part of the Pilarcitos Dam and Reservoir Improvement project will include retrofit of existing open well piezometers and update of inundation study.

4.2 Transmission

Five sub-programs make up the transmission maintenance program. Discussion of tunnels and penstocks are included in the pipeline section. Many of the itemized activities were sometimes performed in concert with WSIP construction, taking advantage of shutdowns that offered opportunities to inspect and replace various assets. Valve exercising continued at the desired pace and appurtenance replacement/repair was accelerated to support WSIP. Corrosion systems continued to be upgraded at a high rate, with cathodically protected transmission pipeline increasing from 75 miles in 2014 to 115 miles in 2016, and expected to increase to 165 miles in 2018 (largely making up for lack of a formal program prior to 2008). Pipeline inspections increased in FY15 and FY16 compared to prior years, due to resources finally being freed from WSIP construction shutdown support.

4.2.1 Pipeline Repair

Approximately $3.6M in repairs were completed on the SJPLs and related appurtenances in FY15 and FY16. Two major repairs were performed on SJPL No. 1; one at Cashman Creek (replacing 65 linear feet) and one just east of San Joaquin Valve House (replacing 165 linear feet).

HHWP takes advantage of pipeline shutdowns to replaces broken appurtenances. Over the next two years, outdated rectifiers on the SJPL CP system will be replaced.

Within the Bay Area, approximately $1.7M in repairs were completed on pipelines and appurtenances in FY15 and FY16. In FY15, there was a leak in the 36”Palo Alto Pipeline that was repaired. In July of 2015, there was a major rupture on the 54” SAPL No. 2 in San Bruno at the Junipero Serra Park entrance. SFPUC crews worked overnight on the emergency repair, in order to keep the City of San Bruno supplied with water. Typically, there is redundancy on the SA2 line from SA3, but SA3 was shut down for the construction work related to Peninsula Pipeline Upgrade Project. In FY16, there was a major leak on the 78”Calaveras treated water pipeline in Sunol. This section failed due to the meandering Calaveras Fault through the Sunol Valley. The leak took place one month before the LCA test in the fall of 2015. In order to keep the LCA test on schedule, a 20 ft section was replaced through an emergency contract.

As pipelines are taken out of service for construction tie-ins or replacement, all pipeline appurtenances must be operable to accommodate de-watering and disinfection activities. Consequently, all related appurtenance valves, vaults, drainage paths and some line valves were serviced on affected pipelines.

4.2.2 Pipeline Inspection

The SFPUC regularly performs internal pipeline inspections to proactively find potential problems with transmission pipelines before major problems occur. A combination of acoustic sounding (with ball peen hammer) and visual inspections are performed for all pipelines. For PCCP, an additional electromagnetic test is performed through a specialized contractor to determine the number of broken pre-stressed wires. These methods have been used throughout the industry for well over 10 years and are considered state-of-the-art methods.

WSTD has created a schedule for inspecting approximately 253 miles of pipeline over the next 20 years (See Appendix C, Table C-2: 20 Year Pipeline Inspection Schedule). This schedule was created using a multi-step process based on a pipeline's likelihood to fail and the consequences of failure. This process emphasized public safety by prioritizing inspections for pipelines that have the highest chance of catastrophic failure and are located in close proximity to the public. Appendix E describes the process used to prioritize pipeline inspections and create the pipeline inspection schedule.

Inspections on the schedule are listed by quarters (generally listing the first date of the quarter as a placeholder for the inspection in that quarter). Once the actual date is scheduled, the inspection date could be changed accordingly.

After pipelines have been inspected, the pipeline condition information from the inspection will be used to help make an informed decision when prioritizing Capital Improvements Projects for each pipeline segment.

Pipeline inspections performed in FY15 and FY16:

SAPL No. 3 (In Baden Valve Lot - T55 to T56R)

Inspected in January 2015. SAPL No. 3 was inspected from the Baden Valve lot to new valve T55. The 66" pre-stressed concrete SAPL No. 3 was installed in 1981 and relined with a 60" steel cylinder pipe with cement mortar lining in 1995. SAPL No. 3 has been modified to accommodate the Baden Pressure Reducing Valve station and Baden Valve Lot upgrades in 2011. Both the 1995 & 2011 linings were in excellent condition with no issues noted. Inspectors observed the new valve T56R open and close without issue.

SAPL No. 2 (In Baden Valve Lot - T56R to R55P)

Inspected in January 2015. The 54" SAPL No. 2 was inspected from the Baden Valve lot to new valve R55. SAPL No. 2 was installed in 1928 and relined with cement mortar lining in 1967. Lining is thinning and failing at the lockbar seams in the section inspected. A full inspection is required.

SAPL No. 2 (Various locations in San Bruno from R12 to R20 - 0.65 miles)

Inspected from June 2015 to October 2015. This 54" diameter ¼" thick lock-bar pipe was constructed in 1927. Cement mortar lining was replaced in 1983. Some of the lining at the spring line on top of the lock-bar have fallen off at many locations. Pipeline thickness is better than 90% at all locations tested. A joint connection failed due to corrosion at Junipero Serra Park on July 27, 2015.

BDPL No. 2 (B50U to B60 - 4.92 miles)

Inspected in July 2015. The 66" BDPL2 was installed in 1935 and constructed with wrought steel and steel concrete cylinder pipe. The wrought steel sections were relined with cement mortar lining in 1961. The cement mortar lining has delaminated in two sections of steel pipeline and have been identified for repair. In addition, fifteen smaller delaminations less than 1-2' were noted in the steel sections and will be repaired in the future. The steel concrete cylinder pipe sections had minor cracking noted at the transition joints at U.S. Highway 101.

BDPL No. 1 (B17 to B20U – 5.2 miles)

Inspected in August 2015. The 60" BDPL 1 was installed in 1925 and constructed with riveted steel pipe. The BDPL1 was relined with cement mortar lining in 1960. In 2001 and 2004, the BDPL1 was modified to accommodate the Hayward Fault Crossing. The inspection team noted that 1960 CML sections of pipe are in good condition and required only minor repairs. The 2001 and 2004 polyurethane sections of pipe have experienced lining failures at multiple joints. The lining failures have been noted and will be repaired in the future.

Sunol Valley Water Treatment Plant 78" Treated Water Pipeline (Entire pipeline – 1.59 miles)

Inspected in September 2015. This inspection was triggered due to the rupture of this pipeline at the Calaveras Fault Line approximately 0.5 mile north of the SVWTP. Other than the pipeline segments adjacent to the rupture, which was damaged and replaced, the other 1.59 miles of pipeline had no major issues.

Calaveras Pipeline (SVWTP to W10 - 1.63 Miles)

Inspected in September 2015. Since this 1.63 mile segment of 66" diameter pipeline is parallel to the 78" diameter Sunol Effluent Pipeline, an inspection was performed at the same time to ensure that earth movement (creep) which may have caused the Sunol Treated Water Pipeline to rupture did not affect this pipeline. No major issues were noted during the inspection.

BDPL4 Hayward Fault Crossing Pipeline (D16 to D17 – 0.41 miles)

Inspected in April, 2016. This 0.41 mile section of 54"diameter pipeline was constructed in 2014. This was an initial service inspection. No major issues were noted.

Calaveras Outlet Conduit (Calaveras Reservoir to V34 – 0.28 miles)

Inspected in June 2016. The 72" Calaveras Outlet Conduit was commissioned in 1992 connecting the Adit, through the core of the existing Calaveras Dam, to the Calaveras Pipeline. The inspection team inspected 688 feet of 1992 pipe and 90 feet of 2013 pipe replacement as part of the CDRP. No major issues were noted.

Coast Range Tunnel

The Coast Range Tunnel was inspected in 2015 (the last inspection was in 1995). The tunnel lining continues to be in excellent condition and no capital work is required. Even the section of the tunnel crossing the Greenville Fault zone showed little indication of damage. Sand deposits and fragments of tunnel lining have accumulated in the shaft alcoves. This accumulated material may need to be removed in the future if it becomes a maintenance issue. Minor seepage was observed. Debris such as unused pumps, PVC tubing and cables was picked up and transported out of the tunnel. No section of the tunnel needs repair. It is recommended that the tunnel be inspected again in 2035.

Irvington Tunnel 1 (Entire tunnel - 3.44 miles)

In 2015 after Irvington Tunnel No. 2 had been thoroughly tested, Irvington Tunnel No. 1 was taken off line and inspected (the last inspection was in 1966). The inspection revealed only superficial deterioration which was repaired in a few weeks for less than $0.5 M. Corrosion was noted at the steel manifold to BDPL1 & BDPL2 at Irvington Portal. The old coal tar lining was removed and the steel manifold was relined with cement mortar lining. In addition, old appurtenances and bypass valves were replaced at the Alameda West Portal.

Mountain Tunnel

Mountain Tunnel will be inspected during an extended shutdown beginning January 3, 2017.

Kirkwood Penstock

Kirkwood Penstock was built in 1964 and conveys the SFPUC water supply from Canyon Power Tunnel to Kirkwood Powerhouse. External and internal inspections were performed in October 2015 and January 2016, respectively. The inspection established a baseline for future monitoring and confirmed that the lining and coating are in adequate condition.

San Joaquin Pipelines

No condition assessments were scheduled for the SJPLs over the last two-year period.

Pipeline inspections planned for FY17:

- San Antonio Pipeline (PCCP), from valves W20 to Y20
- Bay Tunnel (Initial Service Inspection), from valves E20U to E50U
- BDPL No. 4 (PCCP), from valves D50 to D68
- Crystal Spring Pipeline No. 3 (PCCP), from valves L30 to L41K
- Alameda Siphon No. 3 (PCCP), from valves X20 to X22

4.2.3 Valve Exercise Program

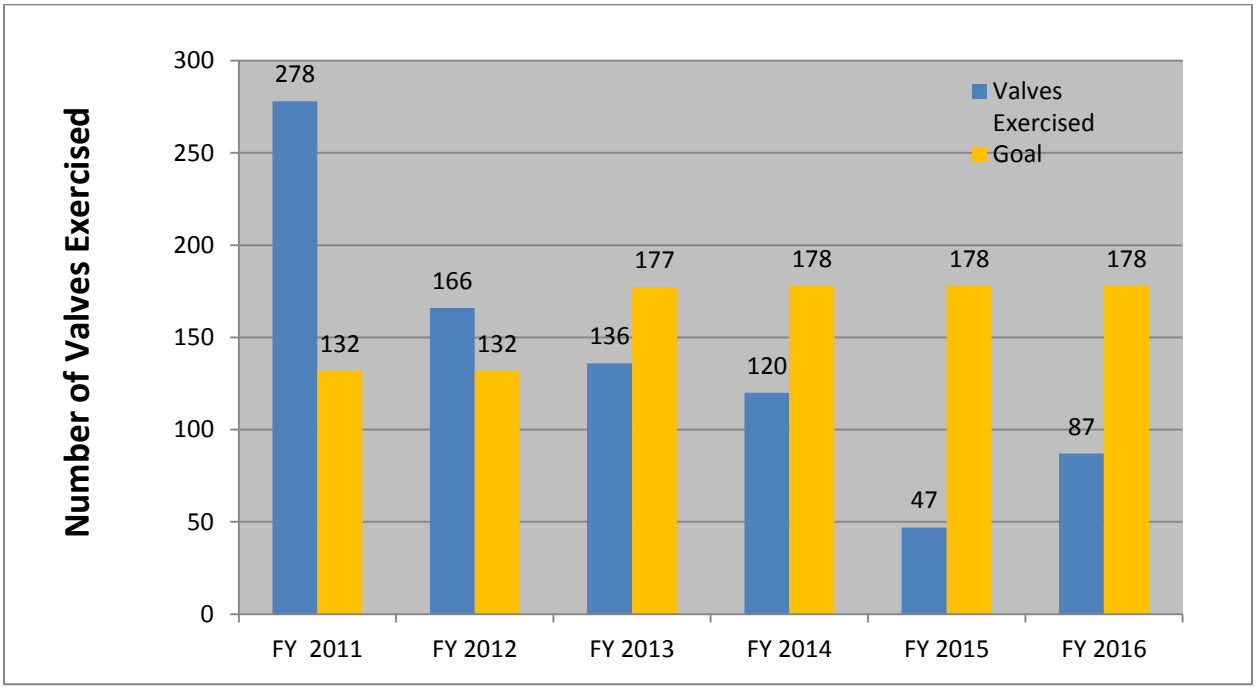
The valve exercise program is designed to extend the useful life of valves, increase reliability, and reduce lifecycle costs. The valve exercise program is based on specifications outlined in the manufactures Operations Manual as well as Best Management Practices (BMPs). The Operations Manual and BMPs determine the scope of the work order and the frequency. The valve exercise program is completed utilizing the Watershed Keepers, Plumbers and the Machine Shop crew. The goal of this program is to assess the condition of the valves, actuators, and appurtenances, as well as exercising the valve to determine operational capabilities and reliability.

The transmission program is designed to ensure all valves are exercised at least once every two years (line valves, cross-over valves, and bypass valves), with some HH's valves being exercised quarterly. This program is largely completed by the plumbing/maintenance crews. If full operations of the valve will not disrupt system operations, the valve to be exercised is fully opened and closed. If full operations of the valve is not possible due to operational constraints, the valve to be exercised is "bumped", i.e. opened (or closed, if already open) at approximately 5%, then closed (or returned to fully open). The first two years of the valve exercise program (FY09 and FY10) adopted a higher than standard rate (once per year) to reduce the backlog of valves that had not been exercised in years. In FY11 and FY12, the objective was reduced to be consistent with American Water Works Association standards now that most valves have been addressed. The once every 2 years objective continues today. Greater priority will be given to valve exercising efforts as the need to support WSIP diminishes.

Prior to WSIP completion, there were 264 valves within the transmission system (not counting the valves along the SJPLs) which translated to an objective of exercising at least 5 valves per week. With completion of BDPL No. 5, new BDPL Nos. 3 and 4 cross-over vaults, Alameda Siphon No. 4, and SAPL No. 3 extension, there are now 35 additional transmission valves (not including new valves on the SJPLs and valves in the treatment plants). Figure 4-1 shows that the goal was to exercise 356 valves every two years. Only WSTD valves are shown in the figure. The total number of valves in Appendix A-8 is larger because recently installed valves have not entered the exercise rotation yet.

As shown in Figure 4-1, the valve exercise rate has declined. In FY17 and FY18, the valve exercise rate and the pipeline inspection effort will both increase as the need to support WSIP declines.

Figure 4-1: Number of Valves Exercised from FY11 through FY16[9]



The other valve exercise program component addresses critical operations valves housed within water treatment facilities that are exercised and maintained by operations staff. Most valves are routinely operated in the course of daily operations. A program for exercising valves not in regular operation is still pending.

WSIP projects have started to wind down in FY16 and there will be an increase in pipeline inspections. WSIP projects during FY15 and FY16 included the tie-in of the Bay Tunnel to BD1, BD2 and BD5, placing the NIT into service and decommissioning of the BD1 and BD2 bay crossing. Warranty Inspections were performed on the BD4 pipeline at the Hayward Fault crossing and an inspection of the existing Irvington Tunnel and outlet manifold. The associated valves related to these tie-ins and shutdowns were tested and exercised.

4.2.4 Corrosion Monitoring / Maintenance Program (FY16)

The corrosion protection program is one of the cornerstones of the SFPUC's asset management and preventive maintenance efforts. Investments in the program are cost-effective, greatly extend the useful life of buried assets, and reduce unplanned outages. In FY10, the SFPUC and Schiff Associates updated the corrosion master plan. The primary objectives of the effort were to update the state of the corrosion protection system for buried assets in the Bay Area.

Prioritized projects derived from the plan were then sequenced in the CIP over 8 years. The master plan first assessed transmission pipelines to determine the adequacy of corrosion protection of the existing system. Then the master plan made recommendations to repair inadequacies and provide improvements for ideal corrosion protection. The cost of repairs and

[9] Not including new valves on the San Joaquin pipelines and valves in the treatment plants

improvements were estimated to be between $18.3 and $22.1 million in 2010. The WSTD started implementing the recommendations in FY11 and will continue to complete the repairs and improvements over the next 8 years. Projects that save the most money and protect the longest stretches of assets are implemented first. The scope of work is implemented over many years to reduce operational, construction, and staffing conflicts. Figure 4-2 summarizes the progression over time of CP on WSTD transmission pipelines.

The 2010 corrosion master plan identified corrosion potential and vulnerabilities from local ground conditions (corrosive soil, stray current, etc.) on 230 miles of transmission pipelines. With this field data, the study determined the adequacy of existing corrosion protection systems. Using those results, the study determined additional corrosion protection projects (including maintenance and monitoring work) that would most effectively and efficiently extend the remaining useful life of pipelines and buried assets.

In 2010, the condition assessment performed as a part of the master plan found that existing CP systems on the WSTD transmission lines were operating at less than adequate levels. Of the cathodically protected pipelines, only 15% of the linear length was providing adequate protection, with the remaining 85% receiving only partial to no protection, leaving the pipeline subject to corrosion. Note that since the implementation of the 2010 corrosion master plan, CP protection of the transmission system has improved 5% to 10% annually.

Based on the analysis, many of the pipelines located in the peninsula and south bay are subject to stray currents. This phenomenon is typically the result of DC-powered light rail transit systems, or one of the numerous other buried utilities applying CP in the vicinity of WSTD pipelines.

The report also indicated that the bulk of the pipeline alignments were installed in corrosive soils. The soil corrosivity is of concern due to age of the infrastructure and specifically that as pipeline coatings age they begin to deteriorate, exposing pipeline steel where corrosion is likely to occur. The more corrosive the soil, the higher the corrosion rate will likely be, resulting in exacerbated metal loss, or loss of pipeline wall thickness.

Remediation of existing CP systems and conducting extensive studies at the areas identified in the report are relatively inexpensive when compared to construction costs of structures such as pipelines and pump stations. Projects were categorized by the type of corrosion protection (for example, electrical isolation) and by pipeline to bring the transmission system to an ideal protected state against corrosion.

Information from planning efforts such as internal pipeline inspections, review of liquefaction conditions, locations of earthquake fault zones, criticality of particular pipelines to the Bay Area delivery capacity, adopted LOS, and to some extent, the adjacent land use and associated liabilities (i.e., public safety and claims) in the event of a pipeline leak or failure, is used in conjunction with the results from the corrosion protection program to guide and prioritize maintenance, R&R, and capital planning.

Implementation of corrosion protection projects also requires knowledge of concurrent maintenance or capital projects as implementation costs are significantly reduced when pipelines are taken out of service for more than one purpose. Similarly, many recommended

corrosion protection projects become unnecessary if assets will be replaced under the current capital program, such as the submarine sections of BDPL Nos. 1 and 2.

During FY13 and FY14, the SFPUC performed an in-depth analysis of the major external corrosion related issues for all the transmission pipelines identified in the updated corrosion master plan. Detailed recommendations including preparation of design and specifications were provided for all necessary corrective actions.

Active corrosion protection program elements and recent accomplishments from FY15 are listed below, along with plans for FY16 and beyond.

Single Line Diagrams

The Single Line Diagrams for all major transmission lines were produced in FY14 which allowed SFPUC engineers to see all pertinent information for each pipeline system, such as insulated joints, rectifiers, test stations, bonding, cross connections, foreign pipeline crossings, and pipe coating systems. The information was first obtained from existing WSTD records and the updated master plan report. It was then verified with in-depth field analysis. The new Single Line Diagrams are used to design new test stations and rectifiers to repair the CP deficiencies for the pipeline system.

New Rectifier CP System

Rectifiers are used to convert AC power to DC power for CP systems. The negative terminal of the rectifier is connected to the pipeline while the positive terminal of the rectifier is connected to the anode bed. A rectifier consists of a circuit breaker, diodes, a step down transformer with various coarse, and fine taps for voltage adjustment.

In addition to renovating the existing rectifiers, the in-depth analysis identified additional CP systems that would be needed to bring the corrosion protection level of the underground pipelines up to the protection criteria established by the National Association of Corrosion Engineers (NACE International). The CP system consists of primarily the rectifier and deep anode. During FY15, SFPUC used field survey information obtained from the in-depth analysis to put together the CP construction bid packages for installation of additional CP systems, which will be divided into three separate phases over four years and $9M. The following table shows the three phases and its corresponding scope.

Cathodic Protection for Transmission Pipelines at Various Locations		
Phase # / Contract No.	**Fiscal Year**	**Scope**
Phase 1 / Contract No. WD-2770	Design: FY15 - FY16 Construction: FY17	Provide and improve the level of corrosion protection for the following pipelines: Crystal Springs No. 1, Crystal Springs No. 2, San Andreas No. 1 and San Andreas No. 2. The pipelines are located along San Francisco, Daly City, South San Francisco, San Bruno and Millbrae. There will be 10 new rectifiers and approximately 52 new test stations installed during the Phase 1.
Phase 2 / Contract No. TBD	Design: FY17 Construction: FY18	Provide and improve the level of corrosion protection for the following pipelines: Palo Alto, BDPL No. 1, No. 2, No. 3 and No. 4. The pipelines are located along Stanford, Menlo Park, Palo Alto, Los Altos, Mountain View, Emerald Hills, Newark and Fremont. There will be 15 new rectifiers and approximately 90 new test stations installed during the Phase 2.
Phase 3 / Contract No. TBD	Design: FY18 Construction: FY19	Provide and improve the level of corrosion protection for the following pipelines: Alameda Siphon No. 1 and No. 2, Calaveras Effluent and Influent lines, Sunset Supply and SVWTP Effluent line. The pipelines are located along Sunol, Fremont, Hillsborough, Burlingame, Millbrae, SSF, Colma, Daly City and San Francisco. There will be 18 new rectifiers and approximately 100 new test stations installed during the Phase 3.

The first phase will provide 10 additional rectifiers with deep anodes to the transmission pipelines located between San Francisco and Millbrae. Also in the first phase, fifty-two (52) additional test stations will be installed along the pipeline alignments, to accommodate the upcoming pipe-to-soil potential surveys (originally, 80 test stations were planned, but there has been some resistance from local agencies to issue permits along their rights-of-way). While fewer test stations translate to more time spent on performing corrosion surveys, the overall corrosion protection of the pipelines is not compromised due to protection provided by rectifiers and anodes. Construction for the first phase is expected to begin in first quarter of FY17. The second and third phases will follow with an additional 33 rectifiers and deep anode

columns, which will cover transmission pipelines in the Peninsula and the East Bay. It is anticipated that 100 or more corrosion test stations will be installed as part of the second and third phases.

During FY15 and FY16, SFPUC staff coordinated with Pacific Gas and Electric (PG&E) to establish the power source locations for 10 additional rectifiers. They also coordinated with local jurisdictions (Daly City, South San Francisco, San Bruno and Millbrae) to procure the permits needed to install the rectifier cabinets on the city sidewalks, anodes and test stations on city streets, and cable connections from the pipelines to the CP systems. SFPUC developed the design drawings and specifications for the bid package to construct the 10 additional rectifiers and 52 new test stations. For FY16 to FY17 SFPUC will develop the design drawings and specifications for the second phase.

During FY15, SFPUC performed a bi-annual survey to evaluate the existing state of the CP system and determine if any remedial action is necessary for the corrosion control of the transmission pipelines. A final survey is being prepared by SFPUC staff to determine if there is a local hot spot where additional CP system is required within the existing CP system.

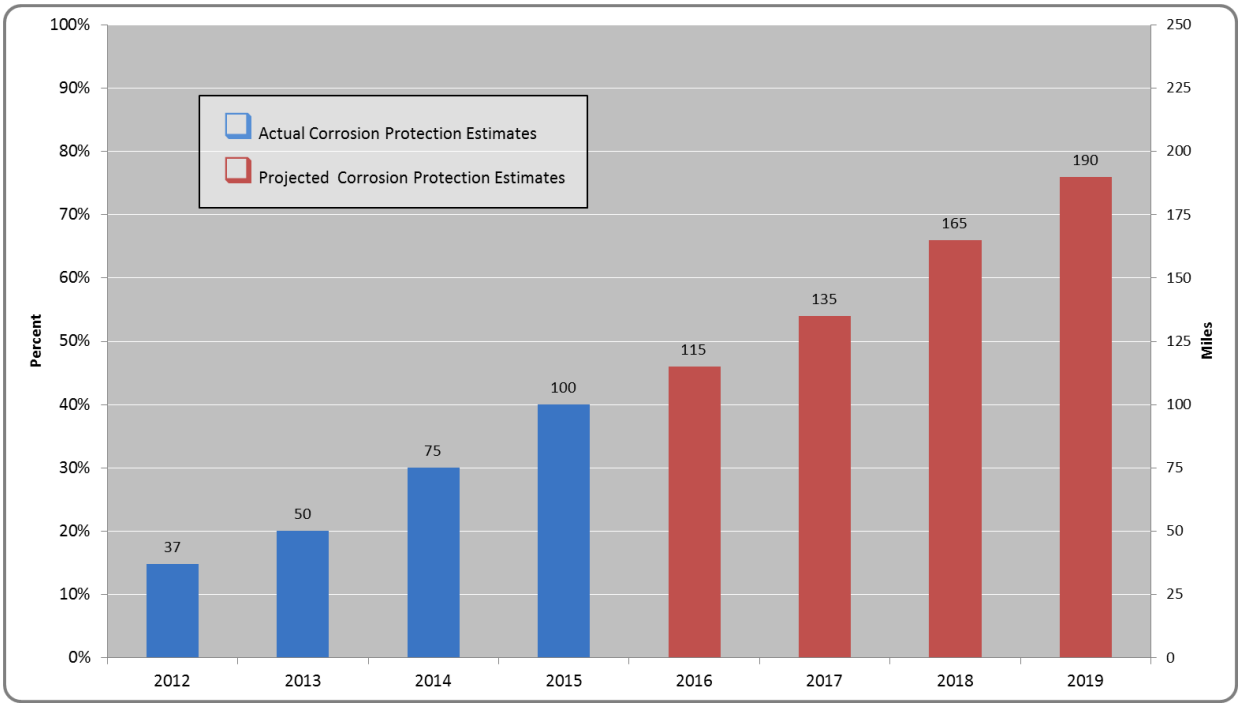
New Remote Monitoring Units to Monitor Rectifiers

The remote monitoring units (RMU) allow the SFPUC to remotely monitor the entire CP rectifier system via the internet. Alarm parameters can be set to notify staff via email or text message in case of loss of AC power, out of range pipe-to-soil potentials, out of range current application, etc. Once the notification is received, staff will be able to remedy issues at each rectifier. Without the RMUs, staff would need to personally visit each site to manually read this information. There are 49 existing RMUs for the rectifiers currently providing CP for the transmission pipelines. For FY15, 20 RMUs required routine maintenance such as replacing the battery and blown fuses. These field activities were completed in FY15. In general, the RMUs have been working as designed. SFPUC corrosion engineering are currently replacing some of the older RMU units with newer control boards and newer antennas.

CP Test Stations

CP test stations are essential for providing a quick connection point to the pipelines for corrosion surveys. The test station typically consists of 2 wires bonded to the pipeline underground and terminating up onto a test board either in a box flush to the ground or onto a post. It is important to have the test stations located at regular intervals along the pipeline alignment for survey efficiency.

Figure 4-2: Cathodically Protected Transmission Pipeline [10]



Pipeline Isolation/Continuity

Pipeline isolation and pipeline continuity are critical elements to establish the limited boundaries of CP. Protected pipeline segments must have continuity (through welded joints or bonding cables) from one piece of pipe (generally 40' long) to the next. The ends of the protected segment must be isolated using insulating flange kits. When these elements are not properly installed or when they fail, repairs (mostly through repairing the insulated flange joint) must be done before CP can be applied effectively. In rare instances, replacement of a gasket is needed, which requires dewatering the pipeline. Additional joints will be restored as needed to accommodate a new CP design system.

Corrosion Surveys

For the next six years, a pipe-to-soil potential survey for each transmission pipeline will be performed every two years. The pipe-to-soil potential survey will indicate if the level of CP is adequate. The survey will also reveal if field conditions have changed from the previous survey or if CP interference is occurring in the field. The rectifiers are normally adjusted by changing the course and fine taps of the step down transformer during the pipe-to-soil potential survey to compensate the changes of the field conditions. After getting existing CP systems back to a reasonable working condition through phases 1, 2, and 3 described above, corrosion surveys will be performed to determine how the system is working and what additional CP upgrades or repairs are needed.

HHWP Corrosion Control

[10] Does not include SJPLs.

HHWP's cathodic protection program has been in place on portions of the SJPL system since 1980. Cathodic protection is on SJPL1 from east of Oakdale to Tesla and SJPL2 and 3 from five miles east of the San Joaquin River to Tesla. In FY14, the SFPUC updated their Cathodic Protection Manual (CPM). The primary objectives of the effort were to document the existing system and to establish a plan for improvements moving forward. The CPM is also used as a guide to manage, maintain, monitor and improve the CP system for the SJPL's. The CPM utilized data from previous SJPL inspections, including the San Joaquin Valley Pipelines Condition Assessment Phase III June 2014 (SJCA). The SJCA was an investigative effort by HHWP to document the various locations of the existing condition of the SJPL's where corrosion is likely to occur due to environmental factors/conditions or pipeline coatings.

The CPM provides recommendations for repair/replace aging CP stations as well as improvements for additional areas for corrosion protection. The cost of repairs and improvements identified in the CPM is estimated at $6 million. Projects identified in the CPM have been prioritized based on largest benefit and are planned to be completed over the next four years.

4.2.5 Meter Improvement Program

The Bay Area relies on numerous flow meters to manage day-to-day operations. Meter data are used for system hydraulics analysis, tracking daily and longer-term water use, computing system water balances, and, for financial purposes, support the computations for wholesale and retail water use which directly affects cost allocations between these customer classes. The objective of the meter improvement program is to comply with contractual requirements, increase meter accuracy, increase reliability (reduce data drop-outs), standardize installations, and lower maintenance costs by reducing emergency call-out repairs.

The meter improvement program implements calibration and maintenance requirements outlined in Appendix J of the Water Supply Agreement, 2009 (WSA). The program focuses on over 40 meters and for the FY15 and FY16 period over 160 calibrations were performed. RWS meters are generally organized into four categories: system input/output meters, in-line meters, county-line meters, and terminal storage meters. Significant detail on these meters, including inventory, required maintenance, and calibration can be found in the WSA. All the meters are regularly calibrated through an independent metering consultant.

The San Francisco/San Mateo county-line meters are a priority of the program due to their role in wholesale revenue requirement cost allocation. Table 4-6 lists the FY15 & 16 calibration frequency of the county-line meters. All required meters were calibrated. The program ensures regularly scheduled calibrations, and as a result has returned more consistent and reliable readings as is shown in Figure 4-3.

Table 4-6: FY15 & FY16 San Francisco/San Mateo County Line Calibration Summary

FY		Date	Crystal Springs No. 1	Crystal Springs No. 2	San Andreas No. 2	San Andreas No. 3	Sunset Supply (LMPS)	Sutro Pipeline (LMPS)	Total Per Quarter
FY15	1st Qtr	Jul-14							6
		Aug-14		✓	✓	✓	✓	✓	
		Sep-14	✓						
	2nd Qtr	Oct-14							6
		Nov-14	✓	✓	✓	✓	✓	✓	
		Dec-14							
	3rd Qtr	Jan-15					✓	✓	6
		Feb-15		✓		✓			
		Mar-15	✓		✓				
	4th Qtr	Apr-15					✓	✓	6
		May-15		✓					
		Jun-15	✓		✓	✓			
FY16	1st Qtr	Jul-15							6
		Aug-15							
		Sep-15	✓	✓	✓	✓	✓	✓	
	2nd Qtr	Oct-15							6
		Nov-15							
		Dec-15	✓	✓	✓	✓	✓	✓	
	3rd Qtr	Jan-16							6
		Feb-16			✓				
		Mar-16	✓	✓		✓	✓	✓	
	4th Qtr	Apr-16							6
		May-16		✓					
		Jun-16	✓		✓	✓	✓	✓	
Total Calibrations For FY15 & FY16			8	8	8	8	8	8	48

✓ = Calibrated

Figure 4-3: San Francisco/San Mateo County Line Calibration History FY09 to FY16

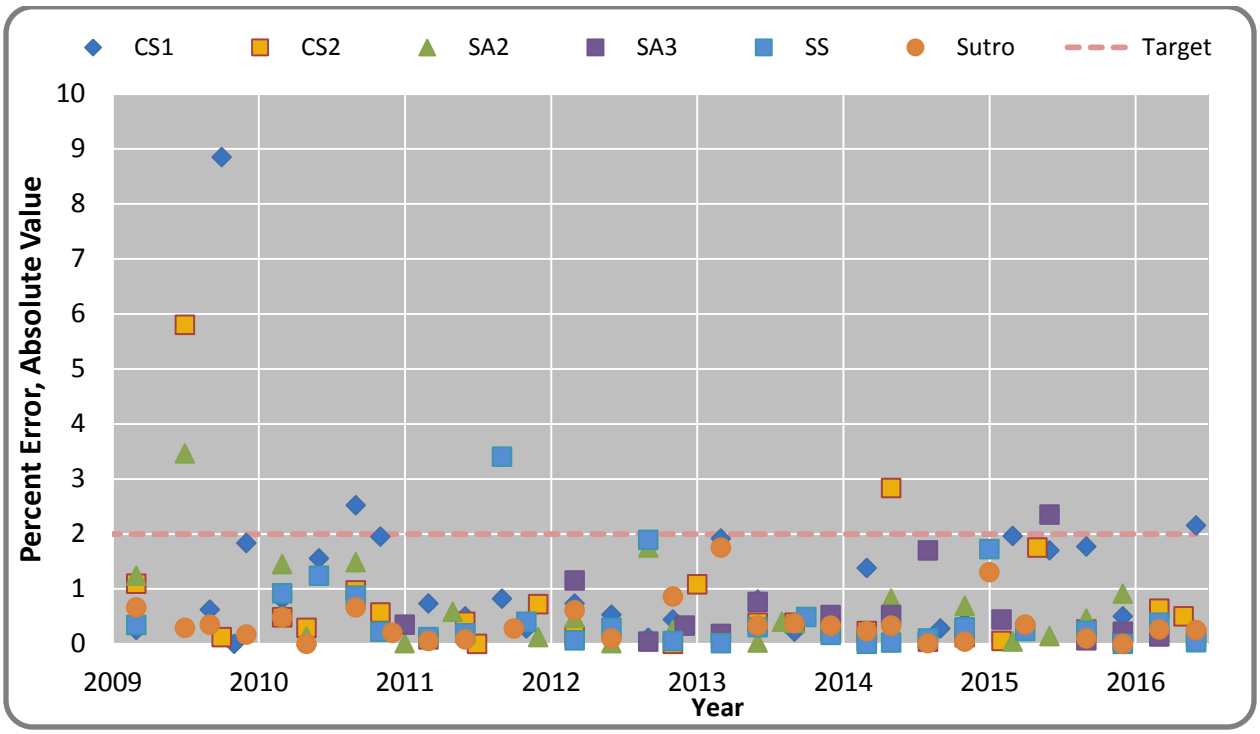


Figure 4-3 shows that over the two year period covered in this report, FY15 and FY16, two data points exceeded the 2 percent requirement in the 2009 WSA: SA No. 3 (2.35%) in Spring 2015, and CS No. 1 (2.2%) in Spring 2016. Per procedure, the day the error was observed during calibration, the independent meter consultant inspected the components, flushed lines, and conducted a repeat test on the same day. The final test indicated both meters to be within 2 percent.

Maintenance of the meters includes regular cleaning and replacement when parts reach approximately 80 percent of the expected usable life. Proactive replacement of meter components greatly improves calibration and meter accuracy. Equipment replacement in FY15 through FY16 is presented in Table 4-7.

Table 4-7: Summary of Meter Equipment Replacement, Installation, and Improvement

J Table Meter Program: Equipment Replacement / Installation / Improvement							
FY	Meter	D/P Transmitter & Related Plumbing	Data Logger	Pitot Tap	New Meter / Level Transmitter	Improve Meter Loop Wiring	Improve Instrument & SCADA Installation
FY13	Crystal Springs 1		✓				
	Crystal Springs 2	✓	✓			✓	✓
	LMPS Sutro						✓
	Balancing Reservoir Level					✓	
	SA3 Raw HTWTP	✓					
	Albers Road Meters 1, 2, & 3	✓				✓	✓
FY14	Crystal Springs 1					✓	
	LMPS Sunset						✓
	Sunset Pipeline (Camp Ida)			✓			
	LMPS Sutro						✓
	Pulgas Dechlor Open Channel					✓	✓
	HTWTP Effluent	✓					
	Pulgas Dechlor Open Channel						✓
	Crystal Springs ByPass Reverse		✓			✓	✓
	Pulgas BDPL 5						✓
FY15	San Andreas #2 Meter Co Line						✓
	University Mound Res Level				✓		
	HTWTP TWR Effluent Meter				✓		
	San Antonio Fwd-Rev Meter		✓				
	Bay Division PL Pulgas #5 Meter		✓				
FY16	Crystal Springs #1 Meter Co Line						✓
	LMPS Sunset-Sutro Intertie						✓
	Bay Division PL Pulgas 1 & 2		✓				
	Bay Division PL Irvington 1, 2 & 5		✓				
	Bay Division PL Irvington #5 Meter			✓			

Each year meter installations are evaluated for upgrades and improvements as part of the calibration routine. Upgrading county-line meters is a priority due to their role in wholesale revenue requirement cost allocation. These improvements generally include better calibration taps and improved vault conditions to protect sensitive equipment prior to reduced performance or failure.

The SAPL No. 3 pipe section that crosses the San Francisco/San Mateo county line was returned to service in FY15 using low-pressure zone water transmitted through the SAPL No. 3 pipeline to feed Merced Manor Reservoir in the City. The flow regime was successfully adjusted to be within the existing venturi meter performance range.

In FY15, the HTWTP began using a new treated water reservoir discharge meter. The meter instrumentation has been calibrated and meter performance is good.

RWS water balance computation

As discussed above reliable and accurate meters are necessary to support customer billing and computation of the wholesale revenue requirement. Additional meters are used to compute the

system water balance. Over the last six years, the annually calculated inflow into the water system has been within 2.5% of the output (i.e., sales to customers, including San Francisco). Results from FY16 are pending. Over a longer span of ten years the difference has been generally decreasing.

This result suggests that overall system losses are likely small. However, in reality, system losses are certainly non-zero, and inflow into the system in some years is less then outflow which suggests some level of meter error in the calculation. Data from one particular meter in the calculation, the one measuring spillage into Crystal Springs Reservoir, is very difficult to calibrate (calibration of this meter isn't required under the contract as it does not impact the wholesale revenue calculation). Additionally, the flow regime at this site is extraordinary from a metering perspective – the flow is never steady and ranges over two orders of magnitude (0 to 200 MGD). Last, between FY00 and FY04, system inflow exceeded output by about 4% in 4 out of 5 years (one year the two were about equal). From FY05 to FY15, inflow exceeded outflow only twice over 11 years. In the summer of 2004, in what appears to have been the moment when outflow began to consistently exceed inflow, the hydraulics and metering configuration at the Pulgas overflow weir was modified to accommodate the installation of the dechloramination facilities. For these reasons SFPUC staff suspect that most of the error in the water balance is caused by meter inaccuracies at the Pulgas overflow weir into Crystal Springs Reservoir. The primary means to ensure meter accuracy is performing the ongoing meter installation evaluations which include regular meter maintenance, calibrations, and upgrades where feasible. A new meter measuring spillage into Crystal Springs Reservoir is proving a more accurate measure of discharges than the weir measuring method. Additionally in FY16, new Advanced Meter Infrastructure (AMI) meters were installed at a majority of the wholesale meter turnouts with a goal to have all turnouts upgraded in FY17. These new meters will improve accuracy at the turnouts and the AMI technology will enable more immediate evaluation of usage and water balance analysis. With most of these efforts in place in FY16, the draft FY16 water balance shows an improved positive balance in FY15. Other potential sources of error are also being investigated.

FY17 and FY18 Planned Work

In addition to replacing aging equipment, the main focus for FY17 and FY18 will include the following:

- SA3 San Francisco/San Mateo County Line Meter: construct an improved access-way to the SA3 county line meter pitot tap location on pipe bridge.
- HTWTP TWR Discharge Meter: perform pitot tap improvement to enable pitot testing.
- SVWTP TWR Effluent Meter: perform pitot tap improvement to enable pitot testing.
- Crystal Springs-San Andreas Force Main Meter – Replace corroded differential pressure unit.
- Irvington Meters 1 & 2: install new pitot taps.
- Calaveras Meter: improve meter instrumentation lay-out.

In prior years a new San Francisco/San Mateo county-line meter on the SSPL upstream of the Lake Merced Pump Station at Camp Ida (Girl Scout Camp) was contemplated. This work has been postponed and will be rescheduled for a future date. The benefits of installing a meter at

this location will be a simpler county-line flow calculation as the proposed new meter will eliminate two meters at LMPS and their required calibrations. The new location is on a long, straight stretch of SSPL. In-lieu of a new meter at this location a new pitot tap at Camp Ida was installed for performing independent flow verification for the existing Sunset and Sutro meters. This pitot has resulted in improved calibrations of both Sunset and Sutro meters Lake Merced Pump Station.

Automated Meter Infrastructure

In winter of 2016, the SFPUC completed AMI upgrades at over 95% of meters for the wholesale customer service connections. Full installation is expected later in FY17. The AMI program allows customers to login to a protected web-page to view their own water usage and track water deliveries from the SFPUC in near real-time. Billing will eventually use this system once the on-site totalizers are confirmed to be consistent with the on-line record keeping.

4.3 Water Treatment

Maintenance and renewal/replacement for six major treatment facilities are covered by this program: HTWTP, SVWTP, SVCF, Pulgas Dechloramination Facility, TTF, and Thomas Shaft Chlorination Station. With the exception of the SVCF, each has undergone some form of capital upgrade as part of WSIP with work completing this FY at HTWTP. The San Antonio, Baden, Pulgas and Crystal Springs pumping stations are also included in this program, because the same staff operate and manage them.

The most significant work to report in FY15 is the completion of dry-year reliability upgrade projects for many East Bay facilities. These upgrades are needed to ensure reliable, continuous and high-rate operation of SAPS, the TTF, Thomas Shaft and SVWTP if and when the SFPUC must treat LCA water for an extended period. The Lower Cherry supply does not qualify for filtration avoidance and must be treated at the SVWTP. The SFPUC successfully treated LCA water in January 2016. The dry year upgrades will provide additional benefits as SFPUC faces the 62-day Hetch Hetchy shutdown in January and February of 2017.

Much of the dry year scope was previously identified in the Water Treatment Program of the CIP and was initiated in FY15 to accommodate the ongoing drought-related needs. Planning and design began in FY14 for eventual construction work in FY15 and FY16 at Tesla, Thomas Shaft, SVWTP, and SAPS. Completed projects include: replacement of the chemical piping between the tank farm and head works at the SVWTP, sludge lagoon valves replacement and monitoring, upgrade of the west decant pump station, grading and drainage around the electrical building, and safety handrails at the SVWTP. Additional work in the East Bay included the Tesla-Sunol microwave link, Sunol Valley fiber optic installation, replacement of an outdated diesel engine with an electric motor and main current breaker replacement at the SAPS; and improvements at Thomas Shaft to reduce explosion potential from methane gas. Projects still underway include the upgrade of the SVWTP computer server room, SAPS breaker and motor control center upgrades, and extensive chemical feed piping replacement for the SVCF. The SVCF has been in continuous operation for ten years. The extreme temperatures in the Sunol Valley coupled with the corrosive nature of the chemicals contributed to the need for replacement of the chemical feed system piping and components.

4.3.1 Maintenance at Operating Facilities

As with prior years, maintenance and renewal/replacement projects were otherwise limited due to WSIP construction and staff availability. However, the highest prioritized work was completed – including warranty inspections for recently completed projects. Other notable FY15 and FY16 accomplishments are listed below by facility.

Calaveras Substation Programmable Logic Controller replacement

This is a significant reliability upgrade at the Substation. This upgrade improves the reliability of HH power to the major Sunol Valley facilities.

Crystal Springs Pump Station

SFPUC staff designed and implemented an automatic pump control strategy. By pumping during off peak hours, the SFPUC saves energy and reduces operating cost. The strategy is under consideration for use at other SFPUC facilities.

HTWTP

Several critical systems supplied by WSIP were commissioned. The sludge handling system including centrifuges and emergency power generators had lingering issues that have now been tested and corrected. Project documentation and the creation of Standard Operating Procedures are under development.

Baden Pump Station

Design and construction of the replacement air compressor system has been awarded and will be completed before the January 2017 HH shutdown.

SCVWD Intertie

The project to replace the diesel generator double contained piping was completed. Staff worked with SCVWD employees and the Milpitas Fire Department to correct all regulatory compliance issues.

Crystal Springs Dam and Outlet Structure

Staff worked with DSOD to complete commissioning of the Crystal Springs Adit and Release structures.

Pond F3E (Sunol Valley)

The San Antonio Back up Pipeline and Pond F3E Pumping Facility were successfully used to discharge water of unacceptable quality from the Coast Range Tunnel inspection in February 2015. The water is captured in Pond F3E and sent to either San Antonio Reservoir or the SVWTP for treatment. This WSIP upgrade is a useful tool that improves RWS reliability.

Environmental Compliance plans and system documentation were updated in FY15, including the RWS Operations Plan, site Hazardous Material Business Plans, Spill Containment and Countermeasure Plans.

Of paramount concern to the SFPUC and the wholesale customers are the structural issues within the Mountain Tunnel (addressed in HHWP's capital plan). In preparation for the planned shutdowns to support construction as well as any unplanned shutdowns of the tunnel, the SFPUC has developed a response plan. Reliability upgrades to the Sunol facilities (post WSIP) and biweekly meetings that plan for the 2017 HH Shutdown support this effort. Additional planning has gone into managing local storage at higher levels to reduce risk to customers during the shutdown of any Upcountry facilities.

Groundwater Storage and Recovery Project

Over the next year the SFPUC will develop staffing and maintenance plans for the new groundwater wells associated with the Groundwater Storage and Recovery Project.

4.3.2 Nitrification Management Program

During FY15 and FY16, the SFPUC continued to implement a proactive nitrification prevention and response strategy that required minimal operational response and prevented disinfectant loss in the distribution system. The following nitrification mitigation strategies were employed:

Regional Water System

- Maintained chloramine residual target of 2.8 milligrams per liter (mg/L) entering the transmission system year round;
- Maximized the use of Hetch Hetchy water during nitrification season, while minimizing local water sources and interties that are relatively nutrient rich;
- Maintained overall chlorine:ammonia ratio of monochloramine to 4.7:1 for water entering Regional System;
- Maintained high pH target in the RWS

San Francisco Retail Water System (within the City of San Francisco)

- Conducted vigilant monitoring for chlorine, free ammonia and nitrite in key pressure zones within San Francisco and continuously evaluated water quality trends throughout the year;
- Provided continuous chlorine trim at seven locations in San Francisco to tie up free ammonia in distribution system;
- Operated mechanical mixers within 8 reservoirs and 4 tanks to prevent stratification and short circuiting of flow;
- Cleaned and disinfected reservoirs and tanks as-needed to remove sediments and biofilm;

- Conducted a minimal number of localized flushing in areas of low chlorine residual and manual chlorine boosting at tanks.

The actions taken in San Francisco are potentially useful actions for wholesale customers who are managing their own nitrification problems. The SFPUC's Water Quality Division (WQD) should be consulted for additional details.

4.4 Buildings and Grounds

The WSTD Buildings and Grounds section serves the maintenance, repair, and operational needs of the facilities, structures, and grounds in San Mateo, Santa Clara, Alameda Counties, with a few facilities in western San Joaquin County. The section strives to preserve and improve departmental assets through both preventive (planned) maintenance and emergency repairs when required, to provide for the comfort of building occupants, and to identify capital improvement needs for these facilities. Assets under the responsibility of this maintenance program include administration buildings, corporation yards, residential cottages, and public recreation facilities such as the Pulgas Temple and the Sunol Temple. There are about 20 watershed structures that are either occupied as residences for staff or used for monitoring or office work in the Bay Area and many more than that Upcountry.

Aside from construction and maintenance, staff also document permits for compliance associated with general corporation yard activities. Work includes:

- Operating and maintaining fuel stations and underground fuel storage tanks to ensure compliance with Bay Area Air Quality Management District (BAAQMD) and SWRCB requirements.
- Coordinating with local jurisdictions and the San Francisco Department of Public Health to manage hazardous waste storage and disposal in the corporation yards.
- Preparing and submitting reports, documentation and permits for generators, pressure vessels and waste hauling.
- Testing and certifying cranes throughout the division ensuring compliance with California safety regulations.
- Documentation of shoring excavations to provide safe working conditions for craft workers.

Highlights of accomplishments and efforts for this program in FY15 and FY16 include:

- Completed remodeling, repairs and upgrades to Crystal Springs Cottage and restoration of service.
- Expansion of re-keying project into field facilities and Millbrae yard.
- Completed first phase of roofing project that includes Pilarcitos and Crystal Springs cottages.
- Development of second phase of roofing project to include Davis Tunnel Cottage, San Andreas Tunnel Cottage, Cypress Work Center, and Upper Crystal Springs Cottage.

- Implementation of the water conservation plan and removal of non-essential landscape, review of irrigation infrastructure and practices, and replacement of inefficient fixtures.
- Decommissioning facilities at the Sunol Golf Course along with the shutdown and disconnecting of building services, boarding of windows, development and implementation of security plan, coordinating with the San Francisco Bay Regional Water Quality Control Board to secure and decertify sewage treatment plant, removal of hazardous materials and development of a plan to demolish and remove the above ground fuel storage tanks.
- Coordination with SFDPW to remove obsolete underground waste oil tank in Millbrae yard.

FY17 and FY18 Planned Work

- Continue to revise and update cottage needs assessments plans.
- Continue to apply water conservation plan, identify and remove non-essential landscapes, expand use of hardscape and drought resistant plantings.
- Implement plans to repair, remodel and provide upgrades to San Andreas Cottage and Lower Crystal Springs Cottage, and restore both to service.
- Implement second phase of roofing project to include Davis Tunnel Cottage, San Andreas Tunnel Cottage, Cypress Work Center, and Upper Crystal Springs Cottage.
- Complete project to remove underground waste oil tank in Millbrae yard.
- Complete removal of above ground fuel tanks at Sunol Golf course.
- Perform review and update of Hazardous Materials Business and Spill Control plans for yards and miscellaneous small facilities and valve lots.
- Begin development of Hazardous Materials and Spill control plan for new the Sunol Yard.
- Provide construction support at the Sunol Yard.

The HHWP shops and buildings are original and vary in age from 45 to 80 years old. In 2009, a condition assessment of the Moccasin Facilities identified deficiencies with many of the buildings. Of greatest concern was the building housing the Plumbing Shop/Field Office/Tool Room. This building had multiple deficiencies including unsafe electrical conditions, unsafe conditions for storing fuel, insufficient workspace area, and inaccessible restrooms.

Currently in construction is a replacement building; 10,000 square feet of combination shops and office building consisting of a plumbing shop, vegetation management shop, ROW shop, electronic technician shop, lockers, shower facilities, and a break room. The project will be completed in 2018. HHWP will propose additional facility upgrades identified in the 2009 condition assessment in future capital plans. Improvements include a warehouse addition, storage, truck port, auto/machine shop addition, carpentry shop addition, material bins and security gate.

The Moccasin Wastewater Treatment Plant serves the town of Moccasin. The town of Moccasin houses employees of the SFPUC. There are about 100 people that live in Moccasin, and approximately 200 people working in Moccasin on weekdays. An evaluation of the treatment plant was done in September 2011. The report highlights many of the operational limitations and challenges currently observed by HHWP staff, including:

- Current design adversely affected by solids, rocks, grit, rags, and debris
- Poor screening facilities
- No grit removal facilities available
- No control of air within aeration basin
- Settling tank subject to mechanical failure
- Difficulty controlling sludge return rates
- Poor flow distribution from aeration tank to clarifier
- Lower camp lift station pump capacities insufficient

HHWP will propose a replacement facility in future capital plans.

4.5 Watersheds and ROW Lands

There are approximately 60,000 acres of watershed land and 200 miles of pipeline ROW in the Bay Area in Alameda, Santa Clara, and San Mateo Counties. The SFPUC manages these lands and the natural resources that depend on them in accordance with the Water Enterprise Environmental Stewardship Policy adopted by the Commission. These "natural" assets include the operations and maintenance of roads, bridges, culverts, fences, gates, and signage. Vegetation management is also an important component and is done to minimize fire risk, avoid and minimize threats from invasive species, protect structural assets, enhance water quality, and protect and/or restore native species and their habitats. Protection and restoration of native species help support compliance with federal and state environmental regulations for the RWS, and hence minimize regulatory risks and uncertainties, which provide for greater water supply reliability for customers.

The Watershed and Environmental Improvement Program (WEIP) is partially supported by WSIP funding, and was initiated to further protect important watershed and ROW lands. Investments include working with willing landowners in watersheds above Bay Area reservoirs to protect and restore water quality and habitat for native species, and also providing education opportunities (e.g., additional recreation) consistent with watershed management plans and ROW policies.

The investment in maintenance, preservation, and restoration of the ecosystem services provided by this "natural" capital is increasingly recognized in traditional water utility asset management, and the SFPUC will continue to work closely with other Bay Area and Pacific Northwest utilities to describe and capture these benefits and their associated operations and maintenance costs.

FY15 and FY16 Highlights

In previous FYs, WSIP funds supported the protection of three properties in the Alameda Watershed in perpetuity. Two of these are now owned in fee by the SFPUC, and are being incorporated into the existing rangeland management program. The third is now owned by Santa Clara County Parks. The NRLMD staff continue to seek additional projects like these, in partnership with the California Rangeland Trust, The Nature Conservancy, Alameda County Resource Conservation District, and Santa Clara County.

The focus for the previous two FYs has been on Peninsula Watershed education and recreation opportunities, specifically closing gaps in regional trails on and around SFPUC property. This work includes the Crystal Springs Regional Trail (operated and maintained by San Mateo County Parks), the Bay Area Ridge Trail (operated and maintained by NRLMD), and the proposed San Andreas Connector, which would link the Crystal Springs Regional Trail to the Bay Area Ridge Trail. All of these proposed projects are described in the Peninsula Watershed Management Plan.

The ROW team assembled to assist WSIP projects with clearing encroachments and confirming/acquiring easements or fee title began to shift their attention to other areas (non-WSIP) of the ROW to ensure access for operations and maintenance activity.

FY17 and FY18 Planned Work

The two regional trails through the Peninsula Watershed – the Crystal Springs Regional Trail and the Bay Area Ridge Trail have significant gaps in them that limit education and recreation opportunities. The SFPUC is assisting San Mateo County Parks with closing the gaps in the Crystal Springs Regional Trail, and is taking the lead to close one of the largest gaps in the Bay Area Ridge Trail. The SFPUC has initiated the planning and design for the Southern Extension of the Bay Area Ridge trail, which would construct a new road/trail south from HWY92 and connect to Golden Gate National Recreation Area and Mid-Peninsula Open Space District lands. The SFPUC was selected to receive a $1.0 million grant to support this project.

The Bay Area Ridge Trail Extension project includes: construction of approximately 6 miles of new trail from HWY 92 south the to the GGNRA Phleger Estate; acquiring a trail easement from Skylawn currently held by the Bay Area Ridge Trail Council for the approximately 1.5 miles of existing trail north of HWY 92 to the SFPUC Cemetery Gate; and operation and maintenance of the entire Bay Area Ridge Trail on the Peninsula Watershed (approximately 16 miles total). The current schedule estimates construction in 2018, with the new trail opening at the end of that calendar year.

The WEIP efforts to protect watershed lands and natural resources, particularly in the Alameda Creek watershed, will continue. The ROW team also continues to diligently clear encroachments and acquire property rights necessary to ensure operations and maintenance of the RWS pipelines.

Other entities operate and maintain utilities in the watersheds and ROW lands. PG&E is currently planning major natural gas line testing and replacement in the Peninsula and Alameda Watersheds, and this will require a large amount of SFPUC staff time to facilitate the

necessary real estate transactions (e.g., new permanent and/or temporary construction easements), and coordinate the construction and environmental compliance activity.

4.6 Communications Systems

Activities in this project include maintenance and upgrades of SCADA, water quality, or radio communication systems. System components are usually implemented at more than one location and are intended to be consistent across the RWS and with other regional communication systems.

Radio

In FY15 and FY16, work on the Upcountry Microwave system expansion in the San Joaquin Valley and connection to the Bay Area system got underway and is nearing completion. Two capital communication projects will be completed by September 2016 at HHWP. The first is a replacement of the failing phone system that was completed in 2015. The second is the San Joaquin Valley Communication System Upgrade project which will connect facilities and allow indication, security and monitoring of the SJPL from the Moccasin Control Room. With the completion of the microwave project, this will enable HHWP to retire the remaining Remote Terminal Units (RTUs) on the project.

Also, the ground work to create a unified SFPUC Voice and Data Radio system was performed.

In FY17 and FY18, the Upcountry Microwave system expansion will be completed. Reliability enhancements to the Bay Area Microwave backbone will be performed. The unified SFPUC Voice and Data Radio solution will be selected and implementation will commence.

The Bay Area system implementation for scope, budget, and schedule is still being developed. A planning level budget of $4.5M and a finish date of late 2019 is in the current forecast.

SCADA

In FY15 and FY16, SCADA integration of many WSIP projects was completed. This integration allows the signals at a particular site to be widely viewable allowing full monitoring and remote operation. Sites and projects included:

- TTF
- Alameda Siphon No. 4
- SAPS
- SVWTP Expansion
- Baden Pump Station
- SAPL No. 3
- Lake Merced Pump Station

- HTWTP Long Term Improvements
- Crystal Springs Pump Station
- BDPL No. 5 East Bay Reaches
- NIT
- San Antonio Backup Pipeline
- Sunol Town Pump Station and Tanks

Major upgrades to SCADA hardware and software infrastructure to improve system functionality, security and reliability included:

- Bay Area SCADA system hardware infrastructure replacement and virtualization
- SCADA software upgrade
- Migration of primary remote site and wide area network communications of the Bay Area SCADA system from Frame Relay to AT&T Virtual Private Network Ethernet technology
- Housing of the Upcountry SCADA system in a new and secure Operations and Data Center
- Hardware and software upgrades to SFPUC's Enterprise Historian (eDNA)

The Wholesale Customer online access to RWS operational data was updated and enhanced:

- Overhauled the Wholesale Customer visualization interface and included map based data presentation to enhance situational awareness
- Online tutorial on how to access RWS operational data was completed and posted on the Wholesale Customer web site
- Instituted Wholesale Customer account maintenance procedures and notifications that resulted in minimizing account deactivations due to inactivity (0-1 per quarter)
- Created Emergency Agency Accounts to facilitate unlimited access during operational emergencies, with 24/7 support
- Implemented geographical system diversity between Millbrae and 525 Golden Gate to increase reliability during a disaster

In FY17 and FY18, efforts will be directed towards:

- Integrating the last remaining WSIP and CIP projects including:
  - Calaveras Reservoir
  - Alameda Creek Dam Fish Passage
  - Alameda Creek Recapture

  - Ground Water Regional Storage and Recovery
- Upgrading the SCADA software, and enhancing the network and hardware to Wonderware 2014 and virtualized server storage infrastructure with focus on security, continuity of operations and disaster recovery
- Upgrading the SFPUC Enterprise Historian (eDNA) software and virtualizing the server environment
- Continuing to replace end-of-life devices at the SCADA RTUs

4.6.1 Security Program

In 2006, a Vulnerability Assessment was performed for the SFPUC by a consultant (LLNL/Guernsey). The assessment was performed partially in response to 9/11, but also to meet proposed AWWA guidelines for security standards. Since that time the Department of Homeland Security initiated the National Infrastructure Protection Plan (NIPP) and the Environmental Protection Agency (EPA) has led development of the Water Sector-Specific Plan (2010). The Water Sector-Specific Plan largely models the AWWA guidelines and may ultimately become a regulatory basis for water utilities. The goal of the Security Program is to bring RWS facilities into compliance with the NIPP and EPA guidelines, as well as to protect employees and customers of the SFPUC.

Typical scope of a security project provides an alarm control and monitoring system (ACAMS) and a video management system (VMS) at each site. The ACAMS system will report and communicate directly with a regional server. The VMS at each location will have a local video recorder for forensic video retrieval. Minimally, a site will be equipped with intrusion detection and access control around the perimeter. Access control will be provided by electrified door hardware and card reader, and includes door position monitoring devices. Selected sites will include video cameras (fixed and operable) to record incidents and to provide the ability for operators to monitor the site remotely.

Security upgrades for the Bay Area were included in WSIP. However, not all facilities deemed critical (Tier 1) were part of WSIP, and security funding for those modified under WSIP was not adequate in all cases. For these reasons, the water CIP is used to complete the program.

Part of WSIP funding was used to establish the overall platform for security. The platform includes the software used to accept, process, store, and display data from various sites. The Bay Area is divided into east and west autonomous zones (independent servers). In addition to the software platform and the on-site hardware installation, a significant integration effort is required to link the two and effectively bring the system into service on site one at a time.

FY16 Summary

In FY15 and FY16, most of the WSTD effort was spent bringing the security systems for additional Tier 1 facilities into service and setting up the necessary professional service contracts (design and installation) to implement the rest of the program. In FY16 the platform for the security system was completed under WSIP. A construction (installation) contract was also completed in FY16 and will be out to bid in November 2016.

As shown below, few systems are presently in service but significant progress is expected in FY17 for both Tier 1 and Tier 2 facilities after the construction contract is awarded.

Tier 1	FY15, 30% in service	FY16, 35% in service
Tier 2	FY15, 40% in service	FY16, 55% in service

In FY15 and FY16, HHWP made many physical security improvements to be compliant with NERC power regulatory standards. These physical improvements affect both water, power and joint facilities. Areas of improved physical security include:

- HHWP Administration Building
- Moccasin Control Room and Back-up Control Room (located within Kirkwood Powerhouse)
- All data server rooms (primary and back-up) and Lenel Security Stations
- Moccasin Network Operation Center
- HHWP will continue to improve physical security including installation of card access at all sites and fencing around critical facilities including Moccasin Compound

4.7 Construction Close-Out Deliverables

Along with performance and acceptance testing, a major responsibility of the SFPUC during WSIP construction is to ensure appropriate asset management deliverables are provided by project teams and contactors prior to project close-out. These deliverables include complete sets of equipment manuals (also called Operations and Maintenance Manuals, or "O&Ms"), warranty information, record and as-built drawings, equipment inventory sheets, and in some cases, specialized trainings, operating permits/agreements, and service agreements.

These deliverables are audited each quarter and reported to WSIP management with formal reports beginning in FY12. With this diligent and sometimes labor intensive tracking program, the percentage of close-out deliverables rose from 18% to 77% between 2012 and 2016. Staff remain focused on acquiring the outstanding deliverables and progress will continue until all WSIP projects close. See Appendix G for status of received deliverables.

4.8 Failure Reporting and Analysis

Equipment and asset failure reporting is a critical function of asset management. Relatively few failure incidents occurred in FY15 and FY16. The most significant ones that occurred were the March 3, 2015 San Antonio Reservoir Raw Water Incident and the major pipe leaks on the SA2 and Sunol Treated Water Pipelines.

RWS staff has spent significant resources on revisiting the March 3, 2015 incident. After an extensive review, there does not appear to be any straightforward or inexpensive way to physically isolate and/or discharge non-compliance water prior to reaching customer turnouts

for events emanating at/near the Alameda Siphons without creating additional problems and difficulties on a day-to-day basis, as well as during an actual repeat event. SFPUC will focus its resources into preventing a similar event by enhancing air gaps/cross connection control, operator training, and event management abilities that are mentioned in the May 2015 citation from the State (i.e., monitoring, modeling, communication, data access/quality, etc.).

One of the SFPUC's goals during a RWS emergency is passing on the most accurate and current information to the wholesale customers. The SFPUC's primary notification tool is I-INFO, which allows the SFPUC to reach out to the largest group in the least amount of time, and pass along the most current and accurate information available. Where individual customers may be impacted to a greater extent, individual calls are made using the contact information provided by the wholesale customers. As more information becomes available, I-INFO is used to keep customers apprised of significant developments.

A powerful tool to help wholesale customers make decisions is eDna. eDna is the SCADA historian linked to the SCADA network. This information is transmitted in near real time. The critical detention time and water quality data utilized for notifications and operational decisions is available to the wholesale customers. Presently, new screens that capture water quality and detention times across the BDPLs are being developed. In the SCADA system, detention times are calculated on the BDPLs in real time. The detention time calculations are useful if they are coupled with the water quality data. There are water quality monitoring stations at a number of sites across the BDPL's. For example, in an incident like the March 3, 2015 event, the first place system operators should look is at Irvington Portal. By identifying the parameter that is out of spec, say turbidity, the operator can use the detention time (available on the same eDna screen) and calculate the estimated arrival time. Wholesale customers' system operators will need to interpret the data to make prudent operational decisions for each utility.

The major pipe leaks in FY16, while disruptive, have straightforward solutions. The SA2 lockbar pipe replacement project is being designed. At a minimum, sections of it will be replaced between HTWTP and the San Bruno City boundary prior to the Mountain Tunnel 90 day shutdown in 2018. The pipe leak on the Sunol Treated Water Pipeline was immediately repaired after the break through an emergency contract in order to stay on schedule for the LCA test in late 2015.

Appendix F contains a full list of reportable incidents during the reporting period along with the root cause of the failure. Corrective actions are documented in individual failure reports. Any of the following circumstances can trigger an incident report: partial or total unplanned outage of a facility (or "near-miss"), unplanned discharge to the environment, employee injury (or anything reportable under Cal/OSHA requirements), drinking water quality violation (or anything reportable under the drinking water permit).

Failures from inadequate preventative maintenance can be addressed by reviewing procedures, designating critical equipment in CMMS, ensuring condition assessments are performed, and by periodically reviewing incident reports with all (not just affected) staff.

4.9 Federal and State Regulatory Compliance

The SFPUC is required to comply with federal and state regulations to meet drinking water standards, safety, and environmental compliance regulations for operations and maintenance of the water system, including the watershed and ROW lands. A variety of regulatory measures associated with operation and maintenance activities are tracked and reported to ensure compliance, including the drinking water system permit administered by the Drinking Water Program (now part of SWRCB). Environmental regulatory compliance is described in more detail in Section 4.9.2.

The RWS must maintain various permits, plans, and procedures for their operations, including wastewater permits, discharge permits, Stormwater Pollution Prevention Plans, Hazardous Materials Business Plans, and Risk Management Plans. The SFPUC currently complies with regulations regarding hazardous material safety with respect to hazardous material disposal and employee safety. In FY15 however, the Alameda County Department of Health and the Alameda County District Attorney's Office filed an enforcement action against the SFPUC, alleging deficient record keeping and storage management of the aqueous ammonia systems in the Sunol Valley. In August, 2016, the City's Board of Supervisors approved settlement of the enforcement action, including payment of a $250,000 fine. All hazardous material and waste permits are captured in the California Environmental Reporting System.

4.9.1 Drinking Water Permit Compliance

SWRCB DDW is responsible for implementing and enforcing drinking water regulations. In FY15, there was an incident of raw water from San Antonio Reservoir entering into the transmission system on March 3, 2015. That incident led to a citation issued by the SWRCB to the SFPUC on May 8, 2016. SWRCB cited the RWS's failure to comply with the applicable water treatment standards under the California Code of Regulations and the drinking water permit issued in 2004. The citation specified ten (10) directives that required SFPUC response[11]. To date, the SFPUC complied with all of the requirements, having sent timely submittals to the SWRCB. The only outstanding task is for the SFPUC to complete a feasibility study that may require updates to the Emergency Response Action Plan. The intent of the study would be to identify and determine if it is possible to improve the system's ability to isolate and subsequently discharge a slug of unapproved water to minimize delivery to customers. The SFPUC plans to complete the study by the end of September 2016.

There were no other reportable citations or non-compliances incurred by the RWS in either FY15 or FY16.

4.9.2 Environmental Compliance

The Water Enterprise Environmental Stewardship Policy provides long-term direction for the management of the lands and natural resources affected by operations of the SFPUC, and this policy includes complying with federal and state environmental regulations. Environmental compliance is also a component of the existing Sustainability LOS goal, and reduces risk

[11] Citation No. 02_04_15C_005 from SWRCB to SFPUC dated May 8, 2015 lists all ten (10) directives.

associated with uncertainty to water supply reliability. Note that the Environmental Stewardship Policy is the responsibility of all Water Enterprise employees, and training is a critical aspect of providing staff with the information necessary to meet this challenge.

The SFPUC's environmental compliance starts with impact avoidance and proactive environmental stewardship. SFPUC activities are reviewed and modified as needed to incorporate BMPs and environmental impact avoidance measures whenever feasible. When impacts cannot be avoided, permits are obtained to comply with environmental laws and regulations such as the California Fish and Game Code, the Clean Water Act, and the California and federal Endangered Species Acts. The San Francisco's Planning Department prepares any necessary California Environmental Quality Act (CEQA) documentation and the SFPUC oversees the compliance with the requirements of these documents. If a project triggers compliance with federal regulations, NRLMD works with the federal lead agency to prepare any required National Environmental Policy Act documents. Applications for third-party use of SFPUC owned watershed and ROW lands are also evaluated for environmental compliance and consistency with SFPUC plans and policies through the Project Review process. The SFPUC regularly evaluates environmental compliance procedures and protocols in an effort to streamline the processes and ensure they are consistent across the system. Environmental compliance for operational and maintenance activities is documented through MAXIMO, in coordination with HHWP and WSTD maintenance planning teams, and the Project Review process, while larger projects maintain separate project-specific records of environmental compliance.

The SFPUC's environmental regulatory compliance includes the fulfillment of the mitigation commitments from WSIP. These WSIP commitments include monitoring and maintenance of the Bioregional Habitat Restoration (BHR) projects, permit-required releases and bypass flows to benefit aquatic species below SFPUC dams and diversion structures, and amphibian and fish monitoring in Alameda and San Mateo Creeks. The BHR includes approximately 2,000 acres of lands set aside in perpetuity on the Alameda and Peninsula watersheds that must be maintained and monitored to meet specific environmental performance measures, as well as conservation bank credit purchases in the San Joaquin Valley. In 2016, the SFPUC began two new BHR projects on the Peninsula which are prerequisites to restoring Lower and Upper Crystal Springs Reservoirs to their historic storage capacity. These BHR projects involve enhancement and establishment of fountain thistle habitat and oak woodland. Support for the BHR effort has been funded by WSIP bond funds, and in recent years increasingly supplemented by CIP programmatic funds. This will continue, and CIP funds will be used to cover costs until an endowment, established in the City Treasurer's Office, is self-sustaining – which is anticipated by 2041.

SFPUC environmental permitting and compliance efforts include the ongoing development of a Habitat Conservation Plan for the Alameda Creek Watershed, Routine Maintenance Agreements and Lake and Streambed Alteration Agreements with the California Department of Fish and Wildlife, permits for compliance with Sections 401, 402, and 404 of the Clean Water Act, California Air Resources Board permits, compliance with hazardous materials regulations, and federal special use permits with the National Park Service, the Unites States Forest Service, and Bureau of Land Management.

4.9.3 NPDES Permit Compliance

The new RWS transmission National Pollutant Discharge Elimination System (NPDES) permit went into effect on January 20, 2016. Separately the individual permit for the Pulgas Dechloramination Facility was rescinded on that same date as the SFPUC now has coverage for the Pulgas Dechloramination Facility under the new transmission permit. The Pulgas Permit was originally effective as of April 1, 2014. Starting in 2016, filter-backwash discharges from the HTWTP are covered under a new permit (NPDES Permit Number CAG382001). Similarly, starting in 2016, treated drinking water discharges are also now covered by a new permit (NPDES Permit Number CAG140001). The SFPUC worked with State and Regional Water Boards during the development of these two new NPDES permits and the SFPUC now has a much more streamlined reporting and compliance process.

The following shows violations between in FY15 through FY16.

Date(s) of violation	**Violation**	**Regulator/Agency**	**Outcome**
June and July of 2015	NPDES permit violation	Central Valley Regional Water Quality Control Board (CVRWQCB)	$27,000 settlement
Description	A treatability study of Cherry Creek water was conducted during testing of LCA in summer of 2015. After treatment, the mobile drinking water treatment plant discharged the water back into Cherry Creek. On several occasions, water quality monitoring data showed chlorine residual amounts in excess of permitted limits, and on one occasion, the Total Suspended Solids (TSS) value exceeded permitted limits (WDRs Order # R5-2013-0074).		

Date(s) of violation	**Violation**	**Regulator/Agency**	**Outcome**
March 12, 2016 - March 15, 2016	NPDES permit violation	CVRWQCB	Unknown as of 6/8/2015.
Description	The violations involved a low freeboard at the Moccasin treated effluent storage pond and a spray field discharge during wet weather. Due to the frequency and the amount of rain received in the beginning of March, HHWP was unable to keep up with pond discharges and maintain pond freeboard levels within the permit requirements of WDRs Order No. 5-00-265.		

Date(s) of violation	Violation	Regulator/Agency	Outcome
April, 2016	NPDES permit violation	CVRWQCB	Unknown as of 6/8/2015.
Description	TDS and NO3 were not sampled in April of 2016 as required by WDRs Order No. 5-00-265.		
* CVRWQCB may choose to levee maximum penalty of $3500 per violation for total of $7000, or may choose to waive penalty since these are minor violations.			

Date(s) of violation	Violation	Regulator/Agency	Outcome
June-July, 2015	NPDES permit violation	SFRWQCB	$6,000 settlement
Description	HTWTP effluent limitation exceedance for copper on 2 separate days during discharge to San Andreas Reservoir.		

Date(s) of violation	Violation	Regulator/Agency	Outcome
April 2014 -January 2016	NPDES permit violation	CVRWQCB	$21,000 settlement
Description	Pulgas Dechloramination Facility effluent limitation exceedance for chlorine on multiple days between April 2014 and January 2016		

Between April 2014 and January 2016, there were seven (7) chlorine exceedances at the Pulgas Dechloramination Facility. The RWQCB fined the SFPUC the $3k minimum mandatory penalty for these exceedances. The violations were from monitoring equipment readings. No impacts to the receiving water (Crystal Springs Reservoir) were noted by SFPUC Biologists. The causes varied, but were often due to equipment failures. Each failure was addressed by either repair or adjustment. The Pulgas Dechloramination Facility is a complicated treatment process. The RWQCB permit in place during 2014 through 2016 was onerous and difficult to continually meet. SFPUC staff worked diligently with the RWQCB to develop a more reasonable permit, which is now in place.

5. Capital Improvement Program

Capital projects that support the RWS are organized into a 10-year CIP that is updated each year and integrated into the SFPUC's Financial Plan and rate-setting calculations. For budgetary purposes, the RWS CIP is contained in two planning documents: the Water CIP (Section 5.3.1) and the HHWP CIP (Section 5.3.2). The Water CIP includes capital projects related to the retail-funded local distribution system. The HHWP CIP includes projects funded by water revenues (retail and wholesale), power revenues, and projects funded jointly from each enterprise. For purposes of presentation here, the retail water capital projects and retail power capital projects are not shown.

5.1 Capital Planning Process

5.1.1 Identifying Potential Capital Projects

In the post-WSIP era much of the focus on the RWS CIP is on maintaining LOS and completion of deferred projects that were not included in WSIP. However capital project scope can be identified through one or more mechanisms. Typically, most capital projects are generated through periodic inspection of facilities or from capital planning work that incorporates operator records, performance data, customer input/complaints, and/or pending regulatory/legislative changes. Additionally, other capital projects emerge from joint capital planning efforts with other agencies such as many of the recycled water projects. A significant amount of capital scope is still developed through more reactive means such as emergency response or unplanned failures of assets.

5.1.2 Cost Estimation and Projecting Cash Flow

For preparation of the CIP costs are largely estimated through analogy to similar and recent projects completed by the SFPUC. Staff experience and recent bids are used to refine the estimate. Appropriate escalation is applied when using prior projects for a cost basis. Additionally costs are escalated throughout future years in the CIP at 3% per year.

Cost estimates include construction contingencies, allowances, soft costs (project management, administration, design, construction management, environmental review, legal, etc.), land acquisition, site remediation, and close-out. Soft costs are usually prorated based on construction costs, historically around 30 - 35%. For major capital projects, an engineer's estimate is performed at the 35% design completion milestone and an independent estimate is performed at the 95% design completion stage.

Cash flow requirements are expressed in terms of annual appropriations required to fund the project without interruption, anticipating funding needs prior to when expenses are incurred. Cash flow is not otherwise front loaded. Construction costs are usually put in the FY coinciding with Commission award of the construction contract even though actual cash payments to the contractor may occur over several years.

For purposes of the CIP, it is assumed that prior appropriated funds will be fully expended. Estimates of annual O&M costs include loaded labor and supplies/materials. Cost estimates for

capital projects are within general ranges that decrease as project uncertainties decrease through the development of the project. Typical industry standard accuracy ranges are:

- Preliminary planning estimates (+50% to –30%)
- Completion-of-planning estimates (+30% to –15%)
- Design-level estimates (+15% to –5%)

These ranges do not represent project contingency, which is retained as a line item in the estimate. An accuracy range is not used for projects under construction because the contract includes contingency (usually 10%), plus allowances.

For major capital projects, the Earned Value Method is used for cost control after the tasks are resource loaded. Progress is tracked by measuring the schedule and cost variances together with the milestone and deliverable variances. A trend program is developed and implemented for large projects, along with a change management process involving key staff. The CIP project summaries used for budgeting and resource planning also partition the cash flow by project phase (planning, design, environmental, construction, etc.)

5.1.3 Prioritization Process

After capital projects are scoped at the planning level and a planning-level cost estimate is calculated the prioritization process begins – usually in October of each year coinciding with the process for adoption of the annual capital plan. Projects are designated as Priority 1, 2 or 3. Priority 3 projects are not included in the Financial Plan and are not sourced with funding.

Priority 1

Priority 1 projects include projects that must be completed to maintain adopted levels of service, ensure safety for employees or the public, avoid significant liabilities, or comply with laws, contracts or Commission policies. These projects are usually not discretionary at the staff level and are highest priority. Other examples of Priority 1 projects include supplemental funding needed to complete construction. Emergency declarations following failure of infrastructure may not be planned or budgeted. A supplemental appropriation can be used, otherwise near-term appropriations are re-prioritized.

Priority 1 projects do not necessarily require Year 1 or even near-term funding. Funding is programmed into appropriate years as needed to ensure project delivery.

Priority 2

Priority 2 projects are reserved for those projects that are cost effective or are otherwise considered to be consistent with BMPs. Examples include projects that extend the life of an asset, allow participation in an externally funded partnership (grants, etc.) or that have a rate of return on investment within 10 years.

Priority 3

Priority Level 3 projects are usually discretionary, are incompletely scoped, have unclear schedule or cost estimate, have external funding yet to be secured, or have pending agreements,

etc. These projects are internally referred to as Candidate Projects and may remain so for more than one budget cycle.

Final Ranking

After this general priority setting process, not surprisingly, more quantifiable ranking is needed before projects can be evaluated for inclusion in the CIP – particularly for Priority 1 projects. The process can also help determine if Priority 1 projects are better classified as Priority 2, or vice versa. A quantifiable prioritization is achieved by using an industry standard risk analysis – applying a risk score to each risk based on consequence and likelihood of failure associated with the risk (see below) that would be addressed by a proposed capital project. Risk in this context is interpreted in terms of ability to address any Priority 1 factors such as LOS, safety, etc.

Figure 5-1: Risk Matrix for Prioritization

Likelihood of Failure		**Risk Matrix**				
Very High	5	11	16	20	23	25
High	4	7	12	17	21	24
Moderate	3	4	8	13	18	22
Low	2	2	5	9	14	19
Remote	1	1	3	6	10	15
Consequence of Failure		1	2	3	4	5
		Level 0	Level 1	Level 2	Level 3	Level 4

5.1.4 CIP Project Management/Project Controls

A project is formally initiated when the planning process begins and a project manager is assigned. At this time a preliminary "planning level" budget is used to establish the project's initial Approved Budget. Assignment of a project manager can vary. Typically the manager resides in the SFPUC Infrastructure Division – the division with primary responsibility for capital project delivery. However, depending on the project scope, expertise, and availability of Water Enterprise staff, the project manager may reside in the Water Enterprise.

During the planning phase many of the methods developed under WSIP remain in use to help ensure adequate scoping, appropriate review by managers and subject matter experts, and to ensure all alternatives are thoroughly vetted and evaluated. Four key planning documents are typically prepared and signed off from key managers. These include the Needs Assessment Report, the Alternatives Analysis Report, the Conceptual Engineering Report, and the Design Criteria. The AAR usually concludes with a recommended alternative that then proceeds to design and environmental review. Many projects will also retain the Steering Committee

concept from WSIP as the primary decision making body for a project. This committee consists of division managers within Infrastructure and the affected operating division.

Budget control usually resides at the program level where annual capital appropriations are placed[12]. Use of the budget within the program can be dedicated to a project by the appropriate division manager where scope is consistent with the corresponding budget request for the program.

Commission action is required for all CEQA actions; the Commission adopts the Mitigation Monitoring and Reporting Programs for a project or records in the agenda that a project is categorically exempt from CEQA. The Commission also approves the project and awards most contracts (professional services, construction, etc.). The Commission may also give direction on the project's scope, budget, schedule, or even its necessity during review and approval of the CIP and budget, or while considering the actions listed above. Final CEQA approval actions are taken by the Planning Commission.

While the project is active, modification to a project's budget can then be controlled by the division manager as long as the budget in the broader capital program that houses the project is not exceeded. Change order authority of 10% for the construction contracts is typically granted by the Commission.

Each quarter the SFPUC publishes a capital report which summarizes the status of each capital project. The status includes comparisons between adopted budgets and schedules and what the project manager is forecasting. At this time the forecasted budget (as discussed above) and schedule may replace prior versions as the new baseline for a project after discussion with the AGM of the Water Enterprise.

5.2 10-Year CIP

There are seven (7) active programs in the RWS CIP including a programmatic planning program used for feasibility planning for future capital projects.

- **Water Treatment Program** – This program focuses on existing and new treatment facilities that typically involve chemical systems and/or water quality monitoring systems. The program includes upgrades of chemical dosage, flow monitoring, valve and pump replacement, chemical handling upgrades, power upgrades, systems to control discharges to maintain compliance with permits, communications, process control equipment to meet more stringent drinking water regulations, seismic improvements, and upgrades to control software.
- **Water Transmission Program** – This program encompasses upgrades to the conveyance/transmission system including pipelines, tunnels, penstocks, valves, appurtenances, meters, CP, pump stations and vaults.
- **Water Supply & Storage Program** – This program encompasses projects involving storage facilities (including dams) and new supply such as desalination, recycled water, and groundwater. The program includes upgrades to structures to meet DWR DSOD requirements including geotechnical work and installation of monitoring systems, modifications to spillways and outlet structures.

[12] The level of budget control is being reviewed during FY17 as the SFPUC converts to a new financial system.

- **Watershed & ROW Lands Management Program** – This program supports projects that improve and/or protect the water quality and/or ecological resources affected by the operation of the SFPUC. Projects in this program include watershed infrastructure maintenance/repair (roads, culverts, fences, etc.) and land acquisition.
- **Communications & Monitoring System Program** – This program is reserved for upgrades to and R&R of regional communication and monitoring systems such as SCADA, radio, security and other data transmission equipment/infrastructure. Assets typically reside in numerous locations region-wide. The major project in the CIP involves construction of a microwave backbone that would provide an independent communication link between Upcountry and the four Bay Area counties served by the SFPUC.
- **Buildings & Grounds Program** – This program encompasses capital improvements to existing buildings, grounds, structures, and rights of way that are not directly related to day-to-day operations or watersheds. Examples include administration buildings, cooperation/storage yards, and miscellaneous properties. The major projects in the CIP include upgrades to the Millbrae and Sunol administration facilities and labs and construction of a new watershed center in Sunol.
- **Programmatic studies** – The programmatic section of the CIP includes water resources-related planning studies. Examples include feasibility studies for recycled water, conservation (including aspects of implementation), and desalination.

One or more projects can form a program, with projects being the basic units of the CIP. A project is typically a stand-alone capital improvement project with a defined and approved scope, budget, and schedule managed by an assigned project manager. R&R projects are also included in the CIP. These projects are usually cash-funded and do not extend the life of the overall asset (or facility).

Budgets are approved and controlled at the program levels outlined above. During budget preparation, forecasted budgets are reviewed for each active or planned capital project, along with reviewing R&R programs, and adjustments are made accordingly. When the budget is prepared for Commission and stakeholder review, staff also document that the capital plan is consistent with LOS.

Programs for the HHWP CIP are differentiated by funding source:

- Water Infrastructure - The Water program includes water only assets and water quality projects, and includes upgrades for increased capacity and reliability to the HHWP Water Infrastructure including continued rehabilitation of the SJPLs.
- Joint Infrastructure - The Joint program includes projects that are used for both water and power assets. Projects in this category are used to support the infrastructure required for the operation and maintenance for both the HHWP water and power systems including improvements to facilities at Moccasin, facilities outside Moccasin, road improvements, facility security and communication projects.
- Power Infrastructure - The Power program includes power assets only. Projects in this category include R&R of HHWP transmission lines and clearance mitigation and improvements to penstocks.

5.2.1 10-Year Water CIP Update FY17 – FY26

The FY17-FY26 10-year Water CIP ("FY17 Water CIP") includes $553.6 million in projects for these programs (not including programmatic projects). Between 2000 and 2004, various condition assessment and vulnerability studies were completed along with an intensive effort to define and adopt LOS to guide the capital program for the RWS. Much of the scope that would become WSIP - largely documented in the FY02 CIP - was derived from these efforts. However many capital projects identified in these early planning studies[13] were not ultimately included in WSIP because there was either no direct linkage to LOS, or the projects themselves from the onset were identified as deferrable to later years after more critical capital projects were completed. With WSIP in the final phases of construction, those projects that address LOS are nearing completion and the focus of capital improvements is shifting to other critical needs such as aging infrastructure and operational improvements. To leverage the work and institutional knowledge from prior condition assessments and vulnerability studies, the improvement needs identified in these studies are being consolidated and reviewed. In addition, these needs are organized into one of the six capital programs (excluding programmatic studies) of the CIP: Water Treatment, Water Transmission, Water Supply and Storage, Watershed and ROW Lands Management, Communications and Monitoring System, and Buildings and Grounds. The consolidation of these project lists was followed by a review of the Master Plan Schedule. The timing of the Master Plans will be coordinated with the CIP schedule, so that the results will be available to inform the planning and design of the CIP projects.

Even though WSIP construction will continue through FY19, WSIP projects have not been included in the CIP since 2010 because all WSIP appropriations were included in prior budget years.

The scope and timing of the projects in the Water CIP are integrated with the planned completion of WSIP projects such that the LOS goals are maintained. One additional project required to meet LOS is outside of WSIP and is managed within the FY17 Water CIP. The Peninsula Pipelines Seismic Upgrade (PPSU) Phase 3 will provide the final segment of seismic upgrades to achieve the seismic LOS. The Groundwater Storage and Recovery Project contributes to the water supply LOS objective but is partially funded from the Water CIP (and managed within the WSIP).

Project-by-project details of the FY17 Water CIP are included in Appendix I. Each project addresses one or more of the following areas:

- Renewal projects that either maintain or enhance LOS;
- Larger capital upgrades required to maintain LOS involving new or replacement facilities with implementation mostly in the later years of the 10-year CIP;
- Necessary capital upgrades to administrative and field support facilities;
- Capital planning studies; and,
- Required monitoring to support capital projects.

[13] [1] 2002 Capital Improvement Program, [2] 2004 Reliability Study Phase III, [3] 2004 Peninsula Improvement Program

No projects in the CIP are needed to directly respond to pending regulatory changes (SWRCB/Drinking Water Program, NPDES, etc.).

5.2.2 10-Year Hetch Hetchy CIP Update FY17 – FY26

The FY17-FY26 10-year HHWP CIP ("FY17 HHWP CIP") includes $859.2 million in projects funded by water rates as either water only or joint with the SFPUC Power Enterprise. In addition to LOS, the HHWP CIP is designed to sustain the SFPUC's existing unfiltered water source and gravity-driven system. Project-by-project details of the HHWP CIP are included in Appendix I. The most significant project in the FY17 HHWP CIP is the Mountain Tunnel Long-Term Improvements Project.

5.2.3 Master Plan Schedule

An essential planning function is provided through regular updates of master plans. Typically, master plans cover certain facility classes such as water treatment plants, or general reliability areas like seismic or corrosion protection, or groups of related assets in a specific geographic location such as the peninsula low-pressure zone. The plans are updated in a staggered schedule with one or two completed each year to moderate workload and facilitate integration into the CIP. The scope of master plans extends beyond a simple condition assessment that may be conducted for a given facility on a regular 3-year or 5-year cycle. Master plans include broader asset and/or operational options and LOS factors. For example, while a condition assessment documents an asset's state of repair and performance and normally generates a corrective work order or review of the preventive maintenance; a master plan will consider whether the asset should be repaired, replaced in kind, upgraded, or abandoned if rendered obsolete. Master plans also occur at the facility level, not the asset level, which allows analyses of how groups of assets are functioning together within a given facility (allowing an engineering process review). Master plans also consider broader failure modes such as seismicity and large-scale facility structural vulnerabilities, and broader planning objectives such as relation to the adopted LOS. The master plan schedule is an important reference document and is included in the CIP.

The tables below list schedules for the relevant master plans and/or major condition assessments.

Table 5-1: Master Plan Schedule – Bay Area

Program	FY Start	FY Completion
Corrosion Protection (completed)[14]	2009	2010
Dam Maintenance Program - Stability Study Update LCSD [15]	2012	2014
San Antonio/Turner Dam	2018	2019
San Andreas Dam	2018	2019
Peninsula High Pressure Zone (Peninsula Pipeline Seismic Upgrade)[16, 17, 18]	2014	2015
Communication Systems	2014	2017
Water Storage – Pilarcitos System Improvements	2015	2018
Chemical Feed Systems – Sunol Valley Chloramination Facility	2016	2017
Peninsula Low Pressure Zone Pipelines	2016	2017
Irvington Tunnel Nos. 1 and No. 2 (Existing)[19]	2015	2015
BDPL Nos. 3 and 4[20]	2016	2017
Alameda Siphons, Calaveras Pipeline, San Antonio Pipeline, San Antonio Back-up Pipeline	2017	2018
BDPL No. 1, 2, and 5 [21, 22]	2017	2018

[14] Schiff Associates, "*Corrosion Survey for Transmission Pipelines Contract No. CS-904.C*," SFPUC, July 2010
[15] URS report, "Lower Crystal Springs Dam Structural Evaluation" (SFPUC, 2013)
[16] Related documents include San Francisco Water Alliance, "*Peninsula Improvement Program Final Report*," SFPUC, March 2002
[17] Related documents include San Francisco Water Alliance, "*Peninsula Improvement Program Technical Memo 2, Hydraulic Modeling of Emergency Operations*," SFPUC, November 2001
[18] MWH/Lee report, "*San Andreas Pipeline No. 2 Extension, Conceptual Engineering Report,*" SFPUC, June 2015
[19] Related documents include URS Corporation, "*Final Technical Memorandum No. 8-01D (New) Tunnel Hydraulics,*" SFPUC CS-820, March 2008 SHOULD BE 2015 report reference
[20] Related documents include URS Corporation, "*Bay Division Pipeline 4 Reaches A and D Condition Assessment*," SFPUC, June 30, 2008
[21] Related documents include Engineering Management Bureau, Water Infrastructure Partners and Project Management Bureau, "*Bay Division Pipeline Reliability Upgrade Phase 2 AAR,*" SFPUC, July 2004
[22] Related documents include Engineering Management Bureau, Water Infrastructure Partners and Project Management Bureau, "*Bay Division Pipeline Reliability Upgrade Phase 3 CER*," SFPUC, January 2005

Program	FY Start	FY Completion
Sunol Valley Water Treatment Plant Reliability Upgrade	2020	2021
HTWTP	2019	2020
Vaults, pump stations, chemical systems, storage tanks, field equipment, etc.	*On-going 5-year, 7-year or 10-year condition assessment cycle.*	

Table 5-2 lists the condition assessment schedule for many of the critical assets managed by HHWP.

Table 5-2: Condition Assessment Schedule – Upcountry

Facility	Condition Assessment Reports	Date of Last Assessment	Date of Next Assessment
Cherry Dam and Release	Assessments are available for discharge facilities. Assessment of dam has not been performed	Mar-2012	2020-2022
Eleanor Dam	Assessments are available for discharge facilities and dam	Jun-2016	TBD
Cherry-Eleanor Tunnel	Informal inspection was performed by HHWP	Oct-2015	TBD
Cherry-Eleanor Pump Station	Evaluation of Cherry/Eleanor pump system (by EMB)	Mar-2016	TBD
Cherry Power Tunnel	Not Available	N/A	TBD
Holm Penstock	Preliminary Damage Assessment after the Rim Fire.	Oct-2013	TBD
Lower Cherry Creek Diversion Dam and Aqueduct	Preliminary Damage Assessment after the Rim Fire.	Oct-2013	TBD
O'Shaughnessy Dam Outlet Work	Assessments are available for discharge facilities.	Jun-2009	TBD
O'Shaughnessy Dam	Assessment of dam has not been performed	N/A	2021-2023
Canyon Power Tunnel	Hetchy Adit Repair Report	Nov-2009	TBD
Kirkwood Penstock	Available	Nov-2014	TBD
Early Intake Bypass Pipeline	Not Available	N/A	TBD
Early Intake Dam	Available	Mar-2014	TBD
Mitchell Ravine	Available	Dec-2009	TBD
Mountain Tunnel	Available	Oct-2008	Jan-2017

Facility	Condition Assessment Reports	Date of Last Assessment	Date of Next Assessment
Priest Reservoir	Evaluation of water quality concerns and some structures.	Dec-2010	TBD
Priest Dam	Stability Evaluation	Sep-1990	2018-2020
Priest Bypass	Not available	N/A	TBD
Moccasin Power Tunnel	Not available	N/A	TBD
Moccasin Penstock	Preliminary assessments available	Oct-2011	TBD
Moccasin Dam	Not Available	N/A	2023-2024
Moccasin Reservoir	Evaluation of water quality concerns and some structures.	Dec-2010	2023-2024
Moccasin Creek Bypass	Available	Jul-2010	TBD
Foothill Tunnel	Available	Jan-2008	TBD
SJPLs	Available for some sections	Various	Nov-2016
Tesla Valvehouse	Not Available	N/A	TBD
Coast Range Tunnel	Available	Apr-2015	TBD
Moccasin Compound	Moccasin Facilities Upgrade Project Needs Assessment Report	Aug-2011	TBD

5.3 Water System Improvement Program

Approximately $1.8 billion in WSIP projects are active during the summer of 2016 and significant program milestones are expected to be reached shortly. Major ongoing construction activities include CDRP, the Fish Passage Facilities at Upper Alameda Creek Diversion Dam (sub-project to the CDRP), and the Regional Groundwater Storage and Recovery Project. As of summer 2016, all but three of the Regional WSIP projects are in service and are meeting their intended level of service goals and objectives. Final administrative closeout of several major projects is expected in the fall of 2016, including the NIT, BDPL Reliability Upgrade – Tunnel (Bay Tunnel), Seismic Upgrade of BDPL Nos. 3 & 4 at Hayward Fault, and HTWTP Long-Term Improvements. After the end of 2016, it is expected that only three Regional WSIP projects will remain active: CDRP (main project as well as the fish passage facilities sub-project), Alameda Creek Recapture, and Regional Groundwater Storage and Recovery. In addition, several support projects as well as the new WSIP Closeout projects created to address miscellaneous items needed to fully meet the intended LOS will continue to the end of the program in 2019.

Table 5-1 lists the current status of WSIP projects. For the purposes of this report and table, projects are considered to be "in service" and subject to asset management programs of the Water Enterprise when substantial completion is reached. This terminology is a departure from WSIP reporting where "close-out" or "completed" may be used. The distinction between these latter terms is not particularly relevant for the owner/operator as a project may be in close-out for many months prior to completion even though the facility is in service.

Table 5-3: Status of Water System Improvement Program Projects

Project	Status
San Joaquin Pipeline System	In service
Rehabilitation of Existing San Joaquin Pipelines	In service
Tesla Treatment Facility	In service
Lawrence Livermore Water Quality Improvement Facility	In service
Alameda Creek Recapture	Design
Calaveras Dam Replacement	Construction
San Antonio Backup Pipeline	In service
New Irvington Tunnel	In service
SVWTP Expansion & Treatment Water Reservoir	In service
Alameda Siphon No. 4	In service
San Antonio Pump Station Upgrade	In service
Seismic Upgrade of BDPL Nos. 3 & 4 at Hayward Fault	In service
BDPL Reliability Upgrade - Tunnel	In service
BDPL Reliability Upgrade – Pipeline (East Bay)	In service
BDPL Reliability Upgrade – Pipeline (Peninsula)	In service
BDPL Reliability Upgrade – Relocation of BDPL 1 & 2	In service
SCADA System - II	In service
System Security Upgrades	In service
BDPL Nos. 3 & 4 Crossovers	In service
BDPL No. 4 Cond. Assessment PCCP Sections	In service
SFPUC / EBMUD Intertie	In service
Pulgas Balancing – Structural Rehabilitation and Roof Replacement	In service
Pulgas Balancing – Modifications of the Existing	In service

Project	Status
Dechloramination Facility	
Crystal Springs / San Andreas Transmission System	In service
Baden and San Pedro Valve Lots Improvements	In service
HTWTP Long Term Improvements	In service
New Crystal Springs Bypass Tunnel	In service
LCSD Improvements	In service
Crystal Spring Pipeline No. 2 Replacement	In service
San Andreas Pipeline No. 3 Installation	In service
Peninsula Pipelines Seismic Upgrade	In service
Sunset Reservoir – North Basin	In service
University Mound – North Basin	In service
Regional Groundwater Storage and Recovery Project	Project in Multiple Contracts; two (2) in Construction and one (1) In service
HTWTP Short Term Improvements – Coagulation & Flocculation	In service
Pulgas Balancing – Discharge Channel Modifications	In service
Cross Connection Controls	In service
HTWTP Short-Term Improvements – Demo Filters	In service
Adit Leak Repair – Crystal Springs / Calaveras	In service
Capuchino Valve Lot Improvements	In service
Pulgas Balancing – Inlet/Outlet Work	In service
Standby Power Facilities – Various Locations	In service
Watershed and Environmental Improvement Program	Ongoing

5.4 Seismic Improvements

During FY15 and FY16, significant seismic improvements have been made for many assets and facilities in the RWS through phased WSIP implementation, preventive maintenance, and small capital projects. Notable WSIP progress during the past two years that has generated significant seismic improvements include completions of HTWTP upgrades, NIT, Bay Tunnel, Bay Tunnel, and PPSU Phases 1 and 2.

Additionally, significant planning and design progress has been reached with PPSU Phase 3, which is the first major seismic project that is not within WSIP. Substantial completion of PPSU Phase 3 is expected in November 2017.

For additional information, specific seismic capital improvements from the last 10 years are listed in Table A-18, displayed from east to west in the conveyance system. Collectively these improvements help meet seismic response and water system performance level of service objectives. WSIP projects not listed in Table A-18 add additional seismic improvements because all new construction uses higher seismic design specifications.

Appendix A: Asset Inventory Tables

Table A-1: Dams

Asset	Dam Type	Location	Completion Date
Bay Area			
Calaveras Dam	Earth	Alameda County	1925
Lower Crystal Springs Dam	Concrete Gravity	San Mateo County	1888/1890 1911
Upper Crystal Springs Dam	Earth	San Mateo County	1877/1891
Pilarcitos Dam	Earth	San Mateo County	1866/1867 1874
San Andreas Dam	Earth	San Mateo County	1870/1875
San Mateo Creek Dam No. 1	Earth	San Mateo County	1898
San Mateo Creek Dam No. 2	Concrete Arch	San Mateo County	1898
Stone Dam	Masonry Arch	San Mateo County	1871
Turner Dam	Earth	Alameda County	1965
Upper Alameda Diversion Dam	Concrete Slab and Buttress	Alameda County	1931
Upcountry			
Cherry Valley Dam	Earth and Rock	Tuolumne County	1955
Early Intake Diversion Dam	Concrete Arch	Tuolumne County	1924
Eleanor Dam	Concrete Buttressed Arch	Tuolumne County	1918
Moccassin Dam	Earth and Rock	Tuolumne County	1929
O'Shaughnessy Dam	Concrete Gravity Arch	Tuolumne County	1923/1938
Priest Dam	Earth and Rock	Tuolumne County	1923

Table A-2: Groundwater Wells/ Filter Galleries

Asset	Number of Wellheads	Location	Capacity
Bay Area			
Pleasanton Well Field	2	Pleasanton	< 1 MGD
Peninsula Conjunctive Use Wells (2018)	16	Various	7.2 MGD
Sunol Filter Gallery		Sunol	7.4 MGD
Upcountry			
Cherry Valley Coumpound Well	1	Cherry Valley	3-7 gpm
O'Sh Backpacker Campground Well	1	O'Shaugnessy	6.8 gpm
O'Sh Dam Campground Well	1	O'Shaugnessy	30 gpm

Table A-3: Supply Reservoirs

Asset	Capacity of Reservoir (ac-ft)	Reservoir Surface Area (sq. mi)	Location
Bay Area			
Calaveras Reservoir	96,800	2.2	Alameda County
San Antonio Reservoir	50,500	1.3	Alameda County
Crystal Springs Reservoir (Upper and Lower)	69,300	2.3	San Mateo County
Pilarcitos Reservoir	3,100	0.2	San Mateo County
San Andreas Reservoir	19,000	0.9	San Mateo County
Upcountry			
Early Intake Reservoir	115		Tuolumne County
Hetch Hetchy Reservoir	360,360 [23]	3.1	Tuolumne County
Lake Eleanor	27,113 [24]	1.5	Tuolumne County
Lake Lloyd (Cherry Valley Reservoir)	273,500 [24]	2.8	Tuolumne County
Moccasin Reservoir	552 [24]	0.05	Tuolumne County
Priest Regulating Reservoir	1,706	0.07	Tuolumne County

Table A-4: Treated Water Storage

Asset	Capacity (MG)	Location
Bay Area		
Town of Sunol (2 tanks)	0.097 and 0.097	Sunol
Niles Reservoir	Decommissioned	Niles
Castlewood Reservoir	0.4	Pleasanton
Pulgas Balancing Reservoir	60	San Mateo
Merced Manor Reservoir	9.5	San Francisco
Sunset Reservoir – North Basin	89.4	San Francisco
Sunset Reservoir – South Basin	87.3	San Francisco
University Mound Reservoir – North Basin	59.4	San Francisco
University Mound Reservoir – South Basin	81.5	San Francisco
Upcountry		
Moccasin Domestic	0.088	Moccasin
Early Intake Domestic	0.044	Early Intake
Cherry Compound	0.066	Cherry
O'Shaughnessy Domestic	0.041	O'Shaugnessy

[23] Capacity with drum gates activated

[24] Capacity with flashboards

Table A-5: Water Treatment Facilities

Asset	Capacity(MGD)	Location
Bay Area		
Tesla Treatment Facility	315	Tracy/San Joaquin County
Thomas Shaft Facility	315	San Joaquin County
Sunol Valley WTP	160	Alameda County
Sunol Chloramination Facility	--	Alameda County
Harry Tracy Water Treatment Plant	160 maximum, 140 sustained	San Mateo County
Pulgas Dechloramination Facility	200	San Mateo County
Upcountry		
Rock River Lime Treatment Plant	400	Tuolumne County
Moccasin Camp UV Facility	0.47 per reactor (2)	Tuolumne County
Early Intake Camp UV Facility	0.47 per reactor (2)	Tuolumne County
O'Shaughnessy Compound UV Facility	0.17 per reactor (2)	Tuolumne County
Cherry Compound Memcor	0.014	Tuolumne County

Table A-6: Water Transmission – Pipelines and Tunnels

Asset	Size	Length (mi)	Capacity (MGD)	Installation Date
Bay Area				
Coast Range Tunnel	10.5′	25	400	1934
Alameda Siphon No. 1	69″	0.6	67	1934
Alameda Siphon No. 2	91″	0.6	134	1953
Alameda Siphon No. 3	96″	0.6	152	1967
Alameda Siphon No. 4	66″	0.6	160	2011
San Antonio Pipeline	60″	2.1	230	1967
San Antonio Backup Pipeline	66″	1.3	230	2014
Calaveras Pipeline	44 - 72″	6	80	1965/1992
Irvington Tunnel	10.7′	3.5	400	1934
New Irvington Tunnel	102″	3.5	400	2014
Bay Division Pipeline No. 1	60″	21.2	46	1925/1933
Bay Division Pipeline No. 2	66″	21.2	59	1935/1936
Bay Division Pipeline No. 3	72″	34	80	1952
Bay Division Pipeline No. 4	90″	34	80	1965/1967 1973
Bay Division Pipeline No. 5	East Bay: 72″ Peninsula: 60″	7 9	80 55	2011/2012
Bay Tunnel	9′	5	120	2014
Pulgas Tunnel	10.3′ horseshoe	1.9		1924
Stanford Tunnel	90″	0.2	80	1949
Palo Alto Pipeline	12″ – 36″	4.4		1938
Crystal Springs Bypass Tunnel	9.5′	3.4	215	1969
Crystal Springs Bypass Pipeline	96″	0.9	215	1970
New Crystal Springs Bypass Tunnel	96″	0.8	215	2011
Sunset Supply Pipeline	60″	13.4	111	1948-1958
Crystal Springs Pipeline No. 1	44″	17.1	10	1885/1956
Crystal Springs Pipeline No. 2	60″	19.3	52	1937/1956
Crystal Springs Pipeline No. 3	60″	3.6	60	1971/1987
San Andreas Pipeline No. 1	44″	12.5	22	1870-1939
San Andreas Pipeline No. 2	54″	12.3	37	1927-1928
San Andreas Pipeline No. 3	60″ – 66″	6.6	65	1992/2014
Sunset Branch Pipeline	60″	1.1	65	1947
Crystal Springs-San Andreas Force main	61″	4.7	90	1898-1932 1968
Stone Dam Tunnel No. 1	4′-6″ x 4′-9″	0.1	45	1872-1948
Stone Dam Tunnel No. 2	3′-6″ x 4′-4″	0.61	45	1872-1948
San Mateo Tunnel No. 1	3′-6″ x 5′-1″	0.65	40	1868
San Mateo Tunnel No. 2	4′-4″ x 4′-6″	0.67	45	1898

Asset	Size	Length (mi)	Flowrate (Design or Operating) (MGD)	Installation Date
Upcountry[3/]				
Canyon Power Tunnel	14' x 14'-6" horseshoe	10.8	Design: 471	1965
Cherry Power Tunnel	12' x 12' horseshoe	5.5	Design: 523	1959
Early Intake Bypass	14' x 14'-6" horseshoe	0.38	NA	1967
Eleanor-Cherry Tunnel	10'-10" x 10'-10" horseshoe	1.1	Operating: 646	1960
Foothill Division Tunnel	13'-4" x 14'-3" horseshoe	16.4	400	1929
Lower Cherry Aqueduct		3.78	Operating: 107	1917
Moccasin Power Tunnel	13' x 13' horseshoe	1	Design: 801	1925
Moccasin Reservoir Bypass Pipeline	108"	0.39	Operating: 320	1972/1988
Mountain Division Tunnel	varies	19.2	Design: 400 at grade of 1.55:1000	1925
Red Mountain Bar Siphon	9.5'	0.48	400[1/]	1970
San Joaquin Pipeline No. 1	56"-72"	47.4	Operating: 75	1932
San Joaquin Pipeline No. 2	61"	47.4	Operating: 80	1952
San Joaquin Pipeline No. 3	78"	47.4	Operating: 150	1968
San Joaquin Pipeline No. 4	78"	17.2	Operating: 150	2011-2013

Table A-7: Water Transmission – Pump Stations

Asset	Number of Pumps	Total Capacity (MGD)	Location
Bay Area			
Lake Merced Pump Station	5	65	San Francisco
Baden Pump Station	3	45	San Bruno
Crystal Springs Pump Station	4	120	San Mateo
Town of Sunol (potable)	2	0.72	Sunol
Sunol Pump Station	3	7.4	Sunol
Pulgas Pump Station	5	185	San Mateo
San Antonio Pump Station	8 (electric) 2 (diesel)	160	Sunol (Jan 2015)
Upcountry			
Cherry-Eleanor Pump Station	10	21.6	Tuolumne County

Table A-8: Water Transmission – Valve Lots

Asset	Valves	Valve Size (in)	Pipeline	Location
Bay Area				
Alameda Creek	V10	60x84	ACD	Sunol
Alameda East Portal	X10	72	AS2	Sunol
	X20	72	AS3	
	X30	60	AS1	
	X32	60	AS1	
	X50	54	AS4	
	X55	54	AS4	
	X95	84	AS4	

Asset	Valves	Valve Size (in)	Pipeline	Location
Alameda +SAPL + SABPL	W35	60	SAPL	Sunol
	W41	60	SAPL	
	W42Y	60	SABPL	
	X23	66	SABPL	
	X24Y	66	SABPL	
	X31	16	AS1	
	X61	12	SUNOL PL	
	X62	12	SUNOL PL	
	X63	12	SUNOL PL	
	X64	12	SUNOL PL	
	X71	96	AS4	
	X72	96	AS1	
	X73	84	AS2	
	X74	84	AS1	
	X75	96	AS3	
	X76	96	AS1	
	X85	72	AS2	
	Y20	54	SAPL	
	Y21	54	SAPL	
	Y22	48	SAPL	
	Y23	60	SAPL	
	Y24	60	SABPL	
	Y25	66	SABPL	
	Y27	66	SABPL	
	Y28	54	SABPL	
	Y30	30	SAPL	
	Y31	24	SAPL	
	Y32	36	SAPL	
	Y35	36	SAPL	
	Y41	20	SAPL	
	Y42	20	SAPL	
	Y43	24	SAPL	
	Y44	36	SAPL	
Alameda West Portal	X15	90	AS2	Sunol
	X24	72	AS3	
	X25	72	SABPL	
	X35	66	AS1	

Asset	Valves	Valve Size (in)	Pipeline	Location
Baden Valve Lot	K50	42	CS2	South San Francisco
	K51M	36	CS2	
	K53P	20	CS2	
	K54R	30	CS2	
	M20	42	SSP	
	M50	60	SSP	
	M53R	30	SSP/SA2	
	M55P	42	SA1/CS2	
	P57M	30	SA1	
	P57R	42	CS2	
	P57R	42	CS2	
	R50	42	SA2	
	R55	54	SA2	
	R55K	36	SA2/SA3	
	R58P	42	SA2/CS2	
	T50	48	SA3	
	T52R	42	SA2/SA3	
	T54M	42	SA2/SA3	
	T55	54	SA3	
	T55P	16	CS2/SA3	
	T56R	42	SA2/SA3	
	T57P	42	CS2	
	T58K	24	CS2/SA3	
Barron Creek	C34	72	BD3	Palo Alto
	C36	72	BD3	
	C35D	42	BD3 & 4	
	D34	90	BD4	
	D36	90	BD4	
Bear Gulch Valve Lot	C58	72	BD3	Atherton
	C60	72	BD3	
	D58	84	BD4	
	D60	84	BD4	
	C59D	42	BD4/BD3	
Bellevue and Pepper Valve Lot	M30	42	SSPL	Hillsborough
	M31	36	SSPL	
	M32K	36	CS2/SSPL	
	M33L	36	CS3/SSPL	
	L30	42	CS3	
Calaveras Boulevard Valve Lot	C20	66	BD3	Milpitas
	C22D	48	BD3/BD4	
	C23D	48	BD3/BD4	
	D20	72	BD4	

Asset	Valves	Valve Size (in)	Pipeline	Location
Calaveras Reservoir	V11	60x84	CAR	Sunol
	V21	30	CLD	
	V22	48	CLD	
	V23	48	CLD	
	V24	60	CLD	
	V25	30	CLD	
	V26	48	CLD	
	V27	48	CLD	
	V31	72	CLD	
	V33	72	CAL	
	V330	42	CAL	
	V34	48	CAL	
	V37	12	CAL	
	V397	66	CAL	
	V40	66	CAL	
	V8011	78	SVWTP Eff.	
	V8021	78	SVWTP Eff.	
	V8200	108	SVWTP Eff.	
	V8210	78	SVWTP Eff.	
	V8222	78	SVWTP Eff.	
	V8230	78	SVWTP Eff.	
	V8240	78	SVWTP Eff.	
	V9	10	CAL	
Calaveras / San Andreas	S49	36x48	CS/SA	San Bruno
Capuchino Valve Lot	M40	42	CPV/SSPL	San Bruno
	M41	24	SS Branch	
	M41A	24	SS Branch	
	M41B	24	SS Branch	
	M43	14	SS Branch	
	M43A	14	SS Branch	
	M43B	14	SS Branch	

Asset	Valves	Valve Size (in)	Pipeline	Location
Crawford Valve Lot	C17	78	BD3	Fremont
	C171	16	BD3/BD4	
	C172	16	BD3/BD4	
	C173	16	BD3/BD4	
	C18D	42	BD3/BD4	
	C19	78	BD3	
	C191	16	BD3/BD4	
	C192	16	BD3/BD4	
	C193	16	BD3/BD4	
	D17	78	BD4	
	D171	16	BD3/BD4	
	D172	16	BD3/BD4	
	D19	78	BD4	
	D191	16	BD3/BD4	
	D192	16	BD3/BD4	
Crystal Spring Reservoir	H10	42	LCR	Crystal Spring
	H11	42	LCR	
	H12	42	LCR	
	H20	42	LCR	
	H21	42	LCR	
	H22	42	LCR	
	H33	60	LCR	
	H53	42	LCR	
	H81	72	CSOS1	
	H82	72	CSOS2	
	H89	60	CS/SA	
	H91	66x60	DSOS	
	H92	66x60	DSOS	
	H94	8	LCR	
	H95	8	LCR	
	J61K	24	CS1/CS2	
	J62K	24	CS1/CS2	
	K60	48	CS2	
	K70	48	CS2	
	L40P	30	CS3	
	L41K	42	CS3	
	L59K	44	CS2/CS3	
	L60	44	CS1	
	L70	44	CS1	
Crystal Springs and El Cerrito Valve Lot	K20	48	CS2	Hillsborough
Edgewood Road Valve Lot	A64D	24	BD1/BD4	San Mateo
	B65D	24	BD2/BD4	
	B66C	20	BD2/BD3	

Asset	Valves	Valve Size (in)	Pipeline	Location
El Camino and Bellevue Valve Lot	K30	36	CS2	Burlingame
El Camino Real/Millbrae Yard Valve Lot	K39P K40	16 30	SA1 CS2	Millbrae
Grimmer Shutoff Station	A17 A18 A191 A19B A19E B17 B18 E15A	66 66 36 36 24 60 60 42	BD2 BD2 BD2/BD5 BD1/BD2 BD2/BD5 BD1 BD1 BD2/BD5	Hayward
Guadalupe Valve Lot	C24 C26 C25D D24 D26	72 72 42 90 90	BD3 BD3 BD3/BD4 BD4 BD4	Santa Clara
Harry Tracy WTP	T10R T11 T12 T20	54 66 20 42	SA3 SA3 SA3 SA3	San Bruno
Hillsborough Valve Lot	M15 M21K	78 36	SSP CS2/SSPL	Hillsborough
Irvington Portal	A09 A10 B10 C10 D10	16 66 60 60 72	Hayward Serv. BD2 BD1 BD3 BD4	Hayward
Hayward/EDMUD Intertie	A21 A22 A23 A24	42 36 36 36	Hayward Intertie Hayward Intertie Hayward Intertie Hayward Intertie	Hayward
New Irvington Portal	A11 A13E B11 C11 D11 E10 E11 H1 H2 H3	60 24 60 78 96 72 72 24 24 24	BD2 BD2/BD5 BD1 BD3 BD4 IT2 BD5 Hayward Pipeline IT1 Manifold IT1 to Hayward Pipeline	Fremont (New Irvington Tunnel)

Asset	Valves	Valve Size (in)	Pipeline	Location
Mountain View/Alviso Valve Lot	C30 C31D C32D D30	42 48 48 72	BD3 BD3/BD4 BD3/BD4 BD4	Mountain View
Millbrae Yard	M42K	36	SSP/CS2	Millbrae
Newark Tunnel Shaft	B20U	66	BD5	Fremont
Newark Valve Lot	A19 A20 A20U A21B A22B B20 E14A E20U	66 48 60 36 30 42 42 72	BD2 BD2 BD5 BD1/BD2 BD1/BD2 BD1 BD5 BD5	Newark (Abandoned in Fall 2014)
Palo Alto Pipeline	F40 F45 F5 F50 F6 F60	36 36 24 24 24 12	PAP PAP PAP PAP PAP PAP	Palo Alto
Paseo Padre Shutoff Station	A14 A15 A161 A16B B14 B15 E14	66 66 36 36 60 60 72	BD2 BD2 BD2 BD1/BD2 BD1 BD1 BD5	Hayward
Pilarcitos Reservoir	S10 S11 S12	24x36 24x36 24x36	PIL PIL PIL	Pilarcitos
Ravenswood Tunnel Shaft	B50U E15 E50U E52B	66 72 60 24	BD5 BD5 BD5 BD2/BD5	Fremont
Ravenswood Valve Lot	A50U	60	BD5	East Palo Alto

Asset	Valves	Valve Size (in)	Pipeline	Location
Redwood City Valve Lot	A60	42	BD1	Redwood City
	A61B	30	BD1/BD2	
	A62B	30	BD1/BD2	
	B60	48	BD2	
	B62	48	BD2	
	E61	60	BD5	
	E61B	42	BD2/BD5	
	F05	24	BD1/BD2	
	F06	24	Palo Alto PL	
	F10	20	Palo Alto PL	
	F20	20	Palo Alto PL	
	F25	24	Palo Alto PL	
	F30	30	Palo Alto PL	
Crystal Springs Bypass Tunnel/ Bypass Pipeline	G10	120x96	Pulgas Tunnel	San Mateo
	G11	120x120	Pulgas Tunnel	
	G20	120x120	CSBT	
	G32	96	NCSBT	
	G34	96	CSBPL	
	G36	78	NCSBT/SSPL	
	G38	60	NCSBPL/CSP2	
	G40	72	CSBPL/SSPL & CSPL2	
	G41	54	CSBPL/SSPL	
	G42	42	CSBPL/SCPL2	
Crystal Springs Pump Station	H81	72	CSOS1	San Mateo
	H82	72	CSOS2	
	H83	60	CSPS-CS/SAPL	
	H84	60	LCR	
	H85	60	CSPS Suction	
	H86	36	CSPS Disc. to	
	H87	72	Potable PL	
	H91	66x60	DSOS	
	H92	66x60	DSOS	
	H97	42	SSPL	
	H98	42	SSPL	
	H99	42	SSPL	
	K10	60	CS2PL	
	M10	60	SSPL	

Asset	Valves	Valve Size (in)	Pipeline	Location
San Andreas Reservoir	N20	54	SA2RW	San Bruno
	N21	54	SA2RW	
	N30	42	SA3RW	
	N31	48	SA3RW	
	N32	48	SA3RW	
	N33	48	SA3RW	
	N40	54	SA2	
	N41	60	SA3RW	
	N44	78	SSB	
	N49	12	SA3RW	
	N50	54	SA3RW	
	N51	60	SA3RW	
	N69	96	HTT Effluent	
	N72	96	HTT Effluent	
	N74	78	SSB	
	P10	24	SA1	
	P11N	16	SA1	
	P12N	16	SA1	
	P48	44	SA1	
	R10	36	SA2	
	R11	54	SA2	
	R12	54	SA2	
	R20	42	SA2	
Pulgas Valve Lot	A68	42	BD1	San Mateo
	A70	24	BD1	
	B68	42	BD2	
	B70	42	BD2	
	B73C	8	BD2/BD3	
	C68	48	BD3	
	C70	48	BD3	
	D68	72	BD4	
	D70	72	BD4	
	E62	60	BD5	
	E68	60	BD5	
	E70	60	BD5	

Asset	Valves	Valve Size (in)	Pipeline	Location
San Antonio Pump Station Valve Lot	X11	20	SVWTP Eff.	Sunol
	X111	20	SVWTP Eff.	
	X112	20	SVWTP Eff.	
	X12	60	SVWTP Eff.	
	X14	66	AS2	
	X22	60	SVWTP Eff.	
	W09	10	Nursery Serv.	
	W11	54	CALPL	
	W12	66	CALPL	
	W15	36	San Ant. PL	
	W20	60	SVWTP Eff.	
	W21	54	SVWTP Eff.	
	W22	54	SVWTP Eff.	
	W30	60	San Ant. PL	
	W31	42	San Ant. PL	
	W32	60	San Ant. PL	
	W33	60	San Ant. PL	
San Antonio Reservoir	Y01	36	SAPL	Sunol
	Y02	36	SAPL	
	Y03	36	SAPL	
	Y04	36	SAPL	
	Y05	36	SAPL	
San Pedro Valve Lot	M60	42	SSPL	Colma
	T60	48	SA3	
	T61M	36	SA3/SSPL	
	T62R	30	SA3/SA2	
	T63R	30	SA3/SA2	
	T64M	36	SA3/SSPL	
	R59	42	SA2	
	R60	42	SA2	
Stanford East Portal	C40	48	BD3	Palo Alto
	D40	72	BD4	
SFWD/SCVWD	C23.1	42	BD3	Santa Clara
	C23.2	42	BD3	
	C23.3	42	BD3/BD4	
	D23.1	42	BD4	
	D23.2	42	BD4	
Stanford West Portal	C50	48	BD3	Palo Alto
	D50	72	BD4	
Stone Dam	S60	22	STD	Stone Dam
	S61	48x48	STD	
Sunset Branch	N75	78	SSB	San Bruno
Sunol Valley WTP	W10	42	SVP	Sunol
	W40	60	SVP	

Asset	Valves	Valve Size (in)	Pipeline	Location
Tissiack Valve Lot	C14 C141 C142 C143 D14 D141 D142 C15D C16 C161 C162 C163 D16 D161 D162	78 16 16 16 78 16 16 42 78 16 16 16 78 16 16	BD3 BD3/BD4 BD3/BD4 BD3/BD4 BD4 BD3/BD4 BD3/BD4 BD3/BD4 BD3 BD3/BD4 BD3/BD4 BD3/BD4 BD4 BD3/BD4 BD3/BD4	Fremont
Upcountry				
Canyon Portal Valve House	CPVH BFV	96	KPH Penstock	Early Intake
Eleanor Release Valves	SG 1 SG 2 G 3 G 4	24 24 24 24	Eleanor Creek	Eleanor
Early Intake Dam	SG 1 SG 2	36 36	Tuolumne River	Early Intake
Cherry-Eleanor Tunnel	SG A SG B	72x96 72x96	Cherry-Eleanor Tunnel	Cherry Pump Station
Mountain Tunnel Headgates	HG 2 HG 3 HG 4	48x60 48x60 48x60	Mountain Tunnel	Early Intake
Cherry Dam	HJ 1 and HJ 2 12" Needle 6" Ball Valve BFV 1 & BFV 2 BFV 3	66 12 6 84 84	Cherry Creek Cherry Power Tunnel	Cherry Valve House
Emery Crossover Valves	EC-EXO101 EC-EXO201 EC-EXO301 EC-EXO102 EC-EXO202 EC-EXO302 EC-EXOUX12 EC-EXOUX23 EC-EXODX12 EC-EXODX23	60 60 72 60 60 72 36 42 30 36	SJPL 1 SJPL 2 SJPL 3 SJPL 1 SJPL 2 SJPL 3 SJPL 1/2 SJPL 2/3 SJPL 1/2 SJPL 2/3	Stanislaus County

Asset	Valves	Valve Size (in)	Pipeline	Location
Granite Portal Valve House	BFV	94	HPH Penstock	Tuolumne County
Oakdale Portal Valve House	ODP101 ODP201 ODP301 ODP401	60 60 78 78	SJPL 1 SJPL 2 SJPL 3 SJPL 4	Tuolumne County
O'Shaughnessy Dam	V1 V2 V3 thru V8 V12 & V13 V15 & V16	72 75 60 36 60	Tuolumne River Canyon Power Tunnel	O'Shaughnessy Dam
West Portal Valve House	BFV 1 & BFV 2	104	Moccasin Penstock	West Portal
Pelican Crossover Valves	PC-PXO101 PC-PXO201 PC-PXO301 PC-PXO102 PC-PXO202 PC-PXO302 PC-PXO402 PC-PXOUX12 PC-PXOUX23 PC-PXODX12 PC-PXODX23 PC-PXODX34	60 60 72 60 60 72 72 36 42 30 36 36	SJPL 1 SJPL 2 SJPL 3 SJPL 1 SJPL 2 SJPL 3 SJPL 4 SJPL 1/2 SJPL 2/3 SJPL 1/2 SJPL 2/3 SJPL 3/4	Vernalis
Roselle Crossover Valves	RC-RXO101 RC-RXO201 RC-RXO301 RC-RXO102 RC-RXO202 RC-RXO302 RC-RXOUX12 RC-RXOUX23 RC-RXODX12 RC-RXODX23	60 60 72 60 60 72 36 42 30 36	SJPL 1 SJPL 2 SJPL 3 SJPL 1 SJPL 2 SJPL 3 SJPL 1/2 SJPL 2/3 SJPL 1/2 SJPL 2/3	Riverbank
San Joaquin Pipeline 4 Tie-In Vault	P4J301 P4J401	60 60	SJPL 3 SJPL 4	Stanislaus County
San Joaquin Pipeline 3 and 4 Throttling Station	T3E331 T3E301 T4E431 T4E401	36 72 36 72	SJPL 3 SJPL 3 SJPL 4 SJPL 4	Stanislaus County

Asset	Valves	Valve Size (in)	Pipeline	Location
San Joaquin Pipeline 2 Throttling Station T2E	T2E201 T2E231	48 30	SJPL 2 SJPL 2	Stanislaus County
San Joaquin Pipeline 2 Throttling Station T2W	T2W201 T2W231	48 30	SJPL 2 SJPL 2	Stanislaus County
San Joaquin River Valve House	SJV331 SJV311 SJV212 SJV231 SJV211 SJV131 SJV112 SJV113	42 42 20 30 30 30 18 24	SJPL 3 SJPL 3 SJPL 2 SJPL 2 SJPL 2 SJPL 1 SJPL 1 SJPL 1	Stanislaus County
Tesla UV Valve House	TUV101 TUV201 TUV301 TUV401	60 60 78 78	SJPL 1 SJPL 2 SJPL 3 SJPL 4	San Joaquin County
Tesla Portal Valve House	TPV101 TPV201 TPV301	60 60 78	SJPL 1 SJPL 2 SJPL 3	San Joaquin County

Table A-9: Water Transmission - Interties

Asset	Capacity (MGD)	Location
Bay Area		
DWR	50	Sunol
EBMUD	30 MGD to/from EBMUD 15 MGD to/from SFPUC 15 MGD to City of Hayward	Hayward
SCVWD	40	Milpitas

Table A-10: Water Transmission – Town of Sunol Distribution System

Asset	Size (in)	Total Length (mi)	Capacity (MGD)
Bay Area			
Town of Sunol Distribution System	4″ 6″ 8″ 2″	0.75 0.66 0.2 0.7	0.15
Upcountry			
Moccasin Camp	N/A	N/A	N/A
Early Intake Camp	N/A	N/A	N/A
O'Shaughnessy Compound	N/A	N/A	N/A
Cherry Valley Compound	N/A	N/A	N/A

Table A-11: Watershed and Lands Management – Watersheds

Asset	Size of Hydrologic Watershed (sq. mi)	Location
Bay Area		
Calaveras Watershed	132	Alameda and Santa Clara County
Crystal Springs Watershed	24.8	San Mateo County
Pilarcitos Watershed	3.8	San Mateo County
San Andreas Watershed	4.1	San Mateo County
San Antonio Watershed	38.5	Alameda County
Upcountry		
Early Intake Watershed	29	Tuolumne County
Hetch Hetchy Watershed	459	Tuolumne County
Moccasin Watershed	0	Tuolumne County
Lake Eleanor Watershed	79	Tuolumne County
Lake Lloyd Watershed	114	Tuolumne County
Lower Cherry Diversion Dam Watershed	32	Tuolumne County
Priest Watershed	2.8	Tuolumne County

Table A-12: Powerhouses

Asset	Power Output at Full Reservoir (MW)	Draft (MGD)	Location	Completion Date
Upcountry				
Kirkwood Powerhouse	125	820	Tuolumne County	1964
Moccasin Powerhouse	110	860	Tuolumne County	1925/1969
Moccasin Low Head Powerhouse	2.9	265	Tuolumne County	1986

Table A-13: Penstocks

Asset	Total Length (mi)	Location	Completion Date
Upcountry			
Kirkwood Penstock	0.37	Tuolumne County	1964
Moccasin Penstock	1.1	Tuolumne County	1925/portions in 1969
Moccasin Low Head Penstock	0.5	Tuolumne County	1986

Table A-14: Watershed and Lands Management – Structures (Non-Operations)

Asset	Status	Type	Location
Bay Area			
North San Andreas Cottage	Active	Watershed Keeper Residence	San Mateo County
San Andreas Cottage	Active	Watershed Keeper Residence	San Mateo County
Sawyer Camp Cottage	Active	Watershed Keeper Residence	San Mateo County
Pilarcitos Cottage	Active	Watershed Keeper Residence	San Mateo County
Davis Tunnel Cottage	Active	Watershed Keeper Residence	San Mateo County
Lower Crystal Springs Cottage	Decommissioned	Watershed Keeper Residence	San Mateo County
Cypress Work Center	Active	Former Cottage – now	San Mateo County

Asset	Status	Type	Location
		Natural Resources offices, work and meeting center	
Upper Crystal Springs Cottage	Active	Watershed Keeper Residence	San Mateo County
Crystal Springs Cottage	Active	Watershed Keeper Residence	San Mateo County
Niles Cottage	Decommissioned	Watershed Keeper Residence	Alameda County
Sunol Yard Cottage	Active	Watershed Keeper Residence	Alameda County
Irvington Cottage	Active	Watershed Keeper Residence	Alameda County
San Antonio Cottage	Active	Watershed Keeper Residence	Alameda County
Alameda East Cottage	Active	Watershed Keeper Residence	Alameda County
Calaveras No. 1 Cottage	Decommissioned	Watershed Keeper Residence	Alameda County
Calaveras No. 2 Cottage	Decommissioned	Watershed Keeper Residence	Alameda County
Polhemus Fluoride Building	Active	Emergency Supply Stockpile and Staging Site	San Mateo County
Mt. Allison	Active	Radio Repeater Site	San Mateo County
Sawyer Ridge	Active	Radio Repeater Site	Alameda County
Pulgas Water Temple	Active	Public Grounds	San Mateo County
Sunol Water Temple	Active	Public Grounds	Alameda County
Tesla Cottage	Active	Operators Residence	San Joaquin County
Andrade Road Cottage	Active	Watershed Keeper Residence	Alameda County
Upcountry			
O'Shaughnessy Office and cottages	Active	Office, other, residence for HHWP essential personnel and NPS	Tuolumne County
O'Shaughnessy UV Treatment Plant	Active	Water treatment	Tuolumne County
Early Intake Cottages and Bunkhouse	Active	Office, other, residence for HHWP essential personnel and NPS	Tuolumne County
Kirkwood Powerhouse	Active	Powerhouse	Tuolumne County
Holm Powerhouse	Active	Powerhouse	Tuolumne County
Canyon Portal Valvehouse	Active	Valvehouse	Tuolumne County
Granite Portal	Active	Valvehouse	Tuolumne County

Asset	Status	Type	Location
Valvehouse			
Cherry Creek Diversion Dam Structures	Active	Gatehouse	Tuolumne County
Lake Eleanor Cottage and Bunkhouse	Active	Office and residence for NPS	Tuolumne County
Cherry Cottages and Bunkhouse	Active	Office, residence for HHWP essential personnel, USFS, NPS	Tuolumne County
Cherry Valvehouse	Active	Valvehouse	Tuolumne County
Burnout Ridge Radio Site	Active	Radio Site	Tuolumne County
Intake Ridge Radio Site	Active	Radio Site	Tuolumne County
Poopenaut Pass Radio Site	Active	Radio Site	Tuolumne County
Cherry Compound Memocor	Active	Water treatment	Tuolumne County
Early Intake UV Treament Plant	Active	Water treatment	Tuolumne County
Duckwall Radio Site	Active	Radio Site	Tuolumne County
Albers Rd Valve House	Active	Valvehouse	Stanislaus County
Alameda Valvehouse	Active	Valvehouse	Alameda County
Cashman Creek Valve House	Active	Valvehouse	Stanislaus County
Emery Road Crossover AUX Control Building	Active	Valvehouse	Stanislaus County
Emery Road Crossover Valve House	Active	Valvehouse	Stanislaus County
Intake Switchyard Control Building	Active	Power transmission control	Tuolumne County
Mather Cabins	Active	Other and residence for NPS	Tuolumne County
Moccasin Camp Offices and Cottages	Active	Office, other, residence for HHWP essential personnel	Tuolumne County
Moccasin Powerhouse	Active	Powerhouse	Tuolumne County
Moccasin UV Treament Plant	Active	Water treatment	Tuolumne County
Moccasin Peak Radio Site	Active	Radio Site	Tuolumne County
Oakdale Office	Active	Office	Stanislaus County
Oakdale Portal Valvehouses	Active	Valvehouse	Stanislaus County
Pelican Crossover Valvehouse	Active	Valvehouse	Stanislaus County

Asset	Status	Type	Location
Roselle Crossover Valvehouse	Active	Valvehouse	Stanislaus County
Rock River Cottage	Active	Residence for HHWP essential personnel	Tuolumne County
Rock River Lime Plant	Active	Water treatment	Tuolumne County
San Joaquin Valvehouse	Active	Valvehouse	Stanislaus County
Priest Cottage	Active	Residence for HHWP essential personnel	Tuolumne County
West Portal Cottage	Active	Residence for HHWP essential personnel	Tuolumne County
South Fork Yard Office and Building	Active	Office and shop	Tuolumne County
Tesla Chlorination Building	Active	Water treatment	San Joaquin County
Tesla Portal Valvehouses	Active	Valvehouse	San Joaquin County
West Portal Valvehouse	Active	Valvehouse	Tuolumne County
Old Moccasin Powerhouse	Not Active	vacant	Tuolumne County
Warnerville Switchyard Control Building	Active	Power transmission control	Stanislaus County
Warnerville Cottages	Active	Residence for HHWP essential personnel	Stanislaus County
Warnerville Shops	Active	Office and shop	Stanislaus County

Table A-15: Buildings and Watersheds – Quarries

Asset	Size (ac)	Location	Purpose
Bay Area			
Casey Quarry	1	San Mateo County	
Skyline Quarry	16	San Mateo County	Emergency Supply Stockpile and Staging
Donovan Quarry	66	Redwood City	Emergency Supply Stockpile

Table A-16: Buildings and Grounds – Corporation Yards

Asset	Size (ac)	Location
Bay Area		
Millbrae Corporation Yard	10	Millbrae
Sunol Corporation Yard	25	Sunol
Upcountry		
Moccasin	6	Moccasin
South Fork Maintenance Yard	1.5	Tuolumne County
Warnerville Yard	2	Oakdale
Oakdale Yard	NA	Oakdale

Table A-17: Rolling Stock

Asset	Quantity
Bay Area	
Passenger Cars	28
Light Duty Trucks	192
Heavy Equipment	111
Trailer Equipment	87
Other Equipment	36
Boats	23
Upcountry	
Passenger Cars	2
Light Duty Trucks, SUVs, Vans	111
Heavy Equipment	28
Trailer Equipment, Equipment on Trailers	62
Other Equipment - Boats	9
Medium & Heavy Duty Trucks	20

Table A-18: Seismic Upgrades

Facility	Date of Completion	Seismic Upgrade
Bay Area		
Tesla Portal	2011	New chemical feed facilities.
Thomas Shaft Chlorination Facility	2011	Built to recent seismic standards, with SCADA remote control. New vent structure.
Alameda East Portal	2011	Seismically upgraded portal with new Alameda Siphon Nos. 2, 3, and 4 connections. New Coast Range Tunnel ventilation system. New overflow pipeline.
Alameda Siphons	2011	New seismically upgraded siphon (No. 4). Seismically upgraded siphons from mixing chamber to Alameda West Portal. Seismically activated isolation valves. New chemical injection facilities
Sunol Valley WTP	2013	Structural and worker safety upgrades and seismic closure valves on all chemical tanks. New emergency generator and fuel tank. Expansion improvements to increase sustainable capacity New treated water reservoir and chlorine contact tank New chemical storage and feed facilities New plant discharge-associated piping
Sunol Yard	2008	Pipe rolling facility for emergency pipeline repair.
San Antonio Pump Station	2011	Seismic upgrades for worker safety. Emergency generator for electric pumps. Replacement of three electrical pump casings
San Antonio Reservoir	2010	SCADA controlled reservoir outlet closure system.
Calaveras Reservoir	2018	New Dam, outlet structure and spillway.
New Irvington Tunnel	2015	Remote controlled valve actuators. Emergency generator.
BDPLs	2011 2011 2007 2012 2011 2012	Seismic upgrade at Hayward Fault, including automatic shutoff valves and reinforced pipeline (No. 1 and 2). Flexible hose connection manifolds across Hayward Fault (No. 1 and 2). Hydraulic Isolation Valves at Hayward Fault (Nos. 3 and 4). Crossover facilities between Nos. 3 and 4 at Barron Creek, Guadalupe River and Bear Gulch. New East Bay pipeline (No. 5) New Peninsula pipeline (No. 5)

Facility	Date of Completion	Seismic Upgrade
	2012 2012 2014	New crossover facilities, isolation valves, and interconnections (No. 5) New control building and emergency generators New Bay Tunnel
EBMUD Intertie	2007	New piping, valving, and pump station – including emergency generator.
SCVWD Intertie	2004	New piping, valving, and pump station – including emergency generator.
Pulgas Valve Lot	2012	Secondary line valves with SCADA remote control New generator
Pulgas Reservoir / Pump Station	2009	Redundant discharge valve.
Pulgas Discharge Channel	2009	Seismic upgrade.
Pulgas Balancing Reservoir	2011	Seismic upgrade to walls and roof.
Pulgas Dechlor Facility	2012	New common inlet and outlet piping Improvements to process control and chemical feed systems and sampling systems
HTWTP	2015	Chemical tank seismic closure valves. Seismic structural upgrades to filters Employee safety seismic upgrades
New Crystal Springs Bypass Tunnel	2011	New tunnel under fault slip and landslide zone. New isolation valves and vaults New standby power
Capuchino Valve Lot	2008	New isolation valves and actuators Valve vault repairs New instrumentation and control systems High pressure zone supply to low pressure zone.
Peninsula Pipelines Seismic Upgrades	2015 2015 2017	Phase 1 - Serra Fault and Colma Creek mitigation measures Phase 2 - New isolation valves and actuators Phase 3 (in progress) - New isolation valves and mitigation of liquefaction in Stern Grove
Baden Valve Lot /Pump Station	2011	Emergency generators New pressure-reducing valves for redundant high pressure zone supply to low pressure zone New isolation valves Seismic upgrade
Millbrae Corporation Yard and Lab	2010	Emergency generator and seismic upgrade.

Facility	Date of Completion	Seismic Upgrade
San Pedro Valve Lot	2011	Seismic upgrade
Sunset Reservoir North Basin	2008	Seismic upgrade of north basin.
University Mound North Reservoir	2011	Seismic upgrade of north basin
Upcountry		
None in 2015/2016		

Appendix B: Emergency Response and Preparedness Plans

List below are the relevant emergency response plans that directly relate to the RWS. Plans not listed below include state-level plans, county-level plans, and some division- or bureau-specific contingency plans.

Table B: Relevant Emergency Response Plans for the Regional Water System

Plan	Draft/Revision Date
Regional Water System Emergency Pipeline Repair Recovery and Readiness Program (EPRRRP)	2004
City and County of San Francisco Emergency Operations Plan	2007
Risk Management Plan – California Accident Release Prevention Program for HTWTP	2007
Cryptosporidium Detection Action Plan	2008
Spill Prevention, Control, and Countermeasure Plan – San Antonio Pump Station	2009
Sunol Valley Chloramination Facility and Water Treatment Plant Hazardous Materials Business Plans	2009
Water Quality Notifications and Communications Plan (Rev. 5)	2010
Water Contamination and Response & Consequence Management Plan	2012
Regional Water System Emergency Disinfection & Recovery Plan	2012
SFPUC Emergency Operations Plan	2012
Water Supply & Treatment Division (WSTD) Emergency Operations Plan	2013
Natural Resources and Lands Management Division (NRLMD) Emergency Operations Plan	2013
SFPUC Continuity of Operations Plan and Annexes	2014
Mountain Tunnel Emergency Restoration Plan	2014
Emergency Action Plans – DSOD Jurisdictional Dams	2016
Water Quality Division (WQD) Emergency Operations Plan and supplemental Field Operations Guide (FOG)	2016
Moccasin Overflow Emergency Response Plan – Moccasin Wastewater Treatment Plant	2016

Appendix C: Condition Assessment Priorities

Table C-1: Existing Non-Linear and Linear Asset Assessment Schedule

Non-Linear Asset Tier	Asset Name	Asset Class	Completion Date of Last Assessment	Scheduled Date of Next Assessment	Number of Asset in Maximo	Number of Asset in Maximo w/ PM	Notes
1	Tesla Treatment Facility	Treatment Plant	July, 2013	June, 2017	651	546	Newly built by WSIP
1	Baden Pump Station	Pump Station	July, 2014	July, 2017	204	82	Significant upgrades performed under WSIP
1	Pulgas Dechloramination Facility	Field Facility	August, 2014	August, 2017	317	93	
1	Pulgas Pump Station	Pump Station	September, 2014	September, 2017	91	55	
1	Alameda East Portal	Tunnel/ Pipeline	June, 2009	October, 2017	47	18	
1	Alameda West Portal	Tunnel/ Pipeline	June, 2009	October, 2014	36	14	
1	San Antonio Pump Station	Pump Station	June, 2009	November, 2017	188	105	Significant upgrades performed under WSIP
1	Pulgas Balancing Reservoir	Reservoir	August 2012	December, 2018	1	0	Significant upgrades performed under WSIP
1	Pulgas Valve Lot	Valve Lot	June, 2009	December, 2017	62	32	
1	San Pedro Valve Lot	Valve Lot	November, 2010	January, 2018	32	16	Significant upgrades performed under WSIP
1	Baden Valve Lot	Valve Lot	December, 2011	January, 2018	36	33	
1	San Antonio Dechlorination Facility	Field Facility	June, 2009	November, 2017	30	1	

1	Sunol Valley Water Treatment Plant	Treatment Plant	February, 2014	February, 2017	2186	634	Significant upgrades performed under WSIP
1	Sunol Valley Chloramination Facility	Field Facility	January, 2014	January 2017	273	109	Not currently scheduled until after construction
1	HTWTP	Treatment Plant	March, 2009	TBD	3281	1359	Not currently scheduled until after construction
1	Thomas Shaft	Field Facility	May, 2009	March, 2017	121	19	
1	New Crystal Springs Pump Station	Pump Station	Under Construction	TBD	92	86	Not currently scheduled until after construction.
2	Millbrae Yard	Corporation Yard	July, 2010	July, 2018	219	113	
2	Sunol Yard	Corporation Yard	July, 2009	TBD	63	38	currently scheduled for replacement
1	Upper Alameda Creek Diversion Dam	Dam	December,2010	TBD	5	2	currently scheduled for upgrade
1	Calaveras Dam	Dam	July, 2010	TBD	13	8	Dam scheduled to be replaced under WSIP
1	Crystal Springs Dam	Dam	July, 2016	TBD	4	2	Significant upgrades performed under WSIP
1	Pilarcitos Dam	Dam	July, 2016	July, 2017	6	1	Annual inspection, per DSOD
1	San Andreas Dam	Dam	July, 2016	July, 2017	8	7	Annual inspection, per DSOD
1	Stone Dam	Dam	July, 2016	July, 2017	2	1	Annual inspection, per DSOD
1	Turner Dam	Dam	July, 2016	July, 2017	8	4	Annual inspection, per DSOD
2	Lawrence Livermore Lab Site 300 Treatment Facility	Field Facility	May, 2010	May, 2017	16	10	
2	EBMUD Intertie	Intertie	March, 2011	Mach, 2017	2	0	
2	SCVWD Intertie	Intertie	January, 2011	January, 2017	185	15	
2	Calaveras Reservoir	Reservoir	-----	-----	62	19	Daily inspections by watershed staff
2	Lower Crystal Springs	Reservoir	-----	-----	19	13	Daily inspections by watershed

	Reservoir						staff
2	Pilarcitos Reservoir	Reservoir	-----	-----	24	14	Daily inspections by watershed staff
2	San Andreas Reservoir	Reservoir	-----	-----	11	9	Daily inspections by watershed staff
2	San Antonio Reservoir	Reservoir	-----	-----	19	10	Daily inspections by watershed staff
2	Upper Crystal Springs Reservoir	Reservoir	-----	-----	2	1	Daily inspections by watershed staff
2	Mount Allison Radio Station	Structure (non op)	August, 2010	August, 2017	0	0	
2	Sawyer Ridge Radio Station	Structure (non op)	August, 2010	August, 2017	7	3	
2	Bellevue & Pepper Valve Lot	Valve Lot	August, 2010	August, 2017	27	16	
2	Caisson	Valve Lot	August, 2010	August, 2017	11	7	
2	Calaveras Valve Lot	Valve Lot	August, 2010	August, 2017	3	3	
2	Capuchino Valve Lot	Valve Lot	August, 2010	August, 2017	27	14	
2	Crawford Valve Lot	Valve Lot	August, 2010	August, 2017	6	0	
2	Dumbarton Valve Lot	Valve Lot	August, 2010	August, 2017	10	9	
2	Edgewood Road Valve Lot	Valve Lot	October, 2010	October, 2017	2	1	
2	Geneva Valve Lot	Valve Lot	October, 2010	October, 2017	8	3	
2	Grimmer Shutoff Station	Valve Lot	October, 2010	October, 2017	6	0	
2	Mountain View/Alviso Valve Lot	Valve Lot	October, 2010	October, 2017	7	1	
2	Newark Tunnel Shaft	Valve Lot	No documented inspection	September, 2017	0	0	
2	Newark Valve Lot	Valve Lot	October, 2010	October, 2017	6	5	

2	Paseo Padre Shutoff Station	Valve Lot	September, 2010	September, 2017	5	0	
2	Polhemus Valve Lot	Valve Lot	March, 2011	August, 2017	10	4	
2	Ravenswood Tunnel Shaft	Valve Lot	No documented inspection	October, 2017	0	0	
2	Ravenswood Valve Lot	Valve Lot	August, 2010	August, 2017	5	5	
2	Redwood City Valve Lot	Valve Lot	October, 2010	October, 2017	7	4	
2	Tissiack Valve Lot	Valve Lot	October, 2010	October, 2017	5	0	
3	San Mateo Creek Dam No. 1 (Mud Dam No. 1)	Dam	August, 2010	August, 2017	1	1	
3	San Mateo Creek Dam No. 2 (Mud Dam No. 2)	Dam	August, 2010	August, 2017	5	3	
3	Casey Quarry	Quarry	August, 2010	August, 2017	14	6	
3	Skyline Quarry	Quarry	-----	Not currently scheduled	4	2	No inspection needed
3	Castlewood Reservoir	Reservoir	October, 2010	October, 2017	11	6	
3	Niles Reservoir	Reservoir	No documented inspection	Not currently scheduled	1	1	Plan for demolition
3	Town of Sunol Distribution System	Town of Sunol	June, 2016	June, 2019	281	28	
3	Crystal Springs/El Cerrito Valve Lot	Valve Lot	May, 2011	June, 2017	6	0	
3	El Camino Real/Bellview Valve Lot	Valve Lot	May, 2011	June, 2017	6	5	
3	El Camino Real/Millbrae Yard Valve Lot	Valve Lot	May, 2011	June, 2017	15	7	
3	Hillsborough Valve Lot	Valve Lot	July, 2010	August, 2017	28	12	

3	Mission and Palm Avenue Valve Lot	Valve Lot	September, 2010	September, 2017	4	2	
3	Sneath Lane Valve Lot	Valve Lot	August, 2010	August, 2017	2	0	
3	Southwest Corner Valve Lot (Stanford Tunnel)	Valve Lot	June, 2011	June, 2017	0	0	
3	Taylor Field Valve Lot	Valve Lot	May, 2009	October, 2017	0	0	
3	West Valve House (Stanford Tunnel)	Valve Lot	August, 2010	August, 2017	0	0	
3	East Bay Wells	Well	May, 2009	October, 2017	10	1	

Table C-2: 20-Year Pipeline Inspection Schedule

									INSPECTION PRIORITY SCORE[25]						
									0.45	0.15	0.15	0.15	0.05	0.05	1.00
Pipeline	**Section**	**Date Last Inspection**	**Date Next Inspection**	**Miles**	**Type**	**Matl.**	**Year Built**	**Dia.**	**Matl.**	**Pop. Density**	**Age**	**Dia.**	**Pipeline PSI**	**Pipeline= 5 Adit=4 Tunnel=1**	**SCORE TOTAL**
San Antonio Pipeline	W20 to Y20	7/1/2008	8/3/2016	2.07	Pipeline	PCCP	1967	60	5	1	2.7	2	0.9	5	
Bay Tunnel (Initial Service Inspection)	E20U to E50U, B50U and A50U		8/24/2016	5.14	Tunnel	Steel	2015	108	1	1	1	5		1	
BDPL No. 4	D50 to D68	5/1/2007	4/1/2017	7.86	Pipeline	PCCP	1967	84-96	5	5	2.7	5	3	5	
CSPL No. 3	L30 to L41K	4/1/2006	4/1/2017	3.61	Pipeline	PCCP	1971	60	5	5	2.5	2	2.9	5	
Alameda Siphon 3	X20 to X22 and X25	7/1/2008	4/1/2017	0.55	Siphon	PCCP	1967	96	5	1	2.7	5	0.5	5	
BDPL No. 3 Crossover Pipeline (Initial Service Inspection)	I-680		7/1/2017	0.41	Pipeline	Steel	2014	78	1	5	1.1	3.5	2.5	5	

[25] See Appendix E for Pipeline Inspection Priority Scoring and Techniques

									INSPECTION PRIORITY SCORE[25]						
									0.45	0.15	0.15	0.15	0.05	0.05	1.00
Pipeline	**Section**	**Date Last Inspection**	**Date Next Inspection**	**Miles**	**Type**	**Matl.**	**Year Built**	**Dia.**	**Matl.**	**Pop. Density**	**Age**	**Dia.**	**Pipeline PSI**	**Pipeline= 5 Adit=4 Tunnel=1**	**SCORE TOTAL**
Crystal Springs Bypass Pipeline	G34 to G41		7/1/2017	0.81	Pipeline	PCCP	1970	96	5	2	2.6	5	1.5	5	**40.15**
Balancing Reservoir Pipeline	All	10/1/2005	10/1/2017	0.21	Pipeline	PCCP	1975	96	5	1	2.4	5	0.1	5	
San Andreas Pipeline 2	R12 to R50		1/1/2018	3.32	Pipeline	Lock-bar / Steel	1927-1928	54	2	5	4	1.6	5	5	**29.90**
CSPL No. 3	P48 to L59K	7/1/2008	4/1/2018	2.54	Pipeline	PCCP	1987	60	5	5	2	2	2.9	5	
San Andreas Pipeline 1	P10 to Baden		4/1/2018	4.41	Pipeline	Steel	1898	44	2	5	5	0.7	2.9	5	**29.80**
San Andreas Pipeline 2	R60 to City Distribution Division (CDD)		10/1/2018	1.70	Pipeline	Lock-bar / Steel	1927-1928	54	2	5	4	1.6	3.7	5	**29.25**
BDPL No. 4	D30 to D40		1/1/2019	8.19	Pipeline	Steel	1965-1973	84-96	1	5	2.7	5	3.7	5	**27.90**
BDPL No. 3	C30 to C40		4/1/2019	8.19	Pipeline	Steel	1952	72-78	1	5	3.2	3.5	3.6	5	**26.35**
BDPL No. 3	C50 to C70		7/1/2019	7.84	Pipeline	RCP	1952	72-78	1	5	3.2	3.5	3	5	**26.05**
BDPL No. 2	B60 to B70		10/1/2019	3.97	Pipeline	Steel	1935	66	1	5	3.8	2.5	3.9	5	**25.90**
Hillsborough Tunnel & Sunset Supply Pipeline	M20 to M30		1/1/2020	2.35	Tunnel / Pipeline	Steel	1955-1958	78-90	1	5	3.1	3.5	2.5	5	**25.65**
CSPL No. 2	K50 to K60		7/1/2020	2.54	Pipeline	Steel	1937	60	1	5	3.7	2	3	5	**24.55**
CSPL No. 2	K40 to K50		10/1/2029	3.86	Pipeline	Steel	1937	54-60	1	5	3.7	2	2.9	5	**24.50**
BDPL No. 1	A60 to A70	10/1/2001	10/1/2020	3.97	Pipeline	Steel	1933	60	2	5	3.8	2	3.9	5	
Sunset Supply Pipeline	M30 to M40		1/1/2021	3.62	Pipeline	Steel	1954-1958	60	1	5	3.1	2	2.9	5	**23.60**
Sunset Supply Pipeline	M60 to CDD		4/1/2021	1.95	Pipeline	Steel	1954-1958	60	1	5	3.1	2	2.7	5	**23.50**
Sunset Supply Pipeline	M50 to M60		7/1/2021	3.41	Pipeline	Steel	1954-1958	60	1	5	3.1	2	2.6	5	**23.45**
CSPL No. 2	K60 to CDD	8/1/2002	4/1/2020	3.68	Pipeline	Steel	1937/1956	60	1	5	3.7	2	3	5	

									INSPECTION PRIORITY SCORE[25]						
									0.45	0.15	0.15	0.15	0.05	0.05	1.00
Pipeline	**Section**	**Date Last Inspection**	**Date Next Inspection**	**Miles**	**Type**	**Matl.**	**Year Built**	**Dia.**	**Matl.**	**Pop. Density**	**Age**	**Dia.**	**Pipeline PSI**	**Pipeline= 5 Adit=4 Tunnel=1**	**SCORE TOTAL**
San Andreas Pipeline 3	T11 to T50		10/1/2022	3.17	Pipeline	Steel	1994	54-60	1	5	2.2	2	5	5	**23.30**
San Andreas Pipeline 3	T50 to T60		4/1/2022	3.38	Pipeline	Steel	1997	54-60	1	5	2.2	2	4.9	5	**23.25**
BDPL No. 4	D10 to D20	1/1/2013	1/1/2022	8.52	Pipeline	PCCP	1967	96	5	5	2.7	5	4	5	
Alameda Siphon 2	X10 to X15	2/1/2003	7/1/2022	0.55	Siphon	Steel	1953	90	1	1	3.1	4.5	0.5	5	
Sunset Supply Pipeline	M10 to M20		7/1/2022	1.35	Pipeline	Steel	1954-1958	78-90	1	2	3.1	4.5	1.5	5	**22.15**
Palo Alto Pipeline	F6 to F60		10/1/2022	5.36	Pipeline	Steel	1938	36	1	5	3.7	0.1	3.6	5	**22.00**
Stanford Tunnel	C40 & D40 to C50 & D50		1/1/2023	0.33	Tunnel	Steel	1952	90	1	3	3.2	4.5		1	**21.05**
San Andreas Raw Water Pipeline 2	N25 to R12		4/1/2023	0.16	Adit	Steel	2010	72	1	5	1.2	3		4	**20.30**
Pulgas Tunnel	Water Temple to A70, B70, C70, D68 and E70		1/1/2024	2.24	Tunnel	Steel	1967	123	1	2	2.7	5		1	**19.55**
San Andreas Raw Water Pipeline 3	N35 to N51		4/1/2023	0.58	Adit	Steel	2010	72	1	5	1.2	3		4	**20.30**
CSPL No. 1	J60 to CDD		7/1/2023	3.86	Pipeline	Steel	1956	44	1	4	3	0.7	3	5	**20.05**
Calaveras Pipeline	V34 to SVWTP		10/1/2024	3.96	Pipeline	Steel	1992	44	1	1	1.8	0.7	4.3	5	**14.40**
San Mateo Creek Dam Pipeline and Tunnel 2	All		10/1/2024	1.61	Tunnel / Pipeline	Steel	1937	48	1	1	3.7	1.1		1	**13.70**
San Antonio Reservoir Pipeline Adit	V27 to Y20		10/1/2024	0.27	Adit	Steel	1967	42	1	1	2.7	0.6		4	**12.95**
Crystal Springs Outlet Tunnel 1	H12 to H87	7/1/2005	7/1/2025	0.10	Outlet Tunnel	Steel	1891	44	1	1	5	0.7		4	
Crystal Springs Outlet Tunnel 2	H23 to H82	7/1/2005	7/1/2025	0.13	Outlet Tunnel	Steel	1931	54	1	1	3.9	1.6		4	

									INSPECTION PRIORITY SCORE[25]						
									0.45	0.15	0.15	0.15	0.05	0.05	1.00
Pipeline	**Section**	**Date Last Inspection**	**Date Next Inspection**	**Miles**	**Type**	**Matl.**	**Year Built**	**Dia.**	**Matl.**	**Pop. Density**	**Age**	**Dia.**	**Pipeline PSI**	**Pipeline= 5 Adit=4 Tunnel=1**	**SCORE TOTAL**
BDPL No. 4	D50 to D68		10/1/2025	7.86	Pipeline	PCCP	1967	84-96	5	5	2.7	5	3	5	
San Antonio Pipeline	W20 to Y20		1/1/2026	2.07	Pipeline	PCCP	1967	60	5	1	2.7	2	0.9	5	
Alameda Siphon 3	X20 to X22 and X25		1/1/2026	0.55	Siphon	PCCP	1967	96	5	1	2.7	5	0.5	5	
Balancing Reservoir Pipeline	All		1/1/2026	0.21	Pipeline	PCCP	1975	96	5	1	2.4	5	0.1	5	
CSPL No. 3	L30 to L41K		1/1/2026	3.61	Pipeline	PCCP	1971	60	5	5	2.5	2	2.9	5	
CSPL No. 3	P48 to L59K		1/1/2026	2.54	Pipeline	PCCP	1987	60	5	5	2	2	2.9	5	
Crystal Springs Bypass Pipeline	G34 to G41		7/1/2017	0.81	Pipeline	PCCP	1970	96	5	2	2.6	5	1.5	5	
BDPL No. 3	C10 to C20	3/1/2007	4/1/2027	8.55	Pipeline	RCP	1952	72-78	1	5	3.2	3.5	4	5	
Sunset Supply Pipeline	M40 to M50	11/1/2007	7/1/2027	3.66	Pipeline	Steel	1954-1958	60	1	5	3.1	2	2.8	5	
BDPL No. 1	A50U to A60	3/1/2009	10/1/2028	4.92	Pipeline	Steel	1933	60	1	5	3.8	2	4.1	5	
BDPL No. 4	D20 to D30	12/1/2009	1/1/2029	8.96	Pipeline	Steel	1965-1973	84-96	1	5	2.7	5	4.1	5	
BDPL No. 3	C20 to C30	3/1/2010	4/1/2029	8.96	Pipeline	Steel	1952	72-78	1	5	3.2	3.5	4.1	5	
San Andreas Pipeline 2	R50 to R60	6/1/2010	7/1/2029	3.38	Pipeline	Lock-bar / Steel	1927-1928	54	2	5	4	1.6	4.9	5	
Alameda Siphon 1	X30 to X35	10/1/2010	1/1/2030	0.56	Siphon	RCP	1933	69	1	1	3.8	2.8	0.5	5	
BDPL No. 2	A10 to A20	10/1/2010	4/1/2030	7.12	Pipeline	RCP & Steel	1935	66	1	5	3.8	2.5	4.1	5	
Crystal Springs Bypass Tunnel	G20 to G32 & G34	1/1/2011	1/1/2030	3.12	Tunnel	Steel	1970	114	1	4	2.6	5		1	
New Crystal Springs Bypass	G32 to G36		10/1/2030	0.80	Pipeline	Steel	2012	96	1	2	1.1	5	1.5	5	
BDPL No. 1	B10 to B20	3/1/2011 & 8/1/2015	7/1/2018	7.11	Pipeline	RCP & Steel	1933	60	2	5	3.8	2	4.1	5	

									INSPECTION PRIORITY SCORE[25]						
									0.45	0.15	0.15	0.15	0.05	0.05	1.00
Pipeline	**Section**	**Date Last Inspection**	**Date Next Inspection**	**Miles**	**Type**	**Matl.**	**Year Built**	**Dia.**	**Matl.**	**Pop. Density**	**Age**	**Dia.**	**Pipeline PSI**	**Pipeline= 5 Adit=4 Tunnel=1**	**SCORE TOTAL**
BDPL No. 4	D10 to D20		7/1/2030	8.52	Pipeline	PCCP	1967	96	5	5	2.7	5	4	5	
San Andreas Pipeline 3	T60 to CDD		1/1/2031	1.94	Pipeline	Steel	2012	36	1	5	1.1	0.1	3.7	5	
BDPL No. 5	E60 to E70		4/1/2031	4.00	Pipeline	Steel	2013	60	1	5	1.1	2	3.9	5	
BDPL No. 5	E50U to Redwood City Valve Lot		7/1/2031	4.93	Pipeline	Steel	2013	60	1	5	1.1	2	4.1	5	
BDPL No. 5	New Irvington Tunnel to Newark Valve Lot		10/1/2031	7.01	Pipeline	Steel	2013	72	1	5	1.1	3	4.1	5	
Alameda Siphon 4	All		1/1/2032	0.54	Siphon	Steel	2013	66	1	1	1.1	2.5	0.5	5	
Sunset Branch	N42 to M41	10/1/2013	4/1/2032	1.11	Pipeline	Steel	1954	61	1	5	3.1	2.1	2.7	5	
CSPL No. 2	K10 to K20	5/21/2014	7/1/2032	2.36	Pipeline	Steel	1937	54-60	1	3	3.7	2	2.3	5	
BDPL No. 2	B50U to B60	7/1/2015	1/1/2033	4.92	Pipeline	Steel	1935	66	1	5	3.8	2.5	4.1	5	
Sunol Valley Water Treatment Plant 78" Effluent Pipeline	All	9/1/2015	4/1/2033	1.59	Pipeline	Steel	1966	78	1	1	2.7	3.5	0.7	5	
Calaveras Pipeline		9/1/2015	7/1/2033	1.63	Pipeline	Steel	1966	66	2	1	2.7	2.5		5	
Irvington Tunnel 1	All	4/4/2015	10/1/2033	3.48	Tunnel	Steel	1933	126	1	2	3.8	5		1	
San Antonio Backup Pipeline	All		1/1/2034	1.32	Pipeline	Steel	2015	66	1	1	1	2.5	0.4	5	
Crystal Springs San Andreas Force Main	H83 to San Andreas		4/1/2034	4.50	Force Main	Steel	2015	60	1	2	1	2		5	
Irvington Tunnel 2	All		10/1/2034	3.59	Tunnel	Steel	2015	102	1	2	1	5		1	
BDPL No. 4	D50 to D68		1/1/2035	7.86	Pipeline	PCCP	1967	84-96	5	5	2.7	5	3	5	
San Antonio Pipeline	W20 to Y20		1/1/2035	2.07	Pipeline	PCCP	1967	60	5	1	2.7	2	0.9	5	

									INSPECTION PRIORITY SCORE[25]						
									0.45	0.15	0.15	0.15	0.05	0.05	1.00
Pipeline	**Section**	**Date Last Inspection**	**Date Next Inspection**	**Miles**	**Type**	**Matl.**	**Year Built**	**Dia.**	**Matl.**	**Pop. Density**	**Age**	**Dia.**	**Pipeline PSI**	**Pipeline= 5 Adit=4 Tunnel=1**	**SCORE TOTAL**
Alameda Siphon 3	X20 to X22 and X25		1/1/2035	0.55	Siphon	PCCP	1967	96	5	1	2.7	5	0.5	5	
Balancing Reservoir Pipeline	All		1/1/2035	0.21	Pipeline	PCCP	1975	96	5	1	2.4	5	0.1	5	
CSPL No. 3	L30 to L41K		1/1/2035	3.61	Pipeline	PCCP	1971	60	5	5	2.5	2	2.9	5	
CSPL No. 3	P48 to L59K		1/1/2035	2.54	Pipeline	PCCP	1987	60	5	5	2	2	2.9	5	
Crystal Springs Bypass Pipeline	G34 to G41		1/1/2035	0.81	Pipeline	PCCP	1970	96	5	2	2.6	5	1.5	5	
Calaveras Pipeline Adit	Calaveras Reservoir to V34	6/7/2016	1/1/2036	0.28	Adit	Steel	2016	72	1	1	1	3		4	

Appendix D: Condition Assessment Tables

Table D-1: Inventory and Condition of Active Pipelines and Tunnels

Bay Area:

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
San Antonio	PCCP	Cement	Concrete	1 pipe section ruptured (2003); 1 leak in 2014.	~300 ft. of pipe replaced with Welded Steel Pipe (WSP) for joint separation from the Calaveras Fault (1998); three pipe segments replaced with WSP to repair damage from pipe burst (2003); 2 segments repaired with WEKO-SEAL in (2014).
Calaveras	Welded steel	Cement	Cement	No documented leaks	Original 1924 pipeline reconstructed from Calaveras Dam to SVWTP in 1992
Alameda Creek Siphon No. 1	RCP	Cement	Concrete	No documented leaks	Valve X32 installed to back up valve X30 (2005)
Alameda Creek Siphon No. 2	Welded steel	Coal tar	Coal tar	No documented leaks	Valve X14 installed to regulate flow from Sunol Valley WTP and Coast Range Tunnel (2000). Valve X10 replaced (2010)
Alameda Creek Siphon No. 3	PCCP	Cement	Concrete	No documented leaks	Valve X24 installed to back up valve X25 (2003); valve X20 replaced (2001)
Alameda Creek Siphon No. 4	Welded steel	Cement	Polyuret hane	New pipe	No pipeline modifications or alignments
Sunol Valley WTP 78″ Treated Water	Welded steel	Coal tar	Cement	Pipe failure caused by axial compression due to ground movement along Calaveras Fault in 2015.	~40′ of buckled pipe replaced with welded steel pipe (2015).
Irvington Tunnel	Unreinforced Cast-in-place concrete	Cement	Cement	No documented leaks	No major work has been done.

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
New Irvington Tunnel	Welded steel	Tunnel	Cement mortar	New tunnel	No major work has been done
BDPL No. 1 (all)	Riveted steel (wrought), RCP from Irvington Portal to Irvington Pump Station	Coal tar	Cement mortar	Numerous leaks 1950-56 in Redwood City; several leaks in East Palo Alto; no leaks after 1956.	Cement mortar lining placed over original coal tar lining (1956-60); CP initiated (1953), expanded (1973), and overhauled (1988); isolation valves installed with new pipelines constructed, both sides of Hayward Fault in Fremont, BDPL Nos. 1 and 2 (2001).
BDPL No. 1 Section C	Riveted steel (wrought), RCP from Irvington Portal to Irvington Pump Station	Coal tar	Cement mortar	A section of BDPL No. 1 was scraped by what looks like the teeth of a backhoe. The incident was reported on 10/05/10. A small amount of water leaked into Newark Valve House. The leak was reported on 09/22/11.	Welders installed a patch and filled the groove made by the backhoe after incident was reported on 10/05/10. After the plate was welded, a 1" IPS plug was installed and the pipe was coated. Water was pumped away shortly after 09/22/11, but there were still leaks intermittently. There is limited access to the site since the BDPL5 contractor is working in the area. This section of pipe inside the old Newark Valve House will be abandoned.
BDPL No. 1 Section E	Riveted steel (wrought), RCP from Irvington Portal to Irvington Pump Station	Coal tar	Cement mortar	During BDPL5 work at Pulgas and while BDPL1 was down, a corroded section was discovered and reported on 04/15/11	After 04/15/11, WSTD crews cleaned out existing area around the hole. A new 3/8" insert was made, welded and the plug was polished.

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
BDPL No. 1 Section F	Riveted steel (wrought), RCP from Irvington Portal to Irvington Pump Station	Coal tar	Cement mortar	On-going exposed joint leaks which are not completely repairable	Replaced missing and damaged bolts to mitigate leaks. This section will be abandoned and replaced when the Bay Tunnel comes on line.
BDPL No. 2 (all)	Welded steel and RCP in Newark and East Palo Alto	Coal tar	Cement mortar	Five corrosion leaks during 1950-55 in Redwood City (fewer than BDPL No. 1)	Cement mortar lining placed over original coal tar lining (1956-60); protected by the same corrosion protection described for BDPL No. 1; same isolation valves on Hayward fault as BDPL No. 1; no corrosion leaks since 1955.
BDPL No. 2 Section C	Welded steel and RCP in Newark and East Palo Alto	Coal tar	Cement mortar	BDPL5 Contractor Ranger Pipelines noticed standing water while trenching and excavating around BDPL2 area in Newark. This was reported to WSTD on 07/27/11. Leak at Newark Valve Lot reported on 01/13/11. Contractor Ranger exposed section of the pipe and created a leak.	BDPL2 section was inspected and a leak on the RCCP was found. Interior repairs were made by welding at 2 or 3 joints as needed in August 2011. WSTD crew assessed the leak in January 2011 and repairs were made by contractor.

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
BDPL No. 2 Section F	Welded steel and RCP in Newark and East Palo Alto	Coal tar	Cement mortar	On-going exposed joint leaks which are not completely repairable	Replaced missing and damaged bolts to mitigate leaks. This section will be abandoned and replaced when the Bay Tunnel comes on.
BDPLs - Submarine Sections	Cast iron	Unknown	Cement	No documented leaks	Internal inspection using ROV in all 5 submarine pipes to detect sound of escaping water (2004), no leaks detected. ROV video inspection of 42" Submarine 1 (1995), no visual anomalies, all joints tight.
BDPL No. 3 Sec. A	RCP	Concrete	Concrete	No documented leaks	Axial slip joint was constructed across Hayward Fault in 1994; isolation valves were installed both sides of Hayward Fault (2006).
BDPL No. 3 Sec. B	Welded steel	Cement	Cement	No leaks, corrosion protection installed	Relocated beneath Guadalupe River and lowered pipeline for Coyote Creek flood channel by SCVWD (1993-1994). Valve C20 replaced (2005).
BDPL No. 3 Sec. C	Welded steel	Cement	Cement	No documented leaks	San Tomas River crossing relocated on bridge above river (1963).
BDPL No. 3 Sec. D	RCP	Concrete	Concrete	No documented leaks	Added flow control valve C68 (2004).

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
BDPL No. 4 Sec A	PCCP	Cement	Concrete	No documented leaks	Axial slip joint was constructed across Hayward Fault (1994); isolation valves were installed on both sides of Hayward Fault (2005); electromagnetic surveys of pre-stress wire performed in 2005 and in 2013 with no major defective pipes found. Ball pin hammer sounding test in 2013 showed two segments have lost compression. They were replaced with steel pipes.
BDPL No. 4 Sec B	Welded steel	Coal tar	Cement	No leaks, corrosion protection installed 1973	Sections relocated beneath Guadalupe River and lowered pipeline for Coyote Creek flood channel by SCVWD (1993-1994).
BDPL No. 4 Sec C	Welded steel	Coal tar	Cement	No documented leaks	None
BDPL No. 4 Sec D	PCCP	Cement	Concrete	One leak (1991): separation of bell ring from steel cylinder	One distressed section was replaced with steel (1991); one distressed section with reinforced (2007); pre-stress wire tests confirmed results from 2007 electromagnetic survey; installed flow control valve D68 (2004).
BDPL No. 5–East Bay Reaches (E10 to E20)	Welded steel	Cement	Cement	New pipe	No pipeline modifications or alignments
BDPL No. 5 – Peninsula Reaches	Welded steel	Cement	Cement	New pipe	No pipeline modifications or alignments
Bay Tunnel	Welded steel	Tunnel	Cement mortar	New tunnel	No major work has been done

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
Stanford Tunnel	Welded steel pipe in tunnel	Cement Grout	Cement mortar	No documented leaks	None
Palo Alto Pipeline	Welded steel	Coal tar	Coal tar	2 leaks (1960s); major leak in Menlo Park (1990); Pinhole leak caused by corrosion pitting (2014).	Major leak caused by cable contractor scoring 1000' of pipe with wheel cutter (1987), repaired by welding rolled steel plates over score; ~700' relocated in Redwood City, 5th St. for CalTrain grade separation and valves F40 and F45 installed (1994); new connections installed to BDPL Nos. 1 and 2 (2002); repair made with 2" Bonney Flange (2014).
San Mateo Pipeline No. 2	Concrete	Concrete	Concrete	No documented leaks	No major work has been identified. Connection to Crystal Springs to San Andreas Pipeline and golf course was reconstructed (2000).
Pulgas Tunnel	Concrete	Tunnel	Concrete	No documented leaks	None
Crystal Springs Bypass Tunnel	Concrete	Tunnel	Concrete	No documented leaks	None
New Crystal Springs Bypass Tunnel (G32 to G38)	Welded steel	Cellular	Elastomeric Polyurethane	New pipe	No pipeline modifications or alignments
Crystal Springs Bypass Pipeline	PCCP	Cement	Concrete	No documented leaks	Landslide material removed above pipeline after inspection showed minimal deflections.
CSPL No. 1	Welded steel	Coal tar	Cement	No documented leaks	Replaced original 44" section; other segments replaced in Brisbane in 1980s.

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
CSPL No. 2 Sec. A	Welded steel	Coal tar	Coal tar	One leak documented in 1992, four leak repairs found during inspection (Oct. 2000) that pre-date 1990 records. Broken valve flange at blow-off near 891 Crystal Springs Rd. on 2/9/13, replaced flange and valve.	K10 to G42 connection became a stagnant leg after 1970 with Crystal Springs Bypass tunnel & pipeline; CP was installed Crystal Springs Pump Station to El Cerrito Road.
CSPL No. 2 Sec. B	Welded steel	Coal tar	Coal tar	Cluster of 6 leak repairs found during inspection (Nov. 2006), leaks are assumed to pre-date 1990 records.	Original gate valves K30 and K31 were replaced with K30 (2006); added valve K20 (1963).
CSPL No. 2 Sec. C	Riveted steel	Coal tar	Cement	No leak repairs since 1962	Original coal tar lining was replaced with cement mortar (1962).
CSPL No. 2 Sec. D	Welded steel	Coal tar	Coal tar	4 documented leaks in 1970s and 1980s	No significant contract work has been identified.

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
CSPL No. 2 Sec. E	Welded steel	Coal tar	Coal tar	23 leak repairs found with inspection in May 2003; all leaks predate 1990 records. A leak was reported on 10/27/11. Blow out at South San Francisco Elm Street (Service 115) took place on 11/25/11. WSIP project engineering oversight on a new section of the pipe. The design did not call for tie rods at flexible coupling. The section was not restrained, it moved and there was a blow out.	About 50% of leak repairs were located near top of Randolph Ave; rebuilt 163 feet beneath Colma Creek (1980); 200 ft. of coal-tar lining replaced with epoxy (2004). A series of Bonney Flanges were welded on pipeline to repair it after the leaks were reported on 10/27/11. Repairs were finished and the area was backfilled with sand and turned over to Ranger pipelines for paving. WSIP project team brought in an Engineering firm to perform a failure analysis. Project team re-engineered this section and instead of tie rods, the pipe was changed to ductile iron and a thrust block was poured to hold the pipe in place. WSTD crews finished repairs in the middle of June 2012 and the section was put back into service in July 2012.
CSPL No. 2 Sec. F	Welded steel	Coal tar	Coal tar with some cement	17 leak repairs found with inspection (Aug. 2002); most leaks in Brisbane within 1000' of Main St. pre-date 1960.	Re-line ~4900 ft. with cement mortar, Brisbane (1982); relocate ~5000 ft. from trestle over marshes (Brisbane) to Cypress Ln, N. Hill Dr. and Guadalupe Pkwy (1956); rebuilt ~ 1000' along Bayshore Blvd (2002); CP installed Main Street to Geneva Ave., Brisbane to Daly City (1959)

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
Crystal Springs No. 2 Pipeline – Section B (K20 to K30 about 100 ft. of pipe)	Welded steel	Tape Wrapped	Epoxy	New pipe	No pipeline modifications or alignments
CSPL No. 3 South	PCCP	Cement	Concrete	No documented leaks	~1000 ft. replaced with welded steel pipe and relocated around expansion of Peninsula Hospital in Burlingame (2006)
CSPL No. 3 North	PCCP	Cement	Concrete	No documented leaks	~700 ft. replaced with welded steel pipe along Bayshore Blvd. as part of the Oyster Point interchange construction (1995)
Sunset Supply Sec. A	Welded steel	Coal tar	Coal tar	No documented leaks	New line valve M15 was installed 60 ft. downstream of G41 (2010)
Sunset Supply Sec. B	Welded steel	Cement	Cement	No documented leaks	New turnout and line valve L30 connected to Crystal Springs No. 3 (1970)
Sunset Supply Sec. C	Welded steel pipe in tunnel	Concrete	Cement	No documented leaks	None
Sunset Supply Sec. D	Welded steel	Coal tar	Coal tar	3 documented leaks (1972, 1975, and 1986).	None
Sunset Supply Sec. E	Welded steel	Coal tar	Coal tar	3 leaks on Helen Drive (1990s).	Original valve M41 replaced by PRVs M41, M41A, M41B (late 1990s)
Sunset Supply Sec. F	Welded steel	Coal tar	Coal tar	1 leak repair found with inspection (Nov. 2007); leak occurred in early 1990s.	None

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
Sunset Supply Sec. G	Welded steel	Coal tar	Coal tar	No documented leaks	Short sections relocated by Bay Area Rapid Transit (BART) at Colma and SSF stations (late 1990s)
Sunset Supply Sec. H	Welded steel	Coal tar	Coal tar	No documented leaks	Relocated to cross I-280 on Junipero Serra Blvd in Daly City (mid 1960s)
Sunset Supply Branch	Steel-welded bell & spigot	Coal tar/Asbestos Wrap	Coal tar	Some redwood plugs were found during the pipeline inspection in 2014 indicating old leak repairs.	The following changes were made in 2013: 1000 ft. of the new SSB/HTWTP Effluent 78″ pipeline was replaced with 60″ pipeline. 355 ft of SSB 60″ pipeline was slip-lined with 48″ steel pipe from old N42 to Meadows School. Valve N42 was replaced with valve N75. Visual and sounding inspections were done in 2014.
San Andreas No. 1	Riveted steel (wrought)	Coal tar	Cement	10 documented leaks (1956-1988) A leak of less than 10 gpm was reported on 10/19/10 in Millbrae close to the Office Depot parking lot.	Original pipeline delivered water from San Andreas Lake to San Francisco. North of Orange Ave., South San Francisco, taken out of service (late 1950s); ~5,5000′ replaced in Millbrae west of El Camino Real; ~800 feet was lowered along El Camino Real in Millbrae (1962); cement mortar lining applied in Millbrae to So. San Francisco (1977). WSTD crews excavated the leak, found a dime size hole on a 4″ riser. Crews installed 4x2 saddle. Hole was back filled and compacted after October 2010.

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
San Andreas No. 2	Steel (lockbar) riveted joints	Coal tar	Cement	17 documented leaks (1953-81); Corrosion leak in front of Daly City Police Station (2013); Large leak caused by corrosion of riveted joint at Junipero Serra Park Entrance (2015).	Cement mortar lining applied from San Bruno to Daly City (1984); relocations, various sections for highway construction in San Bruno, South San Francisco, and Daly City (1960s): Leak repaired with redwood plug and Bonney Flange (add galvanic anodes) in 2013; ~140 of lockbar pipeline replaced with WSP with cement mortar lining (2015).
San Andreas No. 3	Welded steel	Cement	Cement	1 leak followed by a major pipeline failure (1990)	Originally constructed as PCCP, faulty prestressed wires led to a leak in San Bruno followed by a pipe failure in So. San Francisco. Slip-lined with WSP in 1993 and 1997.
San Andreas No. 3 Pipeline - Raw Water at HTWTP	Welded Steel	Cement Mortar	Cement Mortar	Leak at blow off on 04/11/12	Line drained and interior welding repairs done by WSTD crews. Repairs finished in June 2012. This section will be completely replaced by the HTWTP Long Term Improvement Project.
San Andreas No. 3 Pipeline Section (T60 to T70)	Welded steel	2 coats of Epoxy	Cement Mortar	New pipe	No pipeline modifications or alignments
Crystal Springs to San Andreas Pipeline	Welded steel	Coal tar	Cement	No documented leaks	Major rehabilitation under WSIP (complete in 2012)

Appendix E: Pipeline Inspection Priority Scoring and Techniques

Pipeline Inspection Priority Scoring

The following process was used to create the pipeline inspection schedule:

1. Pipelines which have already been inspected were scheduled based on their last inspection date. Steel and RCP Pipelines were scheduled to be inspected every 20 years, and PCCP pipelines every 10 years.

2. Pipeline inspections which have not already been inspected were prioritized based on an analysis of likelihood of pipeline failure and the consequences of failure.
    a. Information was collected on each pipeline segment for parameters such as material, year built, diameter, psi and type of feature and population density.
    b. Once this information was collected, a scoring of 1 to 5 was determined for each parameter. The table below illustrates the scoring method used.

Material	Population Density	Age	Diameter	Pipeline PSI	Pipeline=5 Adit=4 Tunnel=1
PCCP = 5 Steel before welding = 2 Steel & RCP =1	rank 1 -5 1 is least density 5 is highest density	rank 1 -5 1 is newest 5 is oldest	rank 1 -5 1 is smallest diameter 5 is largest diameter	rank 1 -5 1 lowest pressure 5 is highest pressure	Pipelines are more likely to fail then tunnels

3. The next step was to calculate the total risk score from the likelihood of failure and consequences of failure analysis. Each parameter in the total risk score analysis is weighted based on the importance to system operations and past pipe breaks experience. Total risk score is a summation of the weighted parameters.

Total Risk Score = Material (0.45) + Population Density (0.15) + Age (0.15) +Diameter (0.15) + PSI (0.05) + Type of Feature (0.05)

The table below illustrates the weighting given to each parameter.

Inspection Priority Score Weighting

Material	Population Density	Age	Diameter	Pipeline PSI	Pipeline =5 Adit = 4 Tunnel =1	TOTAL SCORE
45%	15%	15%	15%	5%	5%	100%

Pipelines which have never been inspected were scheduled based on their total score. The highest score correlates to the pipelines with the highest likelihood of failure and/or the greatest consequences of failure.

Inspection of Welded Steel Pipe (WSP)

Inspection of WSP is largely visual. An experienced engineer or inspector can detect CML that overrides corroded pipe wall. Slightly bulged mortar delineated by cracks is the telltale sign that is confirmed by scraping or tapping with a hammer to reveal a hollow sound. Corrosion of the pipe wall usually initiates at longitudinal weld seams and over many years spreads longitudinally and circumferentially. As corrosion advances, CML occasionally falls away from the pipe wall, revealing severe corrosion. Where pipe corrosion is minimal, spot repairs are made by staff by cleaning off corrosion and applying fresh mortar. Where corrosion has become more common or extensive, the pipeline shutdown is extended (or re-scheduled) and contractors are involved.

Structural flaws might also develop, particularly at joints, which are slightly weaker than within the barrel of pipe segments. Therefore, hand-applied mortar at every joint is examined for cracks, which can indicate the degree of differential ground settlement or seismic activity. Notes are taken of the degree of joint cracking, to be compared with subsequent inspections years later, to gauge changes, if any. Circumferential cracks away from joints can also indicate that unbalanced forces have acted on the pipeline. Such information is useful in determining how stable the pipeline has been during its service life. Stain gages will installed and monitored at the Hayward and Calaveras fault crossings on BDPL No. 3 and Alameda Siphon No. 4.

A remarkable structural flaw was discovered on BDPL No. 3 in 1993 at the crossing of the Hayward Fault. Spalled CML and severely distorted pipe revealed that seismic creep of the fault was exerting high compressive forces on the pipeline. In 1992 a more subtle condition was observed in BDPL No. 4 at the same location but no conclusions were drawn at the time. The finding in BDPL No. 3 immediately clarified what was happening to both pipelines. These findings led to the design and construction of axial slip joints for both pipelines in 1994 to absorb seismic creep.

In 2000 the effect on CSPL No. 2 was assessed from possible ground movement along San Mateo Creek. Besides examining each joint for hints of movement, engineers and crews shined lights toward each other to illuminate 50 to 100 feet of the interior at a time to check for any slight distortion in alignment. This examination was followed by survey crews with laser instruments to check alignment. No hints of movement were detected.

Some WSP is lined with coal tar, typically older pipelines that have not yet been re-lined with cement mortar. After being In service for 60 years or more, coal tar lining becomes worn in places, typically hand-applied coal tar at welded joints, where corrosion of the pipe wall has begun. Such flaws have been few and minor with little remedial work required. A 2-mile reach of CSPL No. 2, however, has had more general wear of lining that will be repaired during shutdowns for WSIP rehabilitation.

In 2003, inspection of CSPL No. 2 in South San Francisco discovered a 200-foot stretch where coal tar lining had completely failed, resulting in severe pipe corrosion throughout the stretch.

In 2004 contractors were hired to vacuum out debris, clean the pipe interior to white metal, and apply state-of-the-art epoxy lining.

Interior inspection also enables a history of leak repairs to be gathered. Leaks and associated repairs, have been thoroughly documented since 1990, prior to 1990 records exist but they are less complete. In either case, leak repairs remain indelibly obvious as seen from the interior, at least in older pipelines that have not been re-lined with mortar. All leak repairs subsequent to re-lining are obvious by the redwood plugs that poke through the cement lining.

Inspection of Riveted Wrought Steel Pipe

Visual methods of inspection are also suited for riveted pipe. These are the oldest pipelines, dating from the 1920s and earlier. All were originally lined with coal tar, and all were re-lined with cement during 1956-64. All leak repairs prior to relining were obliterated, but the few subsequent leaks are visible from the interior.

The most common flaw in relined riveted pipe is occasional spalling of hand-applied mortar that covers longitudinal rivet courses. These pipelines were originally lined with coal tar, so exposed rivet courses still are largely protected from corrosion. Nevertheless, spalled CML is repaired as permitted by the available shutdown duration.

Inspection of Reinforced Concrete Cylinder Pipe (RCP)

The full strength of RCP resides in the steel cylinder that is embedded in a thick core of high-strength concrete. Individual pipe segments are therefore rigid, so the joints need to be flexible to allow for differential ground settlement. Inspections of RCP examine each joint for signs of movement, showing either as a separation or a compression of joint mortar. Normal conditions are thin streaks of exudate between the mortar and concrete.

Inspections document general cracking of the concrete core. Longitudinal cracks in certain parts of a pipe might indicate an unbalanced vertical load. Circumferential cracks usually indicate bending forces "in beam" upon a pipe segment that the joint does not absorb. Core cracks are usually benign, not requiring repair. When appropriate, general descriptions of core cracks are forwarded to structural specialists.

Inspection of Prestressed Concrete Cylinder Pipe (PCCP)

Inspection methods for PCCP have evolved, responding to cases where pipe has failed suddenly. During the 1990s visual inspection for longitudinal core cracks was augmented by manual sounding of the core with a 16-oz hammer to listen for hollow sounds. Such indicators might be a structural flaw: a loss of compression within the concrete core because of corroded and broken prestress wires wound around the outside of the core. The location and shape of the crack and hollow is critical in determining whether or not the flaw is structural. If a flaw is judged to be structural the pipe must be excavated, examined, and repaired.

An inspection in 1991 found a major hollow in the core, but without a longitudinal core crack. Excavation confirmed a large area of corroded and broken prestress wires. The distressed pipe segment was removed and replaced with a steel segment. A complete forensic dissection of the bad pipe was conducted to reconstruct the sequence of events that led to the distress.

During the 1990s, all PCCP was carefully sounded, but found no other distressed pipe segments. By 2002 two companies developed an electromagnetic (EM) induction technology that, from inside the pipe, could locate and quantify broken pre-stress wires. Contractors were retained to inspect PCCP pipelines.

In 2005 and 2007, however, accuracy issues arose. EM inspection identified three pipe segments as distressed, but manual sounding detected nothing. Excavation and exterior examination followed but found no broken wires. Inaccurate instrument calibration had been at fault.

In 2007, visual observation of the BDPL No. 4, Section D found a longitudinal distress crack accompanied by a major hollow, but EM induction estimated a relatively small number of wire breaks. Excavation of the pipe found 10 times as many wire breaks as the EM survey had estimated. Again, poor calibration was the attributed factor. A PCCP specialist contractor was retained to strengthen the distressed pipe.

EM will continue to be used to assess the structural condition of PCCP, but with careful monitoring of instrument calibration, and with confirming visual and sounding methods inside the pipe. For reliable results with EM, calibration must be done on exact pipe designs as the pipe segments being inspected.

Appendix F: Summary of Incidents and Possible Root Cause

Table F-1: Summary of Incidents and Possible Root Causes

Incident Reports Summary													
	Name	**Date**	**Location**	**Possible Root Cause**									
				Inadequate Preventive Maintenance (PM)	**Inadequate Design**	**Poor Specifications**	**Inadequate Training**	**Poor Procedures**	**Poor Communication**	**Operator Error**	**Unknown**	**Comments**
1	SVCF Loss of power & Loss of flow signal	7/9/2014	SVCF	✔			✔					UPS at Chloramine Facility is in Maximo but does not have PM procedures assigned to it. Training needs to be provided for maintaining the UPS at the Chloramine Facility, including emphasizing the importance of reporting alarms during normal operations.
2	Alameda East Portal Overflow	9/10/2014	AEP	✔	✔							Testing and troubleshooting needed at Valve X-12. Alameda East and Quarry Overflow Radio Alarm Panels are not in Maximo and therefore did not have any PM procedures assigned to them.
3	BDPL 1 & 2 Caisson Vandalism	10/22/2014	Ravenswood		✔							Vandalism and unauthorized entry.
4	San Antonio Raw Water Incident	3/3/2015	SVCF and valves at SAPS				✔			✔		Partnering with SWRCB and Bay Area Water Supply and Conservation Agency (BAWSCA) to develop mitigation plans to mitigate future events.
5	San Andreas Pipeline No.2 Pipe break at San Bruno	7/27/2015	SAPL 2 at the entrance to Junipero Serra County Park at San Bruno	✔	✔							Pipe leak caused by corrosion and age of 1920's lockbar steel pipe. Replacement of SAPL 2 segment through San Bruno is currently in design.
6	Sunol Treated Water Pipeline Leak	9/1/2015	Effluent pipeline exiting SVWTP, parallel to Calaveras Rd, at Nursey	✔	✔							Pipe leak caused by accumulated creep and failure at the joint at the Calaveras Fault crossing.

Incident Reports Summary													
	Name	Date	Location	Possible Root Cause									
				Inadequate Preventive Maintenance (PM)	Inadequate Design	Poor Specifications	Inadequate Training	Poor Procedures	Poor Communication	Operator Error	Unknown	Comments
7	Tesla Low Fluoride	9/29/2015	Tesla UV					✔		✔		Tailgate will to be held to discuss / review the SCADA operations policies and procedures approved in February 2009.
8	Tesla Low Fluoride	9/30/2015	Tesla UV					✔		✔		Tailgate will to be held to discuss / review the SCADA operations policies and procedures approved in February 2009.
9	HTWTP Utility Water Line Break	1/12/2016	HTWTP		✔							Replace relatively new PVC pipe with new ductile iron pipe / fittings following failure of existing pipe.
10	HTWTP Caustic Feed Line Leaks	1/27/2016	HTWTP		✔	✔						Grease reacted with caustic such that it caused slipping of the SS clamp, resulting in leaks.
11	Thomas Shaft Chlorine Event	5/30/2016	Thomas Shaft	✔								Sodium Hypochlorite Pump #1 had a worn seal and rotor. This condition was the root cause of the erratic output.
12	Tesla Loss of Hypo Post Feed	5/30/2016	Thomas Shaft	✔								P-3500 had an unexpected failure. SCADA saw that the motor was still spinning but no flow was going through the flowmeter. When the flowrate dropped, it hit the low feed clamp, causing the system to lock itself to that low feed clamp, keeping P-3200 running. When the flowrate was manually increased, it resulted in a differential speed alarm on P-3200 causing the pump to shut down. Programming prevented the restart P-3200.

Appendix G: Project Closeout Summary

Table G-1: Summary of Project Closeout Data

WSIP Project Name[1]	Forecasted (or Actual) Construction Contract Final Completion Date	Project Status	Received O&Ms	Received Data Sheets	Received Record Drawings	Received As-Builts
San Joaquin Region						
Lawrence Livermore Lab & Thomas Shaft Improvements	3/11/11	Closed	8/10/11	8/16/11	8/12/12	5/30/13
Rehab of Existing San Joaquin Pipelines (Roselle Crossover Package Only)	9/19/11	Closed	12/14/12	9/25/13	9/4/14	9/25/13
San Joaquin Pipeline System - Crossovers & Other Fac (Contract 1)	5/12/2015	Closed	9/25/13	9/25/13	8/23/13	5/6/13
San Joaquin Pipeline System - Western Segment (Contract 2 or B)	10/24/2013	Closed	Feb. 2014	6/20/13	10/23/14	10/23/14
San Joaquin Pipeline System -Eastern Segment (Contract 3 or C)	10/31/2014	Closed	10/27/14	10/27/14	10/14/15	6/25/15
Tesla Treatment Facility (Design-Build Project)	11/30/12	Closed	10/15/13	7/6/12	N/A	5/2/14
Tesla Portal Protection (HH-953)	10/31/2014	Closed	Feb. 2014	7/22/14	2/24/14	11/24/15
San Joaquin Pipeline System - Pelican Crossovers Contract (spool piece- crossovers)	11/30/2013	Closed	2/12/15	6/30/14	6/30/2014	1/27/16
San Joaquin Pipeline Tesla Portal Solid State Decouplers	3/15/2014	Closed	6/12/15	5/1/15	NA	NA

[26]

[26] WSIP Job Order Contract (JOC), WSIP Local Contracts (CDD), and Bio-Habitat Reserve (BHR) are excluded from this table, as these are generally smaller in size*

WSIP Project Name[1]	Forecasted (or Actual) Construction Contract Final Completion Date	Project Status	Received O&Ms	Received Data Sheets	Received Record Drawings	Received As-Builts
San Joaquin Pipeline Emery Air Relief Valves & Pressure Instrumentation Transducers	3/15/2014	Closed	2/12/15	2/12/15	6/30/2014	1/27/16
San Joaquin Pipeline Roselle Air Relief Valves	3/15/2014	Closed	2/12/15	6/30/14	6/30/2014	12/23/15
San Joaquin Pipeline System - Western Segment (Contract 2)	3/15/2014	Closed	NA	NA	6/12/2016	NA
San Joaquin Pipeline System - Eastern Segment (Contract 3)	6/30/2014	Closed	NA	4/17/15	1/27/16	1/27/16
Tesla Treatment Facility (Design-Build) TTF	11/30/2012	Closed	10/15/13	7/6/2012	NA	5/2/14
Tesla Portal Protection	10/31/2014	Closed	Feb. 2014	7/22/14	2/24/14	11/24/15
San Joaquin Pipeline System - Pelican Crossovers Contract (spool piece- crossovers)	11/30/2013	Closed	Done 2/12/15	6/30/14	6/30/2014	1/27/16
San Joaquin Pipeline Tesla Portal Solid State Decouplers	3/15/2014	Closed	6/12/15	5/11/15	NA	NA
San Joaquin Pipeline Emery Air Relief Valves & Pressure Instrumentation Transducers	3/15/2014	Closed	2/12/15	2/12/15	6/30/2014	1/27/16
San Joaquin Pipeline Roselle Air Relief Valves	3/15/2014	Closed	2/12/15	6/30/14	6/30/2014	12/23/15
San Joaquin Pipeline West Segment Interstate 5	3/15/2014	Closed	NA	NA	6/12/2016	NA

WSIP Project Name[1]	Forecasted (or Actual) Construction Contract Final Completion Date	Project Status	Received O&Ms	Received Data Sheets	Received Record Drawings	Received As-Builts
San Joaquin Pipeline East Oakdale Portal	6/30/2014	Closed	NA	4/17/15	1/27/16	1/27/16
San Joaquin Pipeline Tie In Vault	4/19/2015	Closed	NA	NA	1/27/16	1/27/16
San Joaquin Pipeline Throttling Station	12/31/2014	Closed	NA	6/9/15	1/27/16	1/27/16
Tesla Portal - Install Drainage Pipes & Cleanup	10/31/2015	Closeout		1/27/16	4/14/16	7/13/16
Jib crane/proof testing and Blast Doors	7/12/2015	Closeout	NA			
Solar Panel Installation		Pre-Construction				
SJPL No.4 Junction Power		Pre-Construction				
Throttling Station - Solar Panel - Knight's Ferry		Pre-Construction				
Oakdale Upgrades	3/31/2016	Pre-Construction				
Tesla Portal Slab & Other Related Items		Pre-Construction				

WSIP Project Name[1]	Forecasted (or Actual) Construction Contract Final Completion Date	Project Status	Received O&Ms	Received Data Sheets	Received Record Drawings	Received As-Builts
Sunol Valley Region						
Pipeline Repair and Readiness Improvements Project	10/15/08	Closed	8/2/11	WSTD to create new templates	3/27/13	6/25/12
Standby Power Facilities - Various Locations (East Bay)	10/27/08	Closed			3/12/13	4/4/13
Standby Power Facilities - Various Locations (Peninsula)	5/28/10	Closed	Partial Submittal 3/1/10		2/7/2013	7/18/12
San Antonio Pump Station Upgrades	9/30/11	Closed	Partial Submittal 7/1/11	Partial Submittal 12/21/12	4/24/2013	7/5/12
SAPS Motor Replacement	5/12/2014	Closed	6/24/14	7/11/14	10/15/15	None
Alameda Siphon No. 4	8/24/2012	Closed	4/18/14 99% done	4/18/14 Done	NA	Jun. 2013
SVWTP Expansion & Treated Water Reservoir	9/20/13	Closeout	4/18/14	4/18/14	8/15/14	6/2/14
San Antonio Backup Pipeline	12/31/2015	Closeout	4/29/16	4/29/16		
New Irvington Tunnel	8/30/2016	Construction	Partial Submittal 7/19/13	Partial submittal 7/19/13		

WSIP Project Name[1]	Forecasted (or Actual) Construction Contract Final Completion Date	Project Status	Received O&Ms	Received Data Sheets	Received Record Drawings	Received As-Builts
CDRP	4/26/2019	Construction	Partial Submittal 12/9/13	Partial Submittal 12/9/13		
Calaveras Reservoir Oxygenation Project	10/11/2005	Closed	12/10/2012	NA	NA	12/5/2012
Upper Alameda Creek Filter Gallery	5/17/16	Pre-Construction				
Fish Passage Facilities within Alameda Creek Watershed FPFACW	4/21/2018	Construction				

WSIP Project Name[1]	Forecasted (or Actual) Construction Contract Final Completion Date	Project Status	Received O&Ms	Received Data Sheets	Received Record Drawings	Received As-Builts
Bay Division Region						
BDPL Nos. 3 & 4 Crossover / Isolation Valves	1/11/08	Closed	Partial Submittal 11/25/13		6/25/12	5/1/13
SFPUC / EBMUD Intertie	1/31/08	Closed	3/28/14		2/27/13	6/28/12
SCADA System Phase II	2/28/11	Closed	6/21/12		2/7/13	6/19/12
BDPL Reliability Upgrade - Pipeline (East Bay)	6/15/12	Closed	12/12/13	12/2/15	7/9/13	8/23/13
BDPL Reliability Upgrade - Relocation of BDPL Nos. 1 & 2			NA	NA	NA	NA
BDPL Reliability Upgrade - Pipeline (Peninsula)	1/31/14	Closeout	12/12/13	11/2/15	7/9/13	3/22/13
BDL No. 5, Restoration of East Bay, Phase 1	12/30/2012	Closed	NA	NA	NA	NA
BDPL No. 5, Restoration of East Bay, Phase 2	2/26/2013	Closed	NA	NA	NA	NA
BDPL Nos. 3 & 4 Crossovers	12/31/13	Closed	1/31/13	4/12/13	9/10/12	9/16/13
BDPL Reliability Upgrade - Pipeline (Cordilleras MicroTunnel)	4/18/14	Closed	12/30/13	6/6/13	11/4/13	6/4/13
Seismic Upgrade of BDPL Nos. 3 & 4 @ Hayward Fault	9/30/2016	Construction	Partial			
BDPL Reliability Upgrade - Tunnel	5/30/2016	Closeout	7/19/16	Partial	7/12/16	

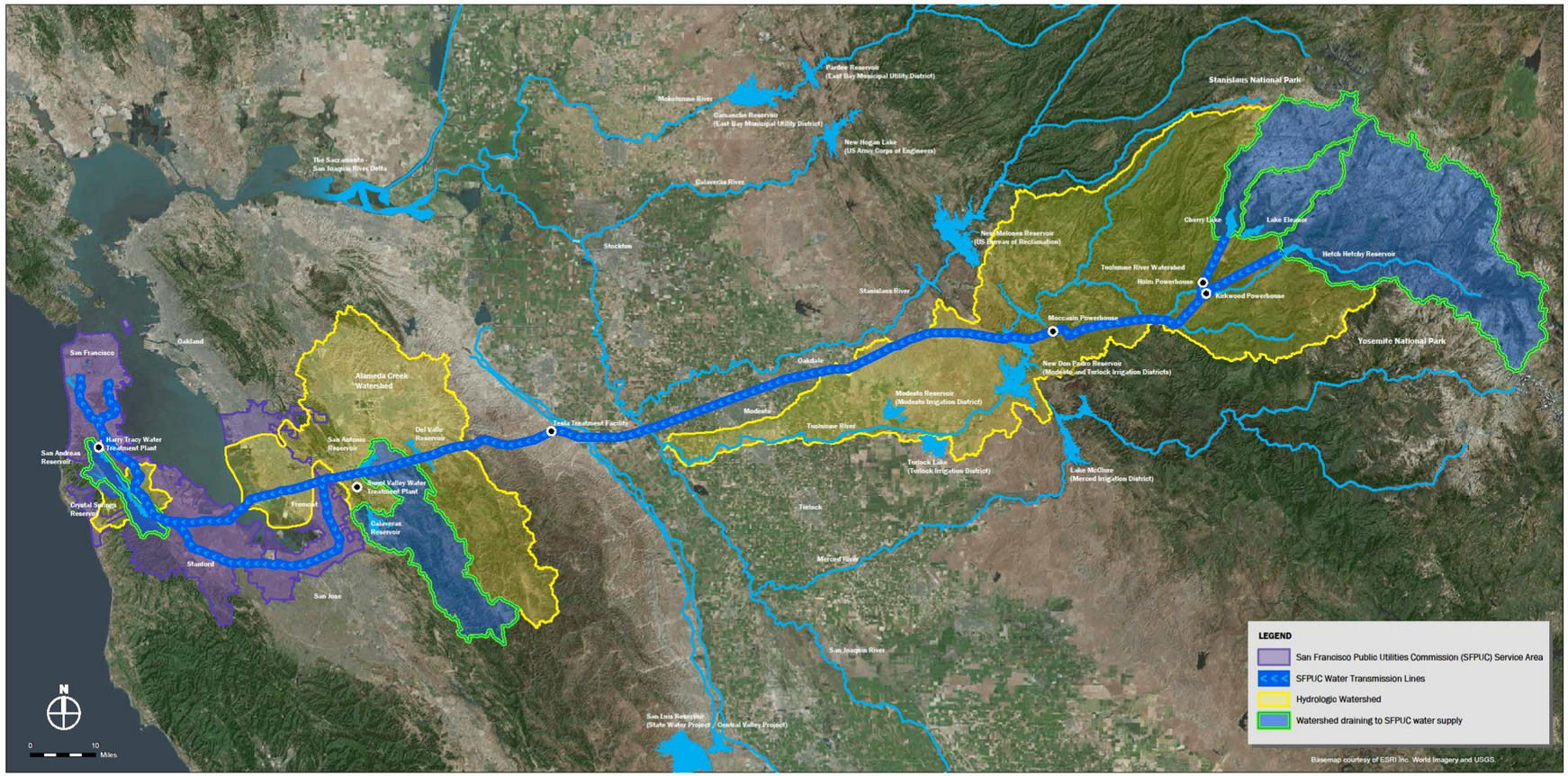
WSIP Project Name[1]	Forecasted (or Actual) Construction Contract Final Completion Date	Project Status	Received O&Ms	Received Data Sheets	Received Record Drawings	Received As-Builts
Peninsula Region						
Pulgas Balancing - Inlet / Outlet Work	2/2/06	Closed	2013	2013	6/24/13	11/26/12
HTWTP - Short Term Improvements - Demo Filters	2/27/06	Closed	5/23/2013	N/A	4/24/13	4/1/13
Adit Leak Repair - Crystal Springs, Calaveras & San Antonio Dams Outlet Towers	3/5/08	Closed	N/A	N/A	N/A	N/A
Capuchino Valve Lot Improvements	3/5/08	Closed			6/24/13	4/3/14
Cross Connection Controls (Phase 2)	11/26/08	Closed	N/A	N/A	N/A	N/A
Pulgas Balancing - Discharge Channel Modifications	12/7/09	Closed			6/24/13	4/3/14
HTWTP - Short Term Improvements - Coagulation & Flocculation/Remaining Filters	3/31/10	Closed	6/19/12	NA	4/24/2013	6/19/12
San Andreas Pipeline No. 3 Installation	6/30/11	Closed	8/19/11	8/23/12	6/19/12	12/30/13
New Crystal Springs Bypass Tunnel	8/12/11	Closed	6/19/12	NA	10/29/2012	6/17/14
Pulgas Balancing - Structural Rehabilitation & Roof Replacement of the Reservoir	9/1/11	Closed			4/24/13	3/12/13

WSIP Project Name[1]	Forecasted (or Actual) Construction Contract Final Completion Date	Project Status	Received O&Ms	Received Data Sheets	Received Record Drawings	Received As-Builts
Baden San Pedro Valve Lots Improvements	12/30/11	Closed	2/21/2013	11/10/11	2/7/13	7/23/12
LCSD Improvements	5/1/12	Closed	N/A	N/A	3/15/12	3/12/13
Pulgas Balancing - Modifications of the Existing Dechloramination Facility	3/20/13	Closed	6/18/13		4/24/13	1/14/13
CSPL No. 2 Replacements	3/30/13	Closeout	4/30/13	4/30/13	4/30/13	7/17/13
CSPL No. 2 Manhole Covers	12/31/2013	Closeout				10/21/2014
Crystal Springs/ San Andreas Transmission Upgrade	12/31/2014	Closeout	6/30/15	95% Done 3/31/15	8/11/15	9/17/15
HTWTP Long - Term Improvements	7/29/2016	Construction				
NCSBT and CSPL2 Settlement		Pre-construction				
Peninsula Pipelines Seismic Upgrade	2/29/2016	Closeout	Done	3/3/16	Draft 6/23/16	

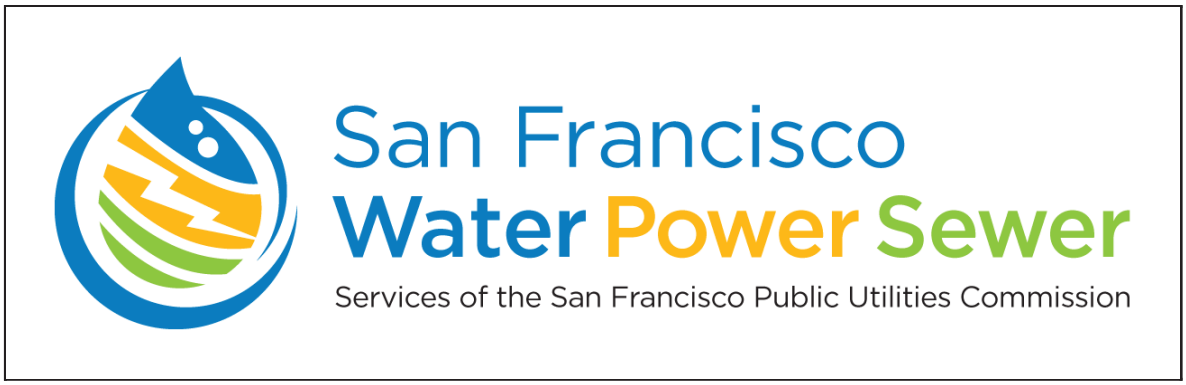
WSIP Project Name[1]	Forecasted (or Actual) Construction Contract Final Completion Date	Project Status	Received O&Ms	Received Data Sheets	Received Record Drawings	Received As-Builts
San Francisco Regional Region						
Sunset Reservoir North Basin Embankment Stabilization	11/11/2006	Closed	11/19/12	11/19/2012	NR	8/22/12
Sunset Reservoir Bypass	11/9/2009	Closed	NA	Oct 2010	NR	2/13/2013
Sunset Reservoir Upgrades - North Basin	8/29/2008	Closed	Oct 2010	Oct 2010	Oct 2010	Oct 2010
University Mound Reservoir Upgrades- North Basin	8/23/11	Closed	6/22/12	5/30/2013	N/A	8/22/2013
Regional Groundwater Storage and Recovery	1/6/2018	Construction				

Appendix H: Watershed Map

Hetch Hetchy Regional Water System, Service Area, Watersheds



Appendix I: FY 17-26 CIP Project Level Detail



Appendix I - FY 17-26 CIP Project Level Detail

Water Enterprise

Capital Plans

Water Enterprise FY 2017 - 2026 Ten Year CIP

San Francisco Public Utilities Commission

	A	B	C	D	E	F	G	H	I	J	K	L	M	N		O	P	Q
1	**USES**	**Project**	**Available Balance as of 12/31/15**	**FY 15-16**	**FY 16-17**	**FY 17-18**	**FY 18-19**	**FY 19-20**	**FY 20-21**	**FY 21-22**	**FY 22-23**	**FY 23-24**	**FY 24-25**	**FY 25-26**	1	**FY 16-25**	**FY 17-26**	**Change**
2	**REGIONAL WATER**														2			
3	**Water Treatment Program**														3			
4	Water Treatment Program	CUW27200	3,647,000	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
5	Tesla UV Facility	CUW27201	611,136	600,000	600,000	280,000	280,000	280,000	280,000	280,000	280,000	280,000	305,000	305,000	5	3,472,000	3,170,000	(302,000)
6	SVWTP & East Bay Fields	CUW27202	2,776,324	700,000	2,970,000	902,000	498,000	400,000	400,000	400,000	400,000	413,000	430,000	430,000	6	6,913,000	7,243,000	330,000
7	HTWTP & West Bay Fields	CUW27203	2,109,567	2,347,000	2,552,000	2,709,000	2,214,000	1,221,000	1,228,000	1,234,000	1,234,000	1,248,000	1,275,000	1,317,000	7	14,262,000	16,232,000	1,970,000
8	**Subtotal**		**9,144,027**	**3,647,000**	**6,122,000**	**3,891,000**	**2,992,000**	**1,901,000**	**1,908,000**	**1,914,000**	**1,914,000**	**1,941,000**	**2,010,000**	**2,052,000**	8	**24,647,000**	**26,645,000**	**1,998,000**
9	**Water Transmission Program**														9			
10	Water Transmission Program	CUW27300	10,388,951	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
11	Corrosion Protection Capital Upgrades	CUW27301	1,983,504	1,850,000	1,850,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,945,000	11	18,900,000	18,995,000	95,000
12	Pipeline Inspection and Repair Project	CUW27302	1,319,186	1,010,000	1,010,000	1,080,000	1,080,000	1,080,000	1,080,000	1,080,000	1,080,000	1,080,000	1,080,000	1,135,000	12	10,660,000	10,785,000	125,000
13	Pump Station Upgrades	CUW27304	2,463,712	910,000	3,410,000	1,180,000	1,180,000	3,680,000	1,180,000	1,780,000	1,180,000	1,216,000	1,230,000	1,278,000	13	16,346,000	17,314,000	968,000
14	Pipeline Improvement Program	CUW27305	2,228,825	3,450,000	5,450,000	13,250,000	40,400,000	48,762,000	16,762,000	21,100,000	16,493,000	103,000	103,000	110,000	14	**115,873,000**	**162,533,000**	**46,660,000**
15	Valve Replacement	CUW27306	845,700	1,013,000	3,013,000	3,350,000	3,350,000	2,350,000	1,350,000	1,350,000	1,350,000	1,390,000	1,398,000	1,450,000	15	12,914,000	20,351,000	7,437,000
16	Vault Upgrades	CUW27307	0	338,000	338,000	675,000	675,000	675,000	675,000	675,000	675,000	694,000	707,000	740,000	16	6,128,000	6,529,000	401,000
17	Calaveras Micro Turbine	CUW27308	3,794,302	2,860,000	2,860,000	0	0	0	0	0	0	0	0	0	17	5,720,000	2,860,000	(2,860,000)
18	Metering Upgrades	CUW27309	162,188	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	206,000	206,000	220,000	18	2,012,000	2,032,000	20,000
19	**Subtotal**		**23,186,368**	**11,631,000**	**18,131,000**	**21,635,000**	**48,785,000**	**58,647,000**	**23,147,000**	**28,085,000**	**22,878,000**	**6,589,000**	**6,624,000**	**6,878,000**	19	**188,553,000**	**241,399,000**	**52,846,000**
20	**Water Supply & Storage Program**														20			
21	Water Supply & Storage Program	CUW27400	4,417,000	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0
22	Dam Structural Upgrades (w/geotech)	CUW27401	1,501,806	994,000	1,589,000	1,817,000	2,567,000	16,479,000	880,000	380,000	380,000	381,000	381,000	383,000	22	25,798,000	25,237,000	(561,000)
23	Potable Reuse & Other Supplies		0	200,000	2,400,000	4,500,000	1,000,000	1,000,000	3,000,000	8,000,000	20,000,000	20,000,000	20,000,000	20,000,000	23	228,000,000	99,900,000	(128,100,000)
24	Merced Manor Reservoir Facilities Repairs		0	270,000	574,000	591,000	6,432,000	0	0	0	0	0	0	0	24	7,867,000	7,597,000	(270,000)
25	Daly City Recycled Water Expansion		0	0	3,000,000	0	29,750,000	35,000,000	20,250,000	0	0	0	0	0	25	0	88,000,000	88,000,000
26	**Subtotal**		**5,918,806**	**1,464,000**	**7,563,000**	**6,908,000**	**39,749,000**	**52,479,000**	**24,130,000**	**8,380,000**	**20,380,000**	**20,381,000**	**20,381,000**	**20,383,000**	26	**261,665,000**	**220,734,000**	**(40,931,000)**
27	**Watersheds & Land Management**														27			
28	Long Term Monitoring & Permit Program (Capital)	CUW28600	0	0	12,002,500	0	0	0	0	0	0	0	0	0	28	0	12,002,500	12,002,500
29	Watersheds & Land Management	CUW27500	12,716,711	0	0	0	0	0	0	0	0	0	0	0	29	0	0	0
30	Watershed Structures Upgrades	CUW27511	694,054	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0
31	Watershed Roads and ROW Management	CUW27512	23,379	2,804,000	1,504,000	1,504,000	1,504,000	1,504,000	1,504,000	1,504,000	1,504,000	1,504,000	1,504,000	1,504,000	31	17,536,000	15,040,000	(2,496,000)
32	Watershed Cottage/Buildings Upgrades	CUW27513	21,706	0	486,000	486,000	486,000	486,000	486,000	486,000	486,000	503,000	503,000	503,000	32	0	4,911,000	4,911,000
33	EBRPD Water System	CUW27514	167,134	0	0	0	0	0	0	0	0	0	0	0	33	0	0	0
34	**Subtotal**		**13,622,984**	**2,804,000**	**13,992,500**	**1,990,000**	**1,990,000**	**1,990,000**	**1,990,000**	**1,990,000**	**1,990,000**	**2,007,000**	**2,007,000**	**2,007,000**	34	**17,536,000**	**31,953,500**	**14,417,500**
35	**Communication & Monitoring Program**														35			
36	Communication & Monitoring Program	CUW27600	2,000,000	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0
37	Microwave Backbone Upgrade	CUW27601	3,114,419	1,500,000	0	450,000	450,000	0	0	0	0	0	0	0	37	1,500,000	900,000	(600,000)
38	WSTD Security System	CUW27602	1,000,000	500,000	939,000	544,000	500,000	500,000	500,000	500,000	500,000	515,000	515,000	515,000	38	5,513,000	5,528,000	15,000
39	**Subtotal**		**6,114,419**	**2,000,000**	**939,000**	**994,000**	**950,000**	**500,000**	**500,000**	**500,000**	**500,000**	**515,000**	**515,000**	**515,000**	39	**7,013,000**	**6,428,000**	**(585,000)**
40	**Buildings and Grounds Programs**														40			
41	Buildings and Grounds Programs	CUW27700	36,310,943	0	0	0	0	0	0	0	0	0	0	0	41	0	0	0
42	Sunol Yard	CUW27701	531,782	25,875,000	6,032,000	3,703,000	286,000	295,000	304,000	313,000	322,000	333,000	335,000	0	42	35,163,000	11,923,000	(23,240,000)
43	Millbrae Yard Upgrade	CUW27703	3,429,275	1,490,000	2,490,000	2,518,000	1,500,000	5,500,000	500,000	500,000	515,000	530,000	530,000	0	43	8,073,000	14,583,000	6,510,000
44	**Subtotal**		**40,272,000**	**27,365,000**	**8,522,000**	**6,221,000**	**1,786,000**	**5,795,000**	**804,000**	**813,000**	**837,000**	**863,000**	**865,000**	**0**	44	**43,236,000**	**26,506,000**	**(16,730,000)**
45															45			
46	**REGIONAL WATER TOTAL**		**98,258,604**	**48,911,000**	**55,269,500**	**41,639,000**	**96,252,000**	**121,312,000**	**52,479,000**	**41,682,000**	**48,499,000**	**32,296,000**	**32,402,000**	**31,835,000**	46	**542,650,000**	**553,665,500**	**11,015,500**
47															47			

Water Enterprise

Capital Plan

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27201 **Program FAMIS #:**CUW272
Project Title:	WTRR-Tesla UV Facility - CUW27201
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Treatment Facility
Type:	Renewal and Replacement
Description:	This project consists of minor upgrades to the Tesla UV Facility to achieve a higher level of performance. Projects include upgrades of chemical dosage, flow monitoring, small valve and pump replacement, chemical handling upgrades, and building ventilation.
Justification:	Many of the projects are identified at the startup of the UV facility and by Operations staff observations. The project will result in more reliable performance.
Operating Impact:	None.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$0**	$0	$0	$0	$0	$0	$0
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$2,016**	$200	$200	$200	$200	$200	$1,016
Construction Management	**$120**	$40	$8	$8	$8	$8	$48
Construction	**$1,034**	$360	$72	$72	$72	$72	$386
Total	**$3,170**	**$600**	**$280**	**$280**	**$280**	**$280**	**$1,450**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27202 **Program FAMIS #:**CUW272
Project Title:	WTRR-SVWTP & East Bay Fields - CUW27202
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Treatment Facility
Type:	Renewal and Replacement
Description:	This project consists of major upgrades to Sunol Valley Water Treatment Plant (SVWTP) to achieve a higher level of performance. Some of Phase 3 was initiated after the WSIP project concluded in Spring of 2014. The budget for FY17 includes the expected replacement of worn plant components such as lighting at the filter basin area, fire protection in the ITS/SCADA server room, cationic polymer piping, chemical feed discharge lines at the hypo and alum chemical skids, chemical control panel removal and chemical tank level control panel consolidation, centralized HVAC control system, modifications to existing vaults to minimize confined space entry to critical valves, main UPS circuit identification and consolidation, dayroom remodel, Operations control center, inner electric gate to conform to security requirements, 48" flocculator drives and controllers, wash water tank discharge valve electrical actuator, and main switchgear power monitoring installation.
Justification:	Many of the projects are identified through condition assessments, operations staff observations, review of level of service, subsequent feasibility studies, and alternative analyses at each major plant. The project will result in more reliable performance.
Operating Impact:	None

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$20**	$0	$20	$0	$0	$0	$0
Environmental Review	**$2**	$0	$2	$0	$0	$0	$0
Design	**$905**	$89	$89	$89	$89	$89	$460
Construction Management	**$447**	$31	$111	$79	$31	$31	$164
Construction	**$5,869**	$2,850	$680	$330	$280	$280	$1,449
Total	**$7,243**	**$2,970**	**$902**	**$498**	**$400**	**$400**	**$2,073**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27203 **Program FAMIS #:**CUW272
Project Title:	WTRR-HTWTP & West Bay Fields - CUW27203
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Treatment Facility
Type:	Renewal and Replacement
Description:	This program consists of upgrades to Harry Tracy Water Treatment Plant (HTWTP) to achieve a higher level of performance, all West Bay Field facility improvements, and Water Quality sample stations in the West Bay. Projects include upgrades of chemical dosage, flow monitoring, valve and pump replacement, and chemical handling upgrades.
Justification:	Many of the projects are identified through condition assessments, operations staff observations, review of level of service and subsequent feasibility studies and alternative analyses at each major plant. A new treatment plant will be completed in 2015.
Operating Impact:	None

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$0**	$0	$0	$0	$0	$0	$0
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$1,988**	$150	$200	$200	$200	$200	$1,038
Construction Management	**$808**	$70	$80	$80	$80	$80	$418
Construction	**$13,436**	$2,332	$2,429	$1,934	$941	$948	$4,852
Total	**$16,232**	**$2,552**	**$2,709**	**$2,214**	**$1,221**	**$1,228**	**$6,308**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27301	**Program FAMIS #:**CUW273
Project Title:	WTRR-Corrosion Protection Capital Upgrades - CUW27301	
Enterprise:	Water	
Organization:	Water - Regional	
Project Manager:	Chow, Jonathan	
Asset Classification:	WTR Water Transmission	
Type:	Capital	
Description:	This program consists of installing testing stations, galvanic and impressed current systems, remote monitoring units, and installation of isolation protection systems for priority assets. The program also provides funding for maintenance of existing systems such as rectifier repairs and sacrificial anode replacements, active systems with impressed current, isolating structures, enhanced monitoring, and pipeline inspection.	
Justification:	Investments in appropriate corrosion protection are essential and a cost effective way to significantly extend the usable life of buried structures such as pipelines and appurtenances.	
Operating Impact:	The project increases operating expenditures by about $10K per year for activities related to managing corrosion data and monitoring systems that are performed by consultants (professional services).	

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$2,965**	$250	$300	$300	$300	$300	$1,515
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$0**	$0	$0	$0	$0	$0	$0
Construction Management	**$1,610**	$160	$160	$160	$160	$160	$810
Construction	**$14,420**	$1,440	$1,440	$1,440	$1,440	$1,440	$7,220
Total	**$18,995**	**$1,850**	**$1,900**	**$1,900**	**$1,900**	**$1,900**	**$9,545**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27302 **Program FAMIS #:**CUW273
Project Title:	WTRR-Pipeline Inspection & Repair Project - CUW27302
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Chow, Jonathan
Asset Classification:	WTR Water Transmission
Type:	Facilities Maintenance
Description:	This project funds inspection (including shutting down, de-watering, and disinfection of pipelines) and minor rehabilitation and repair of pipelines that follow these inspections. Repairs can usually be made in weeks or within one to two months. Appurtenances such as blow-off valves and air valves are replaced and often times mortar lining or polyurethane lining can be repaired in short stretches. Inspections expected in 2016 include BDPL4D, CS3 (P48 to L59K), CS3A (L30 to L41K), San Antonio PL (W20 to Y20), and Alameda Siphon 3.
Justification:	Periodic internal pipeline inspections are essential to minimize pipeline failures. It also provides a condition assessment of our pipelines, which provides a basis for prioritizing pipeline replacements. Routine pipeline inspections are a part of good industry maintenance practice for large diameter transmission pipelines. Pipelines are inspected based on a long-term schedule that is updated each year by the Principal Engineer. First, a long-range recurrence inspection schedule is created based on the elapsed time since the last inspection, the condition of the pipe found on the previous inspection, and pipe material. Second, these schedules are adjusted by up to two years (forward or back in time) to accommodate construction and other system outages that can affect the cost of performing the shutdown and inspection. Third, the criticality of the pipeline is considered, particularly if a segment of pipe will be relied upon with no redundancy during other outages. If a pipeline is particularly critical, other factors carry less weight.
Operating Impact:	None.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$1,805**	$170	$180	$180	$180	$180	$915
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$910**	$90	$90	$90	$90	$90	$460
Construction Management	**$813**	$75	$81	$81	$81	$81	$414
Construction	**$7,257**	$675	$729	$729	$729	$729	$3,666
Total	**$10,785**	**$1,010**	**$1,080**	**$1,080**	**$1,080**	**$1,080**	**$5,455**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27304 **Program FAMIS #:**CUW273
Project Title:	WTRR-Pump Station Upgrades - CUW27304
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Water Transmission
Type:	Renewal and Replacement
Description:	This program funds minor to medium sized overhauls of existing pump stations such as San Antonio Pump Station (SAPS) diesel pump replacement and electrical upgrades, such as MCCs, protective relays, load tap changers. Parts replacement at the Calaveras Substation and SAPS is being considered. Rehabilitating the old Crystal Springs Pump Station by removing abandoned equipment and turning it into usable storage space is also being considered.
Justification:	Based on recently completed condition assessments, and required performance of the major pump stations within the Regional Water System, and the scope of work not included in WSIP, $17M is required to maintain level of service post WSIP.
Operating Impact:	More efficient pumps will lower operating costs by $30K per year.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$316**	$30	$30	$30	$30	$30	$166
Environmental Review	**$517**	$50	$50	$50	$50	$50	$267
Design	**$1,023**	$100	$100	$100	$100	$100	$523
Construction Management	**$1,023**	$100	$100	$100	$100	$100	$523
Construction	**$14,435**	$3,130	$900	$900	$3,400	$900	$5,205
Total	**$17,314**	**$3,410**	**$1,180**	**$1,180**	**$3,680**	**$1,180**	**$6,684**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27305 **Program FAMIS #:**CUW273
Project Title:	WTRR-Pipeline Improvement Program - CUW27305
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Water Transmission
Type:	Renewal and Replacement
Description:	This program funds various pipeline improvement projects: 1. PPSU Phase 3 - $10M FY16/FY17, based on 95% design estimate. Additional seismically reliable isolation valve(s) on SAPL2 at Belle Ave. and Sloat Ave . in SF, additional seismically reliable isolation valve(s) on SAPL2 near Sloat and Junipero Serra Ave in SF, 21 flexible connections to other appurtenances. 2. SA2 - Replace or slip-line up to 2 miles starting from HTWTP and working downstream. AAR and design in FY17, construction in FY18. Assume slip-lining at $2,000/ft. $30M total installed cost. 3. Enhanced Water Quality (WQ) instrumentation - $2M, add two sites with instrumentation packages, SCADA equipped. 4. SVWTP effluent pipeline repair/improvements along fault crossings, helps with LCA/MT reliability. $10M 5. Calaveras Pipeline repair/improvements along fault crossings – in later years of CIP, helps with LCA/MT reliability. $10M 6. CS2 replacement (2 mi)- Alignment, repair/replacement alternatives in FY16/17, design FY17/18, construction FY19 from valve K10 to K20. Move air gap to CSBT location (eliminate 1 mile of dead-end potable transmission pipe). Assume $1,500/ft for open cut/slip line work. The remaining work for this pipeline will continue in the out years. 7. Undermined section of Town of Sunol Pipeline in Arroyo De Laguna $0.5 - 1M, in later years of CIP. 8. $2M has been added for BD4B lining repair for FY16 and FY17 at $1M each. Replacing or slip-lining up to 10 miles of pipeline in densely populated areas where pre-stressed concrete cylinder pipe (PCCP) is present, at mid-point in CIP ($90M in FY19-21).
Justification:	PCCP Reliability Enhancement Program (2003) and BDPL4A & D Condition Assessment (2008) are two reports that point to the significance of monitoring, strengthening, and replacing these types of pipes as needed in order to maintain reliability. Unlike welded steel pipe failures which are typically corrosion leaks from a small hole in the pipeline, PCCP generally fails catastrophically with an explosion in the concrete creating a river of water coming out of a large hole in the concrete pipe.
Operating Impact:	None.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$1,590**	$450	$300	$100	$112	$112	$516
Environmental Review	**$1,900**	$500	$600	$500	$150	$150	$0
Design	**$3,300**	$800	$1,700	$800	$0	$0	$0
Construction Management	**$10,830**	$200	$130	$3,000	$4,000	$1,500	$2,000
Construction	**$144,913**	$3,500	$10,520	$36,000	$44,500	$15,000	$35,393
Total	**$162,533**	**$5,450**	**$13,250**	**$40,400**	**$48,762**	**$16,762**	**$37,909**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27306 **Program FAMIS #:**CUW273
Project Title:	WTRR-Valve Replacement - CUW27306
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Water Transmission
Type:	Renewal and Replacement
Description:	This project replaces aging line valves, air valves, blow-offs, and other pipeline appurtenances not already replaced as part of WSIP and which present cross-connection problems associated with new infrastructure. Includes structural improvements of valve vaults, as required. Also includes Sunol Valley Cross Connections evaluation and upgrades (motivated by March 3, 2015 incident) as well as bringing various out of Water Quality (WQ) spec air vacuum valves up to standard. $3M, $3.3M in FY17 and 18 respectively.
Justification:	Expenditures are required to maintain transmission system reliability and redundancy.
Operating Impact:	The project reduces miscellaneous repairs needed within the regional transmission system.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$991**	$75	$100	$100	$100	$100	$516
Environmental Review	**$501**	$38	$50	$50	$50	$50	$263
Design	**$1,984**	$150	$200	$200	$200	$200	$1,034
Construction Management	**$993**	$75	$100	$100	$100	$100	$518
Construction	**$15,882**	$2,675	$2,900	$2,900	$1,900	$900	$4,607
Total	**$20,351**	**$3,013**	**$3,350**	**$3,350**	**$2,350**	**$1,350**	**$6,938**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27307 **Program FAMIS #:**CUW273
Project Title:	WTRR-Vault Upgrades - CUW27307
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Chow, Jonathan
Asset Classification:	WTR Water Transmission
Type:	Renewal and Replacement
Description:	This project replaces and/or upgrades various vaults within the regional transmission system. Typical upgrades include SCADA installation/upgrades, actuator replacement/electrical upgrades, sump pump replacement, and access improvements and other OSHA-driven safety improvements.
Justification:	Expenditures are required to maintain transmission system reliability and redundancy.
Operating Impact:	The project reduces miscellaneous repairs needed within the regional transmission system.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$483**	$25	$50	$50	$50	$50	$258
Environmental Review	**$247**	$13	$25	$25	$25	$25	$134
Design	**$968**	$50	$100	$100	$100	$100	$518
Construction Management	**$482**	$25	$50	$50	$50	$50	$257
Construction	**$4,349**	$225	$450	$450	$450	$450	$2,324
Total	**$6,529**	**$338**	**$675**	**$675**	**$675**	**$675**	**$3,491**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW2730801 **Program FAMIS #:**CUW273
Project Title:	WTRR-Calaveras Micro Turbine - CUW2730801
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Water Transmission
Type:	Renewal and Replacement
Description:	This project consists of installing a small renewable hydroelectric turbine (approximately 1 MW) on the Calaveras Pipeline near the Sunol Valley WTP using energy from water stored in Calaveras Reservoir that is 300 feet higher than the Sunol Valley WTP. Presently this energy is dissipated using a throttling valve that does not recover the energy. Energy generation is expected to fully supply the Sunol Valley WTP and other electrical use in the Sunol Valley as well as having enough surplus for re-sale by exporting onto the Hetch Hetchy Transmission system. Energy savings will lower operating costs for the Water Enterprise with cost recovery expected in 8 to 10 years. Revenue from energy sales is being negotiated with the Power Enterprise. A Federal Energy Regulatory Commission small conduit license exemption is anticipated, and there will be no streamflow nexus with Calaveras Dam.
Justification:	The project would produce renewal energy and would reduce operational costs.
Operating Impact:	Increased maintenance ($30K per year), reduced energy costs ($325K per year) and increased revenue ($50K per year) for a net savings on operating expenses of $470K per year.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$0**	$0	$0	$0	$0	$0	$0
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$0**	$0	$0	$0	$0	$0	$0
Construction Management	**$260**	$260	$0	$0	$0	$0	$0
Construction	**$2,600**	$2,600	$0	$0	$0	$0	$0
Total	**$2,860**	**$2,860**	**$0**	**$0**	**$0**	**$0**	**$0**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27309 **Program FAMIS #:**CUW273
Project Title:	WTRR-Metering Upgrades - CUW27309
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Li, Annie
Asset Classification:	WTR Water Transmission
Type:	Facilities Maintenance
Description:	This project is to ensure accurate water accounting by maintaining various water meters in the regional water system to provide reliable and precise reads. Upcoming projects include: 1. New Sunset Supply Meter to capture flow to Sunset & Sutro Reservoirs crossing the county-line. This is one of the more expensive installation work on meters (increased cost in FY 2015). 2. San Antonio Forward/Reverse meter, modify vault hatch for easier access and restore sump pump. Albers Road venturi meters upgrade to include Human Machine Interface (HMI) local display at Remote Terminal Units (RTU). 3. New effluent meter (accusonic) needs to develop flow verification procedures with BAWSCA. 4. SA-3 meter, potential to use new CDD installed meter at Merced Manor to be the new county-line meter. SA-2 meter, retrofit to for reverse flow detection. 5. BDPL 1-5 meters at Pulgas Valve Lot, retrofit to read low flow conditions. Update as-built at each of the meter site to reflect most current installation.
Justification:	Accurate flow measurement is needed for system input and deliveries in real time for day-to-day management of the regional water system and for water use report generation.
Operating Impact:	None.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$0**	$0	$0	$0	$0	$0	$0
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$2,032**	$200	$200	$200	$200	$200	$1,032
Construction Management	**$0**	$0	$0	$0	$0	$0	$0
Construction	**$0**	$0	$0	$0	$0	$0	$0
Total	**$2,032**	**$200**	**$200**	**$200**	**$200**	**$200**	**$1,032**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27401 **Program FAMIS #:**CUW274
Project Title:	WTRR-Dam Structural Upgrades - CUW27401
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Feng, Stacie
Asset Classification:	WTR Supply and Storage
Type:	Renewal and Replacement
Description:	This project involves adding geotechnical monitoring at various dam locations. Phase 1 of this program addresses work at Pilarcitos Dam. Phase 2 addresses dam instrumentation work to be done in the out years.
Justification:	In 2008 Division of Safety of Dams (DSOD) notified WTSD that additional geotechnical information was needed at Pilarcitos Dam based on the age of the dam and the findings from the last inspection. Capital upgrades will be known/estimated following the DSOD-required studies. DSOD directed Investigation on the open well piezometers for San Andreas and Pilarcitos Dam. The results of the study show that some of the piezometers are not functioning and require retrofit or replacement.
Operating Impact:	None

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$200**	$200	$0	$0	$0	$0	$0
Environmental Review	**$1,250**	$400	$450	$400	$0	$0	$0
Design	**$2,070**	$550	$910	$610	$0	$0	$0
Construction Management	**$1,379**	$20	$10	$110	$542	$532	$165
Construction	**$20,338**	$419	$447	$1,447	$15,937	$348	$1,740
Total	**$25,237**	**$1,589**	**$1,817**	**$2,567**	**$16,479**	**$880**	**$1,905**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27402 **Program FAMIS #:**CUW274
Project Title:	WTRR- Bay Area Brackish Water Treatment (Desalination) - CUW27402
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Kothari, Manisha
Asset Classification:	WTR Supply and Storage
Type:	Capital
Description:	This project consists of a shared facility, with an estimated capacity of 20 million gallons per day (mgd). It would use brackish water withdrawn at CCWD's Mallard Slough Pump Station, located in eastern Contra Costa County to produce water using reverse osmosis (RO) technology. Water produced by the Project could be blended with supplies from CCWD, EBMUD (Mokelumne Aqueduct), or both. Other partners would receive Project water through transfers or wheeling. The proposed project would operate continuously in all year-types, with the possibility of storing water (including by exchange or transfer) in CCWD's Los Vaqueros Reservoir when demand from the partner agencies was less than plant capacity.
Justification:	This project is intended to produce desalinated water and is part of the SFPUC's diversified water supply strategy. Feasibility studies and pilot test show that the project is viable and the cost is competitive to other water supply options being considered to meet long-term LOS goals of the SFPUC. SFPUC Resolution 11-0161 authorized the SFPUC to carry out site-specific studies. This work is funded under the 505021 Water Supply Master Plan. Preliminary results from the site-specific studies have provided data for GHG emissions, brine discharge, wheeling, and fisheries impacts. Future work is subject to Commission approval. This project is currently included in the Bay Area Regional Reliability (BARR) framework, which includes a broad group of Bay Area water agencies exploring projects that may be beneficial to the region.
Operating Impact:	None.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$800**	$200	$200	$200	$200	$0	$0
Environmental Review	**$5,000**	$0	$0	$0	$0	$0	$5,000
Design	**$20,000**	$0	$0	$0	$0	$0	$20,000
Construction Management	**$5,000**	$0	$0	$0	$0	$0	$5,000
Construction	**$200,000**	$0	$0	$0	$0	$0	$200,000
Total	**$230,800**	**$200**	**$200**	**$200**	**$200**	**$0**	**$230,000**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27403 **Program FAMIS #:** CUW274
Project Title:	WTRR-Potable Reuse - CUW27403
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Kothari, Manisha
Asset Classification:	WTR Supply and Storage
Type:	Capital
Description:	This project tasks the SFPUC to identify opportunities and investigate the potential for direct and indirect potable reuse (DPR and IPR). The SFPUC is participating in research and regulatory review, and is working with other Bay Area water agencies to develop potential project opportunities of up to 5 mgd of drinking water with advanced treatment technologies. Feasibility analysis and pilot efforts are anticipated to advance potable reuse.
Justification:	Feasibility studies and pilot testing will be necessary to show the viability of potable reuse to benefit SFPUC customers. If these projects are viable, they can help meet long-term LOS goals of the SFPUC. Future work is subject to Commission approval.
Operating Impact:	None.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$1,600**	$400	$100	$200	$200	$200	$500
Environmental Review	**$2,000**	$1,000	$0	$0	$0	$0	$1,000
Design	**$2,000**	$1,000	$0	$0	$0	$0	$1,000
Construction Management	**$6,400**	$0	$400	$0	$0	$1,000	$5,000
Construction	**$87,900**	$0	$4,000	$800	$800	$1,800	$80,500
Total	**$99,900**	**$2,400**	**$4,500**	**$1,000**	**$1,000**	**$3,000**	**$88,000**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW2740401 **Program FAMIS #:**CUW274
Project Title:	WTRR-Daly City Recycled Water Expansion - CUW2740401
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Kothari, Manisha
Asset Classification:	WTR Supply and Storage
Type:	Capital
Description:	This project will provide a 3.4 mgd capacity serving customers of the Regional Water System. Fundindg is intended to cover work through construction and close-out. (Note: the planning, initial design, and environmental review for this project is being completed under Local Water CUW27802, the first phase of the Daly City Recycled Water Expansion).
Justification:	This project is intended to develop recycled water and is part of the SFPUC's diversified water supply strategy.
Operating Impact:	None.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$0**	$0	$0	$0	$0	$0	$0
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$3,000**	$3,000	$0	$0	$0	$0	$0
Construction Management	**$9,750**	$0	$0	$9,750	$0	$0	$0
Construction	**$75,250**	$0	$0	$20,000	$35,000	$20,250	$0
Total	**$88,000**	**$3,000**	**$0**	**$29,750**	**$35,000**	**$20,250**	**$0**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27502 **Program FAMIS #:**CUW275
Project Title:	WTRR-Bay Area Watershed and ROW Protection Program - CUW27502
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Ramirez, Tim
Asset Classification:	WTR Watershed Protection/Infrastructure
Type:	Capital
Description:	This program consists of capital projects that improve and/or protect the water quality and/or ecological resources that affect or are affected by the operation of the SFPUC water supply system within the Bay Area counties. Projects may include the repair, replacement, maintenance, and/or construction of roads, fences, or trails that meet these purposes. Projects may also include the acquisition of easements and/or fee title of properties that meet these purposes (within the Pilarcitos Creek, San Mateo Creek, or Alameda Creek watersheds), and other ecosystem restoration or public access, recreation, and education projects.
Justification:	This project provides the resources required to support capital projects that protect and restore the natural resources under SFPUC management, and improve the ability to cost-effectively mange trails, fences, roads, and bridges within the watersheds.
Operating Impact:	The long-term management of SFPUC watershed and ROW lands minimizes the environmental regulatory risk and long-term costs associated with the protection of natural resources that affect or are affected by the operation of the SFPUC water supply system. All projects are the responsibility of Natural Resources and Lands Management Division staff.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$0**	$0	$0	$0	$0	$0	$0
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$0**	$0	$0	$0	$0	$0	$0
Construction Management	**$0**	$0	$0	$0	$0	$0	$0
Construction	**$15,040**	$1,504	$1,504	$1,504	$1,504	$1,504	$7,520
Total	**$15,040**	**$1,504**	**$1,504**	**$1,504**	**$1,504**	**$1,504**	**$7,520**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27601 **Program FAMIS #:**CUW276
Project Title:	WTRR-Microwave Radio Backbone Upgrade - CUW27601
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Carroll, Mary Ellen
Asset Classification:	WTR SCADA/Comm. Systems/Monitoring
Type:	Capital
Description:	This project consists of developing a microwave backbone that would link the entire SFPUC Regional Water System from the Hetch Hetchy Dam site in Yosemite to the rest of the SFPUC sites (San Francisco, San Mateo, Santa Clara and Alameda counties). The project includes the following radio sites: Sawyer Ridge Radio Site, Mt. Allison Radio Site, Regional Water WS&T Admin. Millbrae, Alameda County Sunol Yard, Harry Tracy Water Treatment Plan, Livermore Hills, Entravision Tower, Tesla Portal Radio Site and Thomas Shaft Radio Site.
Justification:	The project will provide much needed redundant emergency communication capability and increased bandwidth for security data transfer.
Operating Impact:	The project will improve current day to day radio communication and security data provision in additional to providing critical redundant emergency communication capability.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$0**	$0	$0	$0	$0	$0	$0
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$0**	$0	$0	$0	$0	$0	$0
Construction Management	**$0**	$0	$0	$0	$0	$0	$0
Construction	**$900**	$0	$450	$450	$0	$0	$0
Total	**$900**	**$0**	**$450**	**$450**	**$0**	**$0**	**$0**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27602 **Program FAMIS #:**CUW276
Project Title:	WTRR-WSTD Security System - CUW27602
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Wilson, Brad
Asset Classification:	WTR SCADA/Comm. Systems/Monitoring
Type:	Capital
Description:	This project aims to design, construct and integrate security infrastructure for the Water Supply and Treatment Division. Upgrade and expand current systems. Design, construct, install and integrate new systems at existing sites.
Justification:	While much of the water system has or will be receiving security system upgrades through WSIP, not all sites are covered and some sites were not fully funded for needed security system upgrades. In addition, this provides a funding source to include security system upgrades in future capital improvement projects.
Operating Impact:	None.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$80**	$30	$50	$0	$0	$0	$0
Environmental Review	**$20**	$5	$15	$0	$0	$0	$0
Design	**$70**	$40	$30	$0	$0	$0	$0
Construction Management	**$28**	$18	$10	$0	$0	$0	$0
Construction	**$5,330**	$846	$439	$500	$500	$500	$2,545
Total	**$5,528**	**$939**	**$544**	**$500**	**$500**	**$500**	**$2,545**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27701 **Program FAMIS #:**CUW277
Project Title:	WTRR-Sunol Yard Upgrade - CUW27701
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Buildings and Grounds
Type:	Renewal and Replacement
Description:	This project replaces the existing facilities with LEED certified facilities, adds storage facilities and reconfigures the Yard layout. Specific improvements include a new Administration Building; Watershed Center; two Shop Buildings; equipment and material Storage Facilities; sanitary and storm drainage collection systems; underground utility systems; Fuel Station with above ground tanks; security-card reader systems; restore historic site walls and entry fountains; parking for SFPUC staff, visiting SFPUC staff, guest and public vehicles); locker and shower facilities; site improvements, Temple Road and the Temple area improvements; and hazardous materials storage facility. The Watershed Center will include interior exhibits and displays; a variety of interactive and hands-on exhibits; classroom; wetlab; staff offices; restrooms; event gathering space with kitchen; conference room; outdoor ampitheater; picnic and play areas; and landscaping.
Justification:	Many of the existing facilities in the Sunol Yard are in extreme disrepair, in need of replacement and do not meet present and future needs.
Operating Impact:	Interim improvements will increase security, lower utility bills (energy), and decrease maintenance costs; overall savings of $10K per year.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$30**	$30	$0	$0	$0	$0	$0
Environmental Review	**$15**	$15	$0	$0	$0	$0	$0
Design	**$60**	$60	$0	$0	$0	$0	$0
Construction Management	**$128**	$50	$78	$0	$0	$0	$0
Construction	**$11,690**	$5,877	$3,625	$286	$295	$304	$1,303
Total	**$11,923**	**$6,032**	**$3,703**	**$286**	**$295**	**$304**	**$1,303**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	CUW27703 **Program FAMIS #:**CUW277
Project Title:	WTRR-Millbrae Yard Upgrade - CUW27703
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Buildings and Grounds
Type:	Renewal and Replacement
Description:	This project consists of upgrades and functional restoration at the Buildings and Grounds of the Millbrae Headquarters including the administrative offices, shops and laboratory facilities in use by the Water Supply & Treatment Division, the Water Quality Division and the Natural Resources & Land Management Division. Specific proposed building scope includes boiler replacement, IT Server Facilities consolidation and reliability upgrades, laboratory functional and occupational safety upgrades, security upgrades, conference facilities lighting, ventilation and connectivity upgrades, renewal and occupational safety required at temporary office buildings and dilapidated shop buildings. Specific proposed yard scope includes waste oil tank replacement, security fencing, lighting and monitoring upgrades.
Justification:	Water Enterprise Buildings and Grounds in Millbrae are essential to the performance of Regional Water System operations and maintenance, assurance of drinking water quality and regulatory compliance, and stewardship of the natural resources and lands outside San Francisco that have been entrusted to the SFPUC. As a result of increasing system complexity and regulation, the services supported at these facilities have grown beyond their capacity, requiring stop-gap measures such as temporary buildings and greater dependence upon off-site storage and outsourcing. Redevelopment of the Millbrae Buildings and Grounds has been under consideration for many years and is not yet a need that has been resolved, so therefore it is not provided for in the current capital plan. The proposed work is intended to address the most urgent measures needed to assure occupational safety, functional efficiency and reliability and regulatory compliance.
Operating Impact:	Interim improvements will increase security and decrease maintenance costs; overall savings of $20K per year. Existing laboratory was retrofitted into an existing office building, and as such, the space was not originally design nor is it conducive for such purposes.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$0**	$0	$0	$0	$0	$0	$0
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$0**	$0	$0	$0	$0	$0	$0
Construction Management	**$0**	$0	$0	$0	$0	$0	$0
Construction	**$14,583**	$2,490	$2,518	$1,500	$5,500	$500	$2,075
Total	**$14,583**	**$2,490**	**$2,518**	**$1,500**	**$5,500**	**$500**	**$2,075**

SFPUC Capital Project Plan
Water Enterprise
Water - Regional

Project FAMIS #:	FUW10204 **Program FAMIS #:**FUW102
Project Title:	WTRR-Watershed Cottages Upgrades - FUW10204/CUW27513
Enterprise:	Water
Organization:	Water - Regional
Project Manager:	Nelson, Chris
Asset Classification:	WTR Watershed Protection/Infrastructure
Type:	Programmatic
Description:	This program supports investments in the operation and maintenance of housing (i.e., cottages) for Water Enterprise staff on SFPUC property in the Bay Area. These are an important aspect of managing land and facilities in remote locations, and allow for quick, efficient, and effective responses to emergencies to better protect natural resources and access to Hetch Hetchy Regional Water System assets.
Justification:	This program improves the ability to cost-effectively manage cottages, and hence access to watershed and ROW lands, and water system infrastructure.
Operating Impact:	The project provides resources required for the long-term management of SFPUC watershed and ROW lands. Projects are the responsibility of existing Natural Resources and Lands Management Division and Water Supply and Treatment Division staff.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$363**	$36	$36	$36	$36	$36	$183
Environmental Review	**$183**	$18	$18	$18	$18	$18	$93
Design	**$723**	$72	$72	$72	$72	$72	$363
Construction Management	**$363**	$36	$36	$36	$36	$36	$183
Construction	**$3,279**	$324	$324	$324	$324	$324	$1,659
Total	**$4,911**	**$486**	**$486**	**$486**	**$486**	**$486**	**$2,481**

9/1/2016

Hetch Hetchy Enterprise FY 2017 - 2026 Ten Year CIP

San Francisco Public Utilities Commission

	A	B	C	D	E	F	G	H	I	J	K	M	N	O	P	Q		R	S	T
1	**USES**	**Project**	**Available Balance as of 12/31/2015**	**Re-Allocation of Existing Balance**	**Total Appropriation through 2017-18 (D+G+H)**	**FY 15-16**	**FY 16-17**	**FY 17-18**	**FY 18-19**	**FY 19-20**	**FY 20-21**	**FY 21-22**	**FY 22-23**	**FY 23-24**	**FY 24-25**	**FY 25-26**	1	**FY 16-25**	**FY 17-26**	**Change**
44	**Hetch Hetchy Water**																44			
45	**Water Infrastructure**																45			
46	Water Infrastructure	CUH100	4,883,839	6,284,260	6,284,260	1,400,000	0	0	0	0	0	0	0	0	0		46			
47	Water Infrastructure - Project Development	CUH100PD	569,193	569,193	569,193	0	0	0	460,000	460,000	460,000	530,000	530,000	530,000	530,000	530,000	47	2,182,000	4,030,000	1,848,000
48	SCADA for Water Assets	CUH100	0	0	0	0	0	0	2,500,000	0	0	0	0	0	0	0	48	0	2,500,000	2,500,000
49	San Joaquin Pipeline Rehabilitation	CUH10001	3,200,452	3,200,452	18,300,452	600,000	5,100,000	10,000,000	6,542,000	8,000,000	8,000,000	8,000,000	8,300,000	7,300,000	8,300,000	28,000,000	49	77,220,000	97,542,000	20,322,000
50	Lower Cherry Aqueduct	CUH10003	8,962,830	8,962,830	8,962,830	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0
51	**Subtotal**		**17,616,314**	**19,016,735**	**34,116,735**	**2,000,000**	**5,100,000**	**10,000,000**	**9,502,000**	**8,460,000**	**8,460,000**	**8,530,000**	**8,830,000**	**7,830,000**	**8,830,000**	**28,530,000**	51	**79,402,000**	**104,072,000**	**24,670,000**
52	**Joint Projects**																52			
53	Infrastructure - Unallocated	CUH10200	38,001,298		0	0	0	0	0	0	0	0	0	0			53			
54	Infrastructure - Project Development	CUH102PD	1,276,441	2,000,000	2,000,000	0	0	0	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	54	364,800	16,000,000	15,635,200
55	Cherry Spillway	CUH10222	49,229	0	0	4,000,000	0	0	0	0	0	0	0	0	0	0	55	14,000,000	0	(14,000,000)
56	Dam Condition Assessment & Repair	CUH10203	102,333	0	0	300,000	0	0	700,000	700,000	700,000	700,000	700,000	700,000	10,000,000	0	56	15,100,000	14,200,000	(900,000)
57	Early Intake Dam Rehabilitation	CUH10218	350,922	0	0	1,960,000	0	0	0	0	0	0	0	0	0	0	57	33,255,000	0	(33,255,000)
58	Facilities Security	CUH10211	565,464	0	0	1,500,000	0	0	500,000	500,000	500,000	1,300,000	1,300,000	1,300,000	2,140,000	300,000	58	9,340,000	7,840,000	(1,500,000)
59	Hetchy Fiber Projects	CUH10210	124,811	0	0	0	0	0	0	0	0	1,000,000	1,000,000	1,000,000	0	0	59	3,000,000	3,000,000	0
60	Canyon Tunnel Rehabilitation	CUH10215	874,415	0	0	0	0	0	0	4,000,000	1,500,000	0	0	0	0	0	60	0	5,500,000	5,500,000
61	Cherry Dam Outlet Works	CUH10216	5,456,514	6,000,000	6,000,000	958,000	0	0	0	0	0	0	0	0	0	0	61	958,000	0	(958,000)
62	Hetch Hetchy Facilities New Construction	CUH10214	306,763	16,000,000	16,000,000	3,260,000	0	0	0	0	0	0	0	0	0	0	62	23,480,000	0	(23,480,000)
63	Hetch Hetchy Facilities - Upgrades	CUH10202	1,502,485	0	3,400,000	500,000	3,400,000	0	1,500,000	1,500,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,500,000	63	10,450,000	18,900,000	8,450,000
64	Microwave System	CUH10201	1,276,441	2,000,000	2,000,000	2,375,000	0	0	0	0	0	0	0	0	0	0	64	2,375,000	0	(2,375,000)
65	Moccasin Wastewater Treatment Plant	CUH10217	465,449	0	0	2,000,000	0	0	0	0	0	0	0	0	0	0	65	3,000,000	0	(3,000,000)
66	O'Shaughnessy Outlet Works	CUH10206	1,294,328	4,200,000	4,200,000	5,000,000	0	0	7,500,000	10,000,000	3,500,000	700,000	700,000	700,000	700,000	0	66	28,250,000	23,800,000	(4,450,000)
67	Mountain Tunnel Lining	CUH10002	1,383,744	0	0	0	0	0	0	0	0	0	0	0	0	0	67	0	0	0
68	Mountain Tunnel Access/Adit Improvement	CUH10219	117,809	10,332,000	12,000,000	2,000,000	1,253,000	415,000	0	0	0	0	0	0	0	0	68	60,000,000	1,668,000	(58,332,000)
69	Mountain Tunnel Inspection and Repair	CUH10220	227,591	3,690,000	23,500,000	0	8,538,000	11,272,000	2,039,000	0	0	0	0	0	0	0	69		21,849,000	21,849,000
70	Mountain Tunnel Improvement Project	CUH10221	268,645	9,266,000	35,000,000	9,317,000	10,814,000	14,920,000	17,527,000	573,457,000	0	0	0	0	0	0	70	567,835,000	616,718,000	48,883,000
71	Road Improvements	CUH10209	1,731,485	1,800,000	5,400,000	1,990,000	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000	2,000,000	2,500,000	71	18,390,000	18,900,000	510,000
72	Communication Systems Upgrades	CUH10213	117,619	0	0	300,000	0	0	300,000	300,000	300,000	300,000	300,000	300,000	5,000,000	0	72	10,300,000	6,800,000	(3,500,000)
73	**Subtotal**		**55,493,786**	**55,288,000**	**109,500,000**	**35,460,000**	**25,805,000**	**28,407,000**	**33,866,000**	**594,257,000**	**12,300,000**	**9,800,000**	**9,800,000**	**9,800,000**	**23,840,000**	**7,300,000**	73	**800,097,800**	**755,175,000**	**(44,922,800)**
74																	74			
	Total for HH Wtr and HH Joint		**73,110,100**	**74,304,735**	**143,616,735**	**37,460,000**	**30,905,000**	**38,407,000**	**43,368,000**	**602,717,000**	**20,760,000**	**18,330,000**	**18,630,000**	**17,630,000**	**32,670,000**	**35,830,000**		**879,499,800**	**859,247,000**	**(20,252,800)**

Hetch Hetchy Enterprise

Water Capital Plan

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH100-PD01	**Program FAMIS #:**
Project Title:	HHW- Water Project Development - CUH100-PD	
Enterprise:	Hetch Hetchy	
Organization:	Hetch Hetchy - Water	
Project Manager:	Leong, Jimmy	
Asset Classification:	Programmatic	
Type:	Programmatic	
Description:	The Project Development (PD) Account captures Program level expenditures. There are four types of charges that will be allocated to the PD Account: 1) Task orders for overall program management and project prioritization tasks, where the costs should be distributed over all CIP Projects. 2) Infrastructure and Hetchy staff performing program level tasks including: capital plan development, budget management (including fund management, and cost reallocations); OPPM and Quarterly Report generation tasks, where the costs should be distributed over all CIP Projects. 3) Portal support for the existing Sharepoint Portal (includes document management and project dashboard reporting) 4) Work Outreach program	
Justification:	The Project Development Account (PD Accounts) funds the capital improvement administrative staff, the project management staff and the professional services that could not be defined to one project detail as the charges would span across the overall program.	
Operating Impact:	Programmatic support is an integral part of the capital program.	

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$4,030**	$0	$0	$460	$460	$460	$2,650
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$0**	$0	$0	$0	$0	$0	$0
Construction Management	**$0**	$0	$0	$0	$0	$0	$0
Construction	**$0**	$0	$0	$0	$0	$0	$0
Total	**$4,030**	**$0**	**$0**	**$460**	**$460**	**$460**	**$2,650**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	**Program FAMIS #:**
Project Title:	HHW- SCADA for Water Assets - CUH100xx
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Pallante, Rocco
Asset Classification:	HHW Communication
Type:	Capital
Description:	HHWP's original SCADA system was built on the Wonderware platform. In 2015, HHWP was required to update equipment and software to meet various cyber standards for NERC Critical Infrastructure Protection power standards. The SCADA system could not meet, or be modified to meet, the new cyber security standards so the power facilities are being moved from the Wonderware SCADA platform to the OSI SCADA system. The power SCADA project is funded under PUH504, WECC/NERC Compliance and will be completed by February of 2016. To eliminate staffing and maintenance inefficiencies of maintaining two completely separate SCADA systems and to provide the same level of security protection, the water SCADA system will be moved to the OSI platform under this . This project will begin in two years.(MRN 464, 464, 465)
Justification:	This project is required to minimize resources required to maintain all SCADA software at HHWP.
Operating Impact:	Insufficient resources to maintain both HHWP water and power SCADA systems and increased cyber access vulnerability.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$125**	$0	$0	$125	$0	$0	$0
Environmental Review	**$200**	$0	$0	$200	$0	$0	$0
Design	**$200**	$0	$0	$200	$0	$0	$0
Construction Management	**$375**	$0	$0	$375	$0	$0	$0
Construction	**$1,600**	$0	$0	$1,600	$0	$0	$0
Total	**$2,500**	**$0**	**$0**	**$2,500**	**$0**	**$0**	**$0**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10001 **Program FAMIS #:**CUH100
Project Title:	HHW- San Joaquin Pipeline Rehabilitation - CUH10001
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Ng, Janet
Asset Classification:	HHW Water Transmission
Type:	Renewal and Replacement
Description:	The SJPL system conveys water from Foothill Tunnel to Coast Range Tunnel. It varies in age from 45 to 80 years. Work was performed under WSIP on SJPL4 and crossovers, but the valves at the crossover facilities were under designed and pipe protection is required for valve closure at the Tesla Ultraviolet facility. To address these issues HHWP reallocated $13.4 million from R&R to HSIP. The sizing of the valves at Tesla is dependent on a surge shaft at Tesla. Once cost estimates are complete, it is likely that HHWP will reallocate more funding from the R&R program to address current deficiencies. Following pipeline isolation and a project to protect the SJPL above Tesla, the system will remain in this configuration until more funds can be requested in the 10-year Capital Plan. Work in progress or proposed under this detail includes: A. Evaluation/Project Development: 1. Internal pipeline assessment to evaluate structural integrity. Lining replacement and ancillary equipment renewal work will be performed during assessment outage to support SJPL functionality. 2. Evaluation of assessment data; development of projects and prioritization of projects; scheduling of high priority projects; and scheduling of large replacement projects in 10-year budget planning process. B. Development of design criteria for SJPL Network including SJPL pipeline system, crossovers, discharge systems, and impacts of Tesla UV. C. Development of emergency response plan including section replacement, weld procedures for renewal/replacement and a list of available contractors. D. Securing all remote SJPL network sites with programmable logic controllers for cyber and physical security. E. Structural hardening of pipeline to mitigate unplanned releases to waterways to meet regulatory requirements. F. Other renewal/replacement projects including cathodic protection, pipeline coating, pipeline lining, improving structural integrity of daylighted sections and installation of monitoring
Justification:	This project is required to meet the Water Levels of Service for Regional Delivery, Water Supply and Sustainability.
Operating Impact:	During winter months the SFPUC water demand is low, which provides an opportunity for HHWP to perform assessment/improvements on sections of the SJPL's system that are out-of service. For safe entry, HHWP relies on single point isolation butterfly valves for protection. Currently the valves at Roselle, Pelican, Tesla and the Line 3/4 tie-in on the east side are under designed for static head conditions. Pipe replacement cost is about $1500/foot. We can delay replacement and probability of unplanned outages of this asset if we maintain an effective life extension program.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$12,680**	$663	$1,300	$850	$1,040	$1,040	$7,787
Environmental Review	**$9,754**	$510	$1,000	$654	$800	$800	$5,990
Design	**$8,779**	$459	$900	$589	$720	$720	$5,391
Construction Management	**$5,853**	$306	$600	$393	$480	$480	$3,594
Construction	**$60,476**	$3,162	$6,200	$4,056	$4,960	$4,960	$37,138
Total	**$97,542**	**$5,100**	**$10,000**	**$6,542**	**$8,000**	**$8,000**	**$59,900**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH101PD01	**Program FAMIS #:**CUH101PD
Project Title:	HHW- Project Development - CUH101-PD	
Enterprise:	Hetch Hetchy	
Organization:	Hetch Hetchy - Water	
Project Manager:	Leong, Jimmy	
Asset Classification:	Programmatic	
Type:	Programmatic	
Description:	The Project Development (PD) Account captures Program level expenditures. There are four types of charges that will be allocated to the PD Account: 1) Task orders for overall program management and project prioritization tasks, where the costs should be distributed over all CIP Projects. 2) Infrastructure and Hetchy staff performing program level tasks including: capital plan development, budget management (including fund management, and cost reallocations); OPPM and Quarterly Report generation tasks, where the costs should be distributed over all CIP Projects. 3) Portal support for the existing Sharepoint Portal (includes document management and project dashboard reporting) 4) Work Outreach program	
Justification:	The Project Development Account (PD Accounts) funds the capital improvement administrative staff, the project management staff and the professional services that could not be defined to one project detail as the charges would span across the overall program.	
Operating Impact:	Programmatic support is an integral part of the capital program.	

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$6,000**	$0	$0	$750	$750	$750	$3,750
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$0**	$0	$0	$0	$0	$0	$0
Construction Management	**$0**	$0	$0	$0	$0	$0	$0
Construction	**$0**	$0	$0	$0	$0	$0	$0
Total	**$6,000**	**$0**	**$0**	**$750**	**$750**	**$750**	**$3,750**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10101 **Program FAMIS #:**CUH101
Project Title:	HHW- Transmission Lines and Distribution - CUH10101
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Lehr, Dan
Asset Classification:	HHW Power Transmission/Switchyards
Type:	Renewal and Replacement
Description:	This includes R&R projects for transmission lines 5/6, 7/8 and 3/4 as well as the distribution system. Work includes: Transmission: This will include reliability projects as well as projects to address North American Electric Reliability (NERC) requirements. Typical projects include, but are not limited to: replacement of insulators, switches, tower infrastructure, grounding, protection and regulatory projects to achieve minimum clearances. Distribution: The distribution system includes distribution lines, dry transformers, distribution substations, disconnect switches, breakers, protection, and metering. Specifically the program includes: Evaluation/ Project Development: -Assessment: Foundation, members, conductor, insulators and grounding -Determination of corrections: -Evaluation of assessment data -Development of projects and prioritization -Scheduling of high priority projects under R&R and CIP Emergency Response Plan: Development of an emergency response plan, including procedures for renewal/ replacement and a list of available contractors Reliable Power: This program encompasses the vegetation management to ensure compliance with NERC regulatory requirements. The program will reduce the potential of conductor vegetation contact as well as reduce fuel loading from understory vegetation within the right of way. Program includes California Environmental Quality Act (CEQA) documentation to identify the environmental impacts and mitigation's. (MRN 282-350) Funding can also be used for other R&R transmission assets, i.e., switchyards and substations.
Justification:	The project is required to meet HHWP's Operational Objectives for Power including Power System Reliability, Regulatory Compliance and Sustainability.
Operating Impact:	The lines need to be maintained to prevent more costly repairs, reduce potential for catastrophic failure and to address safety concerns.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$136**	$0	$0	$17	$17	$17	$85
Environmental Review	**$216**	$0	$0	$27	$27	$27	$135
Design	**$264**	$0	$0	$33	$33	$33	$165
Construction Management	**$400**	$0	$0	$50	$50	$50	$250
Construction	**$1,650**	$0	$0	$207	$206	$206	$1,031
Total	**$2,666**	**$0**	**$0**	**$334**	**$333**	**$333**	**$1,666**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10101 **Program FAMIS #:**CUH101
Project Title:	HHW- Transmission Line Clearance Mitigation - CUH101XX
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Vroman, Mike
Asset Classification:	HHW Power Distribution
Type:	Renewal and Replacement
Description:	For NERC regulatory compliance purposes, HHWP conducted clearance evaluation of the existing 230kV (lines 5 and 6) and 115kV (lines 3 and 4, 7 and 8) transmission lines. Based on the ratings for each circuit, ground clearance discrepancies in each line segment have been identified. This project will provide funding to implement mitigation measures to resolve clearance discrepancies and meet NERC regulatory requirements. The mitigation options will include, but not be limited to, grading work to increase distance from ground to conductors, installing fencing around the deviation area to restrict public access, tensioning conductors to raise conductor up, changing suspension assembly to deadened assemblies, adding an extension to the lattice tower, and/ or replacing existing tower(s) with new lattice tower or tubular steel pole structures.
Justification:	The project is required to meet all HHWP's Operational Objectives for Power.
Operating Impact:	This is a safety liability.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$900**	$90	$90	$90	$90	$90	$450
Environmental Review	**$1,440**	$144	$144	$144	$144	$144	$720
Design	**$1,440**	$144	$144	$144	$144	$144	$720
Construction Management	**$2,700**	$270	$270	$270	$270	$270	$1,350
Construction	**$11,520**	$1,152	$1,152	$1,152	$1,152	$1,152	$5,760
Total	**$18,000**	**$1,800**	**$1,800**	**$1,800**	**$1,800**	**$1,800**	**$9,000**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10113 **Program FAMIS #:**CUH101
Project Title:	HHW- Kirkwood Penstock - CUH10113
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Parkan, Tim
Asset Classification:	HHW Water Transmission
Type:	Renewal and Replacement
Description:	Kirkwood Penstock was built in 1964 and conveys the SFPUC water supply from Canyon Tunnel to Kirkwood Powerhouse. The foundation slab that supports the Kirkwood Penstock experienced significant movement in 1984 and again in February of 2007. The Penstock continues to suffer distress due to creep movement (movement of the foundation materials) and damage can be observed at one of the fixed saddles directly below anchor block 2. The movement has not yet impacted the service utility. The project team has established a short-term work plan for the asset, which includes repairs due to recent damage, installation of a monitoring system, procurement of emergency spare equipment, and the development of robust monitoring and emergency action plans. The short-term work plan is currently in the design phase; a construction contract is scheduled to be advertised during the summer of 2016. (MRN 58, 88) Currently, the CUH10113 budget is sufficient to fund the short-term work plan; however, there is not enough funding to cover a long-term strategy for this asset. When additional funding is provided, the project team will develop a long-term work plan which is anticipated to include repairs to the lining, recoating the exterior of the Penstock, extensive foundation treatment and rock protection at selective locations. The long-term strategy will go through the formal planning phase per the Infrastructure procedures. (MRN 58, 88)
Justification:	This project is required to meet the Water Levels of Service for Water Supply and Regional Delivery. The project is also required to meet HHWP's Operational Objectives for Power including Power System Reliability and Sustainability.
Operating Impact:	Failure of these facilities will impact HHWP's ability to deliver water that meets filtration avoidance criteria and generate power.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$200**	$200	$0	$0	$0	$0	$0
Environmental Review	**$200**	$200	$0	$0	$0	$0	$0
Design	**$400**	$400	$0	$0	$0	$0	$0
Construction Management	**$320**	$320	$0	$0	$0	$0	$0
Construction	**$2,880**	$2,880	$0	$0	$0	$0	$0
Total	**$4,000**	**$4,000**	**$0**	**$0**	**$0**	**$0**	**$0**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH102PD	**Program FAMIS #:**
Project Title:	HHW- Project Development - CUH102-PD	
Enterprise:	Hetch Hetchy	
Organization:	Hetch Hetchy - Water	
Project Manager:	Leong, Jimmy	
Asset Classification:	Programmatic	
Type:	Programmatic	
Description:	The Project Development (PD) Account captures Program level expenditures. There are four types of charges that will be allocated to the PD Account: 1) Task orders for overall program management and project prioritization tasks, where the costs should be distributed over all CIP Projects. 2) Infrastructure and Hetchy staff performing program level tasks including: capital plan development, budget management (including fund management, and cost reallocations); OPPM and Quarterly Report generation tasks, where the costs should be distributed over all CIP Projects. 3) Portal support for the existing Sharepoint Portal (includes document management and project dashboard reporting) 4) Work Outreach program	
Justification:	The Project Development Account (PD Accounts) funds the capital improvement administrative staff, the project management staff and the professional services that could not be defined to one project detail as the charges would span across the overall program.	
Operating Impact:	Programmatic support is an integral part of the capital program.	

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$16,000**	$0	$0	$2,000	$2,000	$2,000	$10,000
Environmental Review	**$0**	$0	$0	$0	$0	$0	$0
Design	**$0**	$0	$0	$0	$0	$0	$0
Construction Management	**$0**	$0	$0	$0	$0	$0	$0
Construction	**$0**	$0	$0	$0	$0	$0	$0
Total	**$16,000**	**$0**	**$0**	**$2,000**	**$2,000**	**$2,000**	**$10,000**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10203 **Program FAMIS #:**CUH102
Project Title:	HHW- Dam Condition Assessment and Rehabilitation - CUH10203
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Hannaford, Margaret
Asset Classification:	HHW Watershed Storage and Release
Type:	Renewal and Replacement
Description:	This project includes a condition assessment on all reservoirs and dams as well as more immediate projects to address safety or environmental concerns. Upcoming work includes: Priest Dam – The Priest Dam deflection monitoring data review was completed in August 2013, and identified several monitoring deficiencies that are required for dam safety purposes. Additionally, the report identified the need for future geotechnical investigations and analyses to address the overall stability issues that exist. This project will construct monitoring instrumentation as well as perform an overall condition assessment of the dam, including a stability analysis. This project will be completed about 2019. There may be a substantial project in the future. (MRN 365) Eleanor Dam - A formal condition assessment of Eleanor Dam is now included in the program schedule; the project is scheduled to be completed in August of 2016. There may be a substantial project in the future. (MRN 18) Cherry Dam – A formal condition assessment of Cherry Dam is now included in the program schedule; the project is scheduled to be completed in October of 2021. (MRN 14) O'Shaughnessy Dam - A formal condition assessment of O'Shaughnessy Dam is now included in the program schedule; the project is scheduled to be completed in July of 2019. (MRN 256) Moccasin Dam - A formal condition assessment of Moccasin Dam is now included in the program schedule; the project is scheduled to be completed in July of 2020. (MRN 229)
Justification:	This project is required to meet the Water Levels of Service for Water Supply, Regional Seismic Reliability and Sustainability. The project is also required to meet HHWP's Operational Objectives for Power including Power System Reliability and Sustainability.
Operating Impact:	Issues with these facilities resulting in loss of storage or conveyance may impact the SFPUC water supply reliability and/or HHWP's ability to deliver water, maintain the current safe yield and generate power. Loss of storage would result increased frequency and level of rationing to SFPUC water customers.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$710**	$0	$0	$35	$35	$35	$605
Environmental Review	**$1,704**	$0	$0	$84	$84	$84	$1,452
Design	**$1,420**	$0	$0	$70	$70	$70	$1,210
Construction Management	**$2,130**	$0	$0	$105	$105	$105	$1,815
Construction	**$8,236**	$0	$0	$406	$406	$406	$7,018
Total	**$14,200**	**$0**	**$0**	**$700**	**$700**	**$700**	**$12,100**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10211 **Program FAMIS #:**CUH102
Project Title:	HHW- Facilities Security Project - CUH10211
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Lehr, Dan
Asset Classification:	HHW Communication
Type:	Capital
Description:	This funds physical security upgrades at existing HHWP facilities currently not being rehabilitated. The security at many HHWP Moccasin and remote facilities lack sufficient security measures to minimize the risk of intrusion. This project will fund security measures including fencing, card access and camera monitoring. (MRN all building assets)
Justification:	This project is required to meet the Water Levels of Service and HHWP's Operational Objectives for Power for Sustainability.
Operating Impact:	HHWP is installing new fiber and microwave communication throughout the project. Enhanced security monitoring can now be installed at remote locations and carried over the new communication system.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$392**	$0	$0	$25	$25	$25	$317
Environmental Review	**$663**	$0	$0	$50	$50	$50	$513
Design	**$446**	$0	$0	$40	$40	$40	$326
Construction Management	**$730**	$0	$0	$35	$35	$35	$625
Construction	**$5,609**	$0	$0	$350	$350	$350	$4,559
Total	**$7,840**	**$0**	**$0**	**$500**	**$500**	**$500**	**$6,340**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10210 **Program FAMIS #:**CUH102
Project Title:	HHW- Hetchy Fiber Projects - CUH10210
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Parkan, Tim
Asset Classification:	HHW Communication
Type:	Capital
Description:	CUH10213.XX Two Way Radio System: The SFPUC is considering using a 450megahertz (MHz) frequency system. To ensure the system would function in mountainous terrain, the SFPUC tested a mobile system and results were impressive. The SFPUC is considering leasing the frequencies and radios from a vendor but HHWP does not have cash funding available. In addition, the costs for the vendor to serve HHWP are greater because additional equipment will have to be installed at HHWP radio sites to provide coverage and due to the lack of customers in the region, it is not cost effective for the vendor to install the equipment. Given these circumstances, HHWP would like to proceed with purchasing a 450 MHz frequency system, that will be designed to be compatible with the system being leased by the SFPUC but HHWP will own their frequencies and radios. If approved, this project would proceed immediately to purchasing. (MRN 486, 487, 488, 490, 492, 493, 502) CIP CUH10213.XX Fiber from Modesto to Moccasin: The SFPUC is interested in entering into a contractual agreement, specifically an Indefeasible Rights of Use or IRU for fiber within the City and to Moccasin. The vendor already owns fiber within the City and the SFPUC's facilities in Millbrae, but the fiber from Modesto to Moccasin would have to be constructed. The SFPUC has consulted with the bond fund council regarding the IRU and SFPUC has received written approval that the program qualifies for bond funding. HHWP would like to proceed with this project immediately. Once the project is complete, HHWP will not only have improved connectivity but the SPFUC will be able to use the Moccasin Server Building as a disaster recovery site. If approved, this project would proceed immediately. (New asset) R&R CUH10213.XX Fiber/Microwave Connectivity: This detail will fund small hops to improve connectivity and real-time monitoring at remote facilities.
Justification:	The fiber project will serve as Hetch Hetchy's primary means of broadband communication with SFPUC facilities.
Operating Impact:	HHWP needs additional bandwidth to use applications being deployed by the SPFUC and to house one of the SPFUC disaster recovery systems.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$150**	$0	$0	$0	$0	$0	$150
Environmental Review	**$240**	$0	$0	$0	$0	$0	$240
Design	**$240**	$0	$0	$0	$0	$0	$240
Construction Management	**$450**	$0	$0	$0	$0	$0	$450
Construction	**$1,920**	$0	$0	$0	$0	$0	$1,920
Total	**$3,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$3,000**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10215 **Program FAMIS #:**CUH102
Project Title:	HHW- Canyon Tunnel Rehabilitation - CUH10215
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Ng, Janet
Asset Classification:	HHW Water Transmission
Type:	Renewal and Replacement
Description:	This project involves rehabilitation of the Hetchy Adit at Canyon Tunnel. Canyon Tunnel, built over 45 years ago, is approximately 10 miles long and delivers the SFPUC water supply from O'Shaughnessy Reservoir to Kirkwood Penstock. The tunnel is in good condition, but rehabilitation work is required due to recent recorded leakage at this tunnel access point. Temporary repairs have been made, but further repairs are needed to reduce leakage and increase reliability of the system. Scope includes installation of a new reinforced concrete plug downstream of the existing plug. The new plug can be built while the Canyon Tunnel remains in service. Once the downstream plug is in-place and tested, a short duration outage will be needed to remove the existing sliding-steel bulkhead door to allow the full pressure to reach the new plug. This project is being delayed because of boundary correction issues. (MRN 2)
Justification:	This project is required to meet the Water Levels of Service for Water Supply and Sustainability. The project is also required to meet HHWP's Operational Objectives for Power including Power System Reliability and Sustainability.
Operating Impact:	Failure at the Hetchy Adit will impact deliveries to SFPUC water customers. In the event of failure, customer deliveries will have to be met 100% from local bay area reservoirs or Tuolumne River emergency supply (Lower Cherry Aqueduct or directly from the Tuolumne River). There will also be an impact to generation while the facility is out of service.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$550**	$0	$0	$0	$400	$150	$0
Environmental Review	**$165**	$0	$0	$0	$120	$45	$0
Design	**$495**	$0	$0	$0	$360	$135	$0
Construction Management	**$275**	$0	$0	$0	$200	$75	$0
Construction	**$4,015**	$0	$0	$0	$2,920	$1,095	$0
Total	**$5,500**	**$0**	**$0**	**$0**	**$4,000**	**$1,500**	**$0**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10202 **Program FAMIS #:**CUH102
Project Title:	HHW- Hetch Hetchy Facilities Upgrades - CUH10202
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Ng, Janet
Asset Classification:	HHW Structures
Type:	Renewal and Replacement
Description:	HHWP maintains about 80 structures which may be up to about 90 years old. This project is for capital improvement of those facilities.
Justification:	This project is required to meet the Water Levels of Service for Sustainability. The project is also required to meet HHWP's Operational Objectives for Power for Power System Reliability, Regulatory Compliance and Sustainability.
Operating Impact:	Not all facilities meet HHWP staff needs and/or current safety/building codes. In addition, there are deferred maintenance needs to address.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$512**	$92	$0	$41	$41	$54	$284
Environmental Review	**$567**	$102	$0	$45	$45	$60	$315
Design	**$945**	$170	$0	$75	$75	$100	$525
Construction Management	**$811**	$146	$0	$64	$64	$86	$451
Construction	**$16,065**	$2,890	$0	$1,275	$1,275	$1,700	$8,925
Total	**$18,900**	**$3,400**	**$0**	**$1,500**	**$1,500**	**$2,000**	**$10,500**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10206 **Program FAMIS #:**CUH102
Project Title:	HHW- O`Shaughnessy Dam Outlet Works - CUH10206
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Parkan, Tim
Asset Classification:	HHW Water Distribution
Type:	Renewal and Replacement
Description:	This project includes the rehabilitation of O'Shaughnessy Dam (OSD) in order to restore the intended functionality of the existing outlet works system which includes the drum gates and the release system through OSD to Canyon Tunnel and the Tuolumne River. The budget for the OSD Outlet Works detail is currently $29 million. After evaluating the project's scope, the project team refined the total cost estimate to $88 million (Class 5 estimate in 2015 dollars). The project delivery team organized the work into a series of seven subprojects based on operations, budget, type of construction, and location. Because the project is currently under funded, the project team worked with HHWP'S management to establish a priority ranking for the subprojects to maximize the benefits of the existing budget. The prioritization effort concluded that only four of the seven subprojects can move forward at this time due to budget limitations. The four approved subprojects will be completed prior to year 2022 and include: - Drum Gate Automation (design phase complete) - Access & Drainage Improvements - Drum Gate Rehabilitation (upgrading the hinges and rivets, recoating the gate, existing seals and repairing the spillway concrete) - Installation of New Bulkhead System & Butterfly Valve and Rehabilitation of Slide Gates This project will also address reliability issues of the OSD outlet works system and the dam itself that have not been addressed above as needed to restore functionality and maintain these assets until additional funding is obtained to complete remaining projects. The three unfunded remaining projects for O`Shaughnessy Dam Outlet Works are: - Replacement of 72" Needle Valve & Rehabilitation of 72" Butterfly Valve - Replacement of 60" Needle Valves & Controls - Diversion Tunnel Rehabilitation An additional $136 million is required to complete the remaining three subprojects. (MRN 255, 256, 262, 263)
Justification:	This project is required to meet the Water Levels of Service for Water Supply and Sustainability. The project is also required to meet all HHWP's Operational Objectives for Power including Power System Reliability, Regulatory Compliance and Sustainability.
Operating Impact:	A failure of some of these components can result in lost water supply and inability to operate the facility safely under various hydrological conditions. Some assets will impact the SFPUC water customer safe yield increasing the level and frequency of rationing.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$2,240**	$0	$0	$750	$1,000	$350	$140
Environmental Review	**$854**	$0	$0	$225	$300	$105	$224
Design	**$2,114**	$0	$0	$675	$900	$315	$224
Construction Management	**$1,330**	$0	$0	$375	$500	$175	$280
Construction	**$17,262**	$0	$0	$5,475	$7,300	$2,555	$1,932
Total	**$23,800**	**$0**	**$0**	**$7,500**	**$10,000**	**$3,500**	**$2,800**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH102 **Program FAMIS #:**CUH102
Project Title:	HHW- Mountain Tunnel Rehabillitation Project - CUH10219 thru21
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Wong, Johanna
Asset Classification:	
Type:	Renewal and Replacement
Description:	Constructed between 1917-25, Mountain Tunnel (MT) is a critical, non-redundant link in the Hetch Hetchy water system, conveying SFPUC water supply from Kirkwood Powerhouse to Priest Reservoir . Due to tunnel's 90 years of operation, deferred maintenance, as well as the construction deficiencies in the early 1900s, sections of the tunnel have deteriorated, some more extensively than others. MT improvements to enhance SFPUC's ability to provide reliable, high-quality water to its customers, will be carried out through three projects: 1. MT Adits & Access Improvement and Emergency Restoration Plan 2. MT Inspection and Repair 3. MT Tunnel Bypass Mountain Tunnel Adits & Access Improvement Project will enlarge Adits 5/6 and 8/9 to accommodate quick entry of construction crews and equipment into the tunnel; and will improve access roads to the said adits. Project will also provide for the implementation of the Emergency Restoration Plan. Mountain Tunnel Inspection & Repairs Project provides for a tunnel inspection in 2017 to update the Condition Assessment conducted in 2008, as well as short-term repairs in 2017 and 2018 to reduce the risk of failures in the concrete lining prior to the long-term project being implemented. Mountain Tunnel Bypass Project will provide for evaluation of alternatives for the Mountain Tunnel facility, and eventually, the design and construction of the preferred engineering alternative that will keep this vital component of the Hetch Hetchy Water and Power System in reliable service for years to come. SFPUC has made a commitment to confirm the final long-term alternative (new 12-mile bypass tunnel or rehabilitation of existing tunnel) after an in-depth tunnel inspection and condition assessment has been conducted in 2017. Budget and schedule is based on the Bypass Tunnel alternative which has an anticipated construction phase between from 2020 to 2027 (MRN 238-241, 244, 245)
Justification:	A catastrophic failure, although possible, is unlikely without continued gradual degradation. The more likely type of anticipated failures are "local collapses", which would not impact power generation but would create water quality events in terms of turbidity in the water supply. The likelihood of localized collapses is moderate to high. Depending on the configuration of the system, this type of event could interrupt the delivery of the Tuolumne diversion to Water Supply and Treatment. Technology Policy: The project provides for reliable, high quality service, but is not specifically technology-related.
Operating Impact:	Depending on the configuration of the system, a "local collapse" could interrupt the delivery of the Tuolumne diversion to Water Supply and Treatment. Continual degradation of the asset could lead to a catastrophic failure.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$23,237**	$8,114	$2,258	$2,548	$10,317	$0	$0
Environmental Review	**$4,989**	$1,705	$3,280	$4	$0	$0	$0
Design	**$29,308**	$3,534	$10,206	$15,338	$230	$0	$0
Construction Management	**$49,758**	$1,091	$1,863	$535	$46,269	$0	$0
Construction	**$532,943**	$6,161	$9,000	$1,141	$516,641	$0	$0
Total	**$640,235**	**$20,605**	**$26,607**	**$19,566**	**$573,457**	**$0**	**$0**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10209 **Program FAMIS #:**CUH102
Project Title:	HHW- Road Improvements - CUH10209
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Lehr, Dan
Asset Classification:	HHW Right of Way
Type:	Renewal and Replacement
Description:	HHWP is responsible for maintaining 14 bridges and about 40 miles of paved roadways that provide access to facilities. Many of these bridges and road are used by the public. Most of the roads and bridges were constructed many years ago and some are in need of repair, rehabilitation, and/ or replacement. All facilities have been evaluated and for bridges alone, project costs are over $75 million to address safety, structural and seismic concerns on the bridges used by the public. This detail will fund smaller R&R Projects identified and include: Improve site clearance recovery zone (in process) Signage and object marker placements (complete) Centerline marking (only where it currently exists) Slope stability improvement (will be performed as identified) Guardrails (in design) Pavement projects (in design) R&R projects on small bridges (in various stages of design and construction) (MRN 226, 243, 400, 402, 407, 414-425, 429, 430, 457) Detail to fund large projects, including bridge replacement will be requested in the current budget year, (Candidate project Bridges under Joint).
Justification:	This project is required to meet the Water Levels of Service for Regional Seismic Reliability, Regional Delivery Reliability, Water Supply and Sustainability. The project is also required to meet HHWP's Operational Objectives for Power including Power System Reliability and Sustainability.
Operating Impact:	These public roads and bridges must be maintained so staff can access critical assets and remote facilities. Work must be performed to meet current standards and operating needs.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$945**	$90	$90	$90	$90	$90	$495
Environmental Review	**$1,890**	$180	$180	$180	$180	$180	$990
Design	**$1,512**	$144	$144	$144	$144	$144	$792
Construction Management	**$1,323**	$126	$126	$126	$126	$126	$693
Construction	**$13,230**	$1,260	$1,260	$1,260	$1,260	$1,260	$6,930
Total	**$18,900**	**$1,800**	**$1,800**	**$1,800**	**$1,800**	**$1,800**	**$9,900**

SFPUC Capital Project Plan
Hetch Hetchy Enterprise
Hetch Hetchy - Water

Project FAMIS #:	CUH10213 **Program FAMIS #:**CUH102
Project Title:	HHW- Communication Systems Upgrades - CUH10213
Enterprise:	Hetch Hetchy
Organization:	Hetch Hetchy - Water
Project Manager:	Bettencourt, Eric
Asset Classification:	HHW Communication
Type:	Renewal and Replacement
Description:	The SFPUC is interested in entering into a contractual agreement, specifically an Indefeasible Rights of Use or IRU for fiber within the City and to Moccasin. The vendor already owns fiber within the City and the SFPUC'S facilities in Millbrae, but the fiber from Modesto to Moccasin would have to be constructed. The SFPUC has consulted with the bond fund council regarding the IRU and SFPUC has received written approval that the program qualifies for bond funding. HHWP would like to proceed with this project immediately. Once the project is complete, HHWP will not only have improved connectivity but the SFPUC will be able to use the Moccasin Server Building as a disaster recovery site. Funding is available in HHWP's existing budget to complete this project. This project includes all communication assets, i.e., microwave, fiber, phones, two-way radio system and devices that relay data from remote sites. Funding has been requested in FY25 to address equipment that has reached its expected life and/or to replace technology that has expired. Two-way Radio: The SFPUC is considering using a 450 megahertz (MHz) frequency system. The SFPUC is considering leasing the frequencies and radios from a vendor but HHWP does not have cash funding available. In addition, the costs for the vendor to serve HHWP are greater because additional equipment will have to be installed at HHWP radio sites to provide coverage and due to the lack of customers in the region, it is not cost effective for the vendor to install the equipment. Given these circumstances, HHWP would like to proceed with purchasing a 450 MHz frequency system, that will be designed to be compatible with the system being leased by the SFPUC but HHWP will own their frequencies and radios. If approved, this project would proceed immediately to purchasing. (MRN 486, 487, 488, 490, 492, 493, 502) This detail will also fund small hops to improve connectivity and real-time monitoring at remote facilities. Once inst
Justification:	This project is required to meet the Water Levels of Service for Regional Delivery Reliability and Sustainability, and HHWP's Operational Objectives for Power including Power System Reliability and Sustainability.
Operating Impact:	HHWP's business operations and SFPUC's ability to use the Moccasin Server Building as a disaster recovery site are impacted by available bandwidth. This project would alleviate bandwidth issues and provide for future growth.

All values in $1,000	2017 - 2026	2017	2018	2019	2020	2021	2022 - 2026
Planning	**$680**	$0	$0	$30	$30	$30	$590
Environmental Review	**$340**	$0	$0	$15	$15	$15	$295
Design	**$680**	$0	$0	$30	$30	$30	$590
Construction Management	**$680**	$0	$0	$30	$30	$30	$590
Construction	**$4,420**	$0	$0	$195	$195	$195	$3,835
Total	**$6,800**	**$0**	**$0**	**$300**	**$300**	**$300**	**$5,900**