2010 State of the Regional Water System

September 2010

D R A F T

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List of Abbreviations

CIP	Capital Improvement Program
gpd	gallons per day
gpm	gallons per minute
mgd	million gallons per day
SFPUC	San Francisco Public Utilities Commission
WSIP	Water System Improvement Program. A $4.6 billion program created to repair, replace, and seismically upgrade the system's deteriorating pipelines, tunnels, reservoirs, pump stations, storage tanks, and dams.
WTP	Water Treatment Plant

1. Purpose of the Report

The SFPUC Regional Water System provides water to 2.5 million residential, commercial, and industrial customers in the San Francisco Bay Area. Approximately one-third of these deliveries are to retail customers in San Francisco, while wholesale deliveries to 26 suburban agencies in Alameda, Santa Clara, and San Mateo counties comprise the other two-thirds.

The system is designed to deliver over 350 million gallons of water per day, and consists of over 280 miles of pipelines, over 60 miles of tunnels, 11 reservoirs, five major pump stations, three major water treatment plants and many ancillary field treatment facilities. System reliability is essential to the all communities that depend on water from this system as their primary water source. Cost effectiveness and efficiency are also important to ensure rates are as low as possible. These objectives are brought together in the SFPUC's asset management program which is described in this report which includes:

- A catalog of the physical assets;,
- A summary of the current condition of physical assets;
- Maintenance programs and strategies ensuring reliable performance;
- Capital Improvement Program (CIP) documenting planned system investments; and,
- Adopted levels of service driving operating and capital expenditures.

The report is intended to be a comprehensive reference defining key terms and overall programs in place to manage the performance, condition, and reliability of the regional water system. With this in mind, the report outlines a program designed based on industry standards for asset management and answers basic questions such as:

- What are the assets?
- What condition are these assets in, what is their value, and what is their remaining useful life?
- What are the replacement costs for assets?
- What investments are being made in maintenance programs and capital improvements to reliably achieve adopted levels of service?

This report is being developed at an important time as the SFPUC enters the later stages of the Water System Improvement Program (WISP), a $4.6 billion program created to repair, replace, and seismically upgrade the system's deteriorating pipelines, tunnels, reservoirs, pump stations, storage tanks, and dams. The WSIP is one of the largest water infrastructure programs in the nation and the largest infrastructure program ever undertaken by the City of San Francisco. The program is funded by a bond measure that was approved by San Francisco voters in November 2002 and includes more than 80 projects throughout the service area – from San Francisco to the Central Valley – to be completed by the end of 2015.

One of the key achievements of the WISP was the development of clear levels of service objectives which are used to drive capital investment priorities. More recently, the SFPUC has developed additional asset management levels of service objectives to ensure that new assets are appropriately maintained and replaced so that levels of service are maintained into the future.

Finally, this report is also designed to respond to a contractual requirement outlined in the July 2009 Water Sales Agreement among the 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.*

1.1 Report Organization

Following the introductory text in Section 1, a comprehensive overview of the assets in the Regional Water System and their general condition as of September 2010 is provided in Section 2. This structured discussion explains the asset classification system and provides a useful reference for the asset inventory. Section 3 documents completed maintenance work and capital projects during FY10 and outlines planned work for the next two fiscal years (FY11 and FY12). Together these two sections provide a snapshot in time of the "State of the Regional Water System".

Sections 4, 5, and 6 provide descriptions of the general asset management program for reference. The relationship among asset management functions is outlined in Section 4. Section 5 documents many maintenance strategies and support systems and Section 6 outlines the program used to regularly assess the condition of assets as well as the specialized programs for dams and linear assets (pipelines).

The proposed $255M 2012 CIP is outlined in Section 7 along with short project descriptions. Section 8 provides summary expenditure tables related to maintenance and renewal/replacement (R&R).

2. Description of System Assets and Facility Condition

This section summarizes the assets of the Regional Water System. Section 2.1 describes the major components of the Regional Water System. Section 2.2 discusses the hierarchy utilized to divide the system into individual facilities, assets, and equipment follows a general description of the system. A systematic classification method is essential to managing maintenance, inspection, repair, and capital investment required to deliver the defined levels of service due to the number of assets in the system (over 8,000). Section 2.3 discusses the assets contained in each of the major classes.

2.1 Regional Water System Background

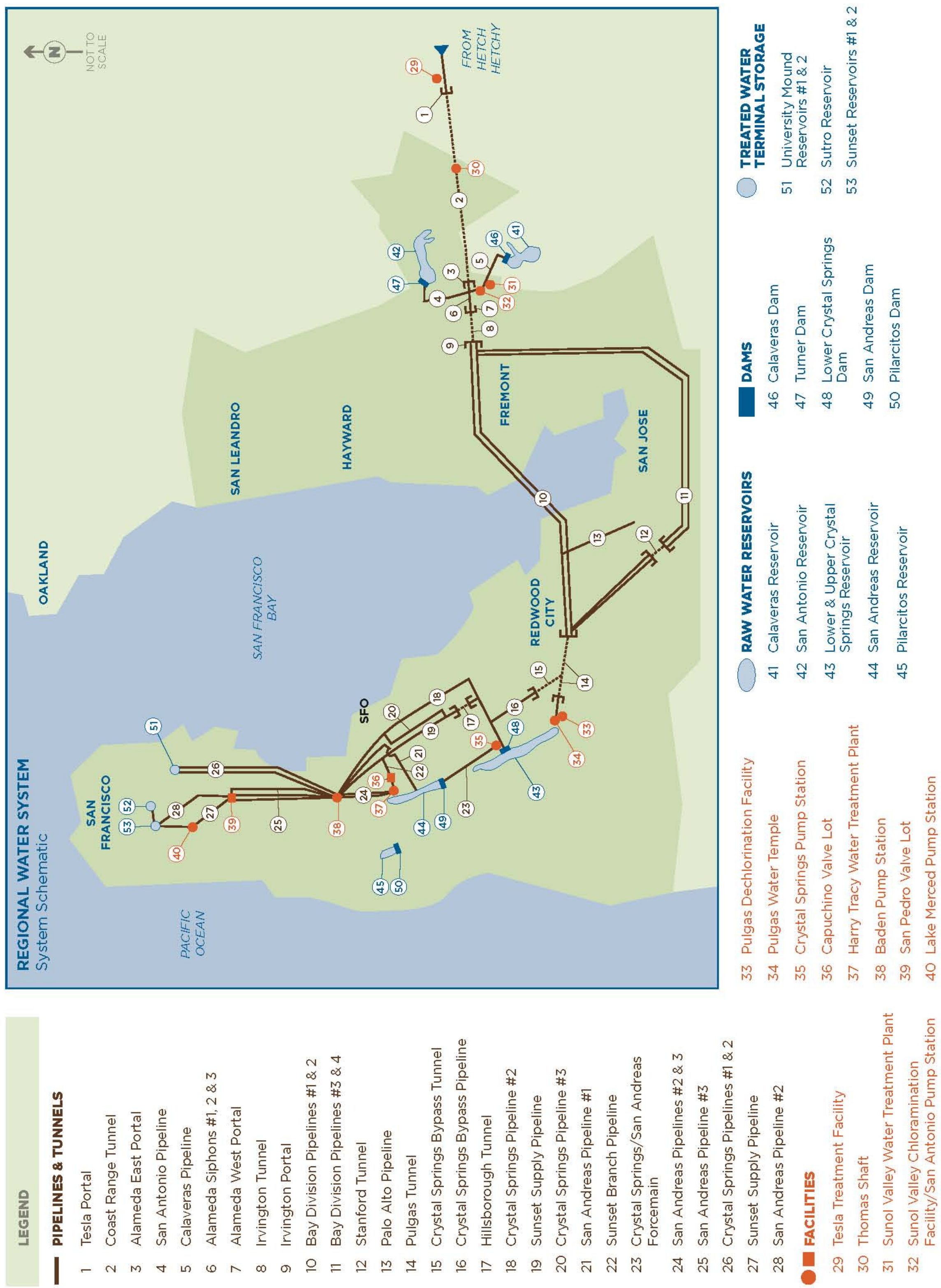
The Regional Water System conveys water from primary sources in Hetch Hetchy and various local sources to the City of San Francisco and 25 wholesale agencies in the Bay Area. Figure 2-1 is a schematic diagram of the regional water system showing pipelines and tunnels, treatment facilities, dams and reservoirs.

The regional water system begin at the Tesla Portal, where water received from the Hetch Hetchy Division is disinfected at the Tesla Treatment Facility, then travels through the 25-mile Coast Range Tunnel to the 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 the Tesla Portal.

At the Alameda East Portal, Hetch Hetchy water is split among the three Alameda Creek Siphons. Under normal operating conditions, Hetch Hetchy water is chloraminated and fluoridated by the Sunol Chloramination Facility in the mixing chamber before reaching the Alameda West Portal where water enters the Irvington Tunnel. Hetch Hetchy water can also be diverted to San Antonio Reservoir or the Sunol Valley Water Treatment Plant (Sunol Valley WTP). The Calaveras and San Antonio Reservoirs collect local runoff from their surrounding watersheds to supplement Hetch Hetchy water. All local reservoir water in the East Bay is conveyed to the Sunol Valley Water Treatment Plant where it is treated prior to entering the Alameda Siphons.

From the Irvington Tunnel, the blend of Hetch Hetchy water and water treated at the Sunol Water Treatment Plant is split into the four Bay Division Pipelines at the Irvington Portal in Fremont. Bay Division Pipelines Nos. 1 and 2 continue west from the Irvington Portal, under San Francisco Bay near the Dumbarton Bridge, through the Ravenswood area, to the Pulgas Tunnel just west of Redwood City. Bay Division Pipelines Nos. 3 and 4 travel south from the Irvington Portal and follow the south shore of the San Francisco Bay through Santa Clara, Sunnyvale, Mountain View, the Stanford Tunnel, and Palo Alto to the Pulgas Tunnel just west of Redwood City where all four pipelines meet. Water in the Pulgas Tunnel is diverted into the Crystal Springs by-pass tunnel and pipeline when needed to meet demand on the peninsula; when no demand exists, water continues to the Pulgas Temple and spills into Upper Crystal Springs Reservoir after being dechloraminated at the Pulgas Dechloramination Facility. The Palo Alto Pipeline is supplied by Bay Division Pipelines Nos. 1 and 2, and supplies water south from Redwood City to Palo Alto, Stanford and Menlo Park.

Figure 2-1: Schematic Diagram of Regional Water System



From the Crystal Springs Bypass Tunnel and Pipeline, Hetch Hetchy/Sunol Valley WTP water is transmitted north along the Peninsula into the City of San Francisco's "low zone" system via the Sunset Supply Pipeline and Crystal Springs Pipelines Nos. 1, 2 and 3. The terminal storage for "low zone" water consists of the University Mound Reservoir in San Francisco, which is supplied from Crystal Springs Pipelines Nos. 1 and 2. The Sunset Supply Pipeline low-zone water is transmitted north along the Peninsula to the Lake Merced Pump Station in San Francisco where it is pumped into the high zone Sunset Reservoir and Sutro Reservoir in San Francisco.

The Crystal Springs watershed on the Peninsula supplies Lower and Upper Crystal Springs Reservoirs. Pilarcitos watershed supplies are also used to supply Lower Crystal Springs Reservoir. The San Andreas 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 (Harry Tracy WTP) draws from San Andreas Reservoir for supply and produces "high zone" water. Treated water from Harry Tracy WTP is transmitted to the San Andreas Pipeline Nos. 2 and 3 and the Sunset Branch Pipeline. The San Andreas Pipeline Nos. 2 and 3 reach high zone reservoirs in San Francisco. The Sunset Branch Pipeline connects high-zone to low water in the Sunset Supply Pipeline through a pressure reduction valve at the Capuchino Valve Lot. Baden Pump Station allows low zone water from Crystal Springs Pipeline No. 2 to be pumped each of the high zone pipelines. Both of these connections between pressure zones greatly increase operational flexibility, particularly during construction work and in emergencies. The Pilarcitos watershed and reservoir to the west of San Andreas Reservoir is used to partially supply the Coastside County Water District.

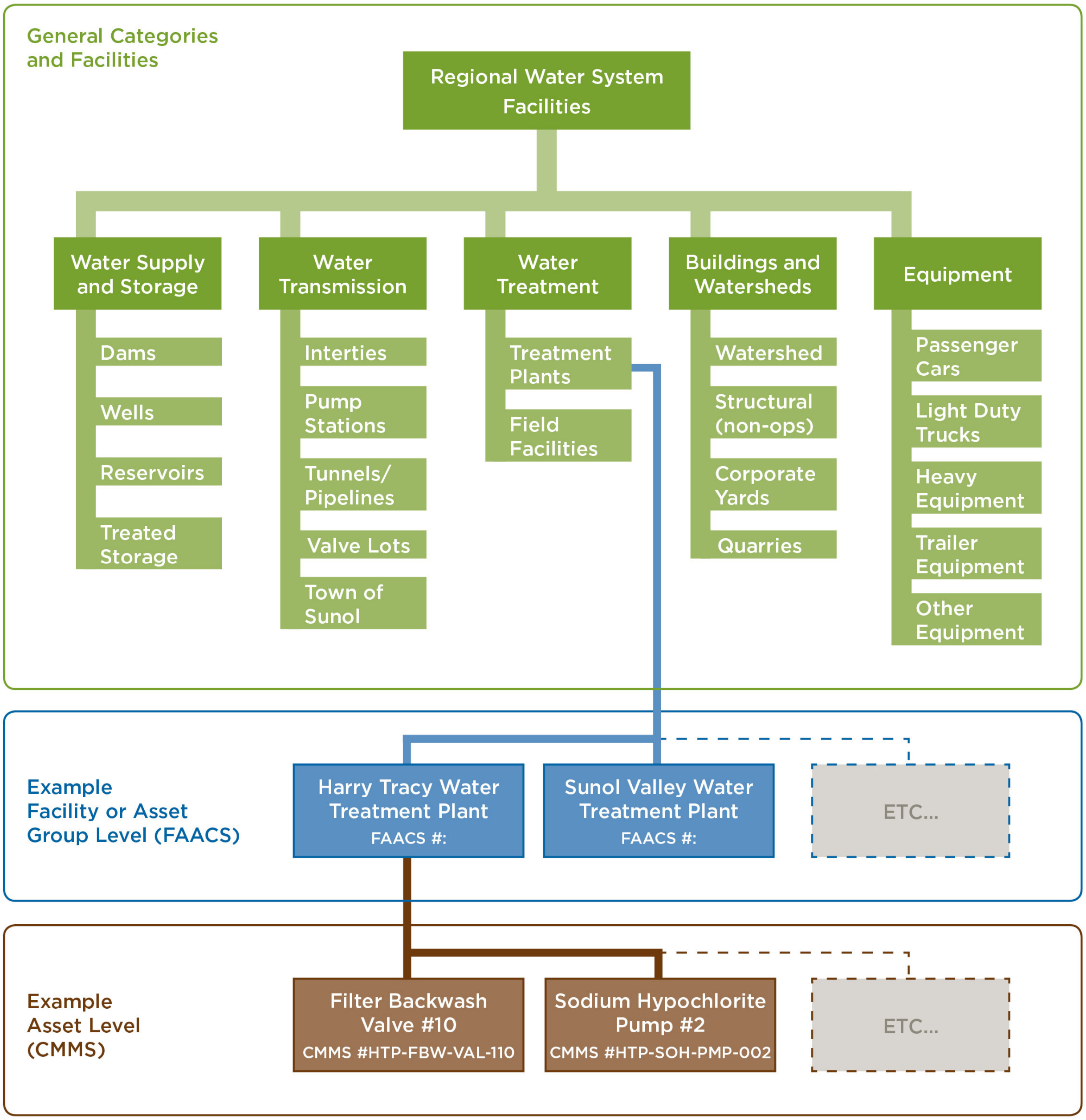
2.2 Asset Hierarchy and Catalog System

The Regional Water System is comprised of thousands of pieces of equipment most of which are considered to be assets for financial and management purposes. For the purposes of this report, "equipment", "asset" and "facility" are defined as:

- Facility – A collection of assets or equipment at a specific geographic location often housed within one or more structures (e.g. Harry Tracy Water Treatment Plant).
- Asset – Any piece of equipment greater than $5,000 in value, with a useful life of longer then three years, and/or serving some critical role in daily operations. Assets also include structures, land and water bodies, as well as linear assets such as pipelines and roadways.
- Equipment – Any specific electrical or mechanical implement, including instrumentation used in the daily operation of the Regional Water System that is not considered to be an asset.

Each facility of the regional water system is assigned to one of four general categories shown in Figure 2-2. These categories are: Water Supply and Storage, Water Transmission, Water Treatment, and Buildings and Watersheds. The fifth category, Rolling Stock, consists of groups of assets such as vehicles.

Figure 2-2: Regional Water System Asset Hierarchy



2.3 Description of Regional Water System Facilities

This section outlines the five asset categories and includes a brief condition assessment. Where applicable, existing Water System Improvement Program (WSIP) projects and future capital improvement program projects are discussed.

2.3.1 Water Supply and Storage Facilities

Dams

A list of the Regional Water System dams is given in Table A-1 for reference. The regular dam inspection and monitoring program is outlined in Section 6.3. All dams in the regional water system are regularly monitored and surveyed independent of capital work. For jurisdictional dams, annual field inspections are conducted by the State Division of Safety of Dams (DSOD).

Calaveras Dam

Since 2002, Calaveras Dam has been lowered to 40 percent of design capacity due to seismic safety concerns. The SFPUC is presently planning to replace the dam with a new structure of earth and rock fill. The dam will be of equal height and improved seismic design and will be constructed immediately downstream under the WSIP. Upon completion, Calaveras Reservoir will return to being the system's largest local reservoir and represents more than half of the SFPUC storage capacity in the Bay Area.

San Antonio Dam

San Antonio Dam is the newest dam in the system. There are no structural issues with the dam and known deficiencies with monitoring equipment were addressed in FY 2010 through an upgrade project

Alameda Creek Diversion Dam

The Alameda Creek Diversion Dam is structurally sound but the sluicing gates have limited operationally ability. The entire structure will be modified under WSIP and will include a new fish passage ladder and screened intake into the diversion tunnel that leads to Calaveras Reservoir.

Lower Crystal Springs Dam

On the Peninsula, most of the focus is on Lower Crystal Springs Dam. In 1983, DSOD mandated that the maximum allowable water surface elevation of the 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 (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. Under the WSIP, necessary improvements are expected to be made by 2012 so that the dam can safely pass the Probable Maximum Flood event, and thereby restore the maximum storage capacity of the reservoir. The project involves widening the spillway, raising the parapet wall, and replacing the stilling basin with a new, larger facility. The dam remains structurally sound and no immediate studies are planned.

Upper Crystal Springs Dam

Upper Crystal Springs Dam is a non-DSOD jurisdictional dam that separates upper and lower Crystal Springs Reservoir. Although the dam is adjacent to the San Andreas fault and gate valves in the outlet culverts are not operational (nor generally needed), no improvements to the dam are planned.

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 west side of the dam abutment). No improvements are planned although the emergency release capacity is under active review by DSOD in conjunction with the WSIP upgrades to the inlet structure to the Harry Tracy Water Treatment Plant.

Pilarcitos Dam

DSOD is presently investigating Pilarcitos Dam, the oldest dam in day-to-day use. Geotechnical work will be completed in 2011 and DSOD recommendations are expected in 2012.

Stone Dam

Stone Dam, located in the Pilarcitos system, is in satisfactory structural condition but is largely silted in due to lack of regular dredging. Stone Dam is a non-DSOD jurisdictional dam.

San Mateo Creek Dam No. 1

Various vegetation management 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.

San Mateo Creek Dam No. 2

San Mateo Creek Dam No. 2 is nearly filled with silk (approximately 600 cubic yards was recently removed) but is structurally sound. Maintenance of the Pilarcitos system will become more regular once permits are negotiated with the regulatory agencies. San Mateo Creek Dam No. 2 is a non-DSOD jurisdictional dam.

Wells

Groundwater wells represent the newest and oldest facilities in the regional water system. 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 general regional system. Meanwhile, on the peninsula the Regional Groundwater Storage and Recovery Project, part of the WSIP, will coordinate the use of both groundwater and surface water to increase water supply reliability during dry years or in emergencies. Project wells are located in San Mateo County and are being implemented 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.

Supply Reservoirs

Reservoirs and dams are separate facilities and accordingly have differing maintenance programs and schedules. Maintenance, repair and replacement related to supply reservoirs (listed in Table A-3) includes limnological monitoring, application of algaecide, maintenance to aeration (or oxygenation) systems, boating facilities, and outlet structures. Aeration systems have recently been added to Calaveras and San Antonio Reservoirs. A system for Pilarcitos is in the planning phase.

In 2009 the SFPUC began testing the use of sodium percarbonate as a more environmentally responsible alternative to copper sulfate for algae management. Tests to date have been limited to Calaveras Reservoir although recently the environmental approvals have been obtained for all local reservoirs. Sodium percarbonate is generally less effective than copper sulfate and considerably more expensive, but when used properly the product can control certain types of algae blooms. Outlet structure repairs to Crystal Springs, Calaveras, and San Andreas are being completed under WSIP, including seismic upgrades.

Treated Water Storage

The treated water storage reservoirs listed in Table A-4 require regular water quality and security monitoring, extensive SCADA instrumentation maintenance, regular removal of sediment, and structural upgrades. The north basins of University Mound and Sunset Reservoirs are being seismically upgraded under WSIP. General rehabilitation to Sunset Reservoir also includes repair of deteriorated concrete, replacement of the reservoir liner, replacement of inlet piping, and installation of security fencing. The roof of the Pulgas Balancing Reservoir is also being re-built under WSIP to improve seismic performance. The Town of Sunol treated water tanks will likely be overhauled as part of the fire suppression system upgrade for the town. No extensive capital work is planned for Merced Manor following work completed as part of the 1998 A&B bond-funded seismic upgrade project, nor is any major work planned for the much smaller Castlewood Reservoir as both of these facilities are in generally good condition. A small SCADA project may be initiated at Castlewood to improve the reliability of communications.

2.3.2 Water Transmission Facilities

Pipeline Inventory and Condition

Pipelines of the Regional Water System range greatly in terms of installation date, pipeline material, pipeline condition, and operational importance. The present inventory is shown in Table A.5. Early transmission projects completed by the Spring Valley Water Company between 1890 and 1930 were constructed from either cast iron or wrought steel[1]. 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. 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 San Andreas No. 1, the 54" portion of Crystal Springs No. 2, and Bay Division No. 1. The three submarine pipelines beneath Dumbarton Strait are cast iron.

A brief period of materials development utilized a longitudinal mechanical "lockbar" that fastened the edges of rolled steel plates, thus replacing longitudinal rivet courses. Only one

[1] 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.

such pipeline remains active, the 54” San Andreas Pipeline No. 2, constructed in 1928; San Andreas Pipeline No. 2 has riveted joints.

Welded steel pipe (WSP) was developed in the early 1930s. Many pipelines under Hetch Hetchy and SFWD construction contracts utilized WSP. Longitudinal seams are welded in the shop during fabrication with an automatic arc welding process. Circumferential joints are arc welded in the field by hand.

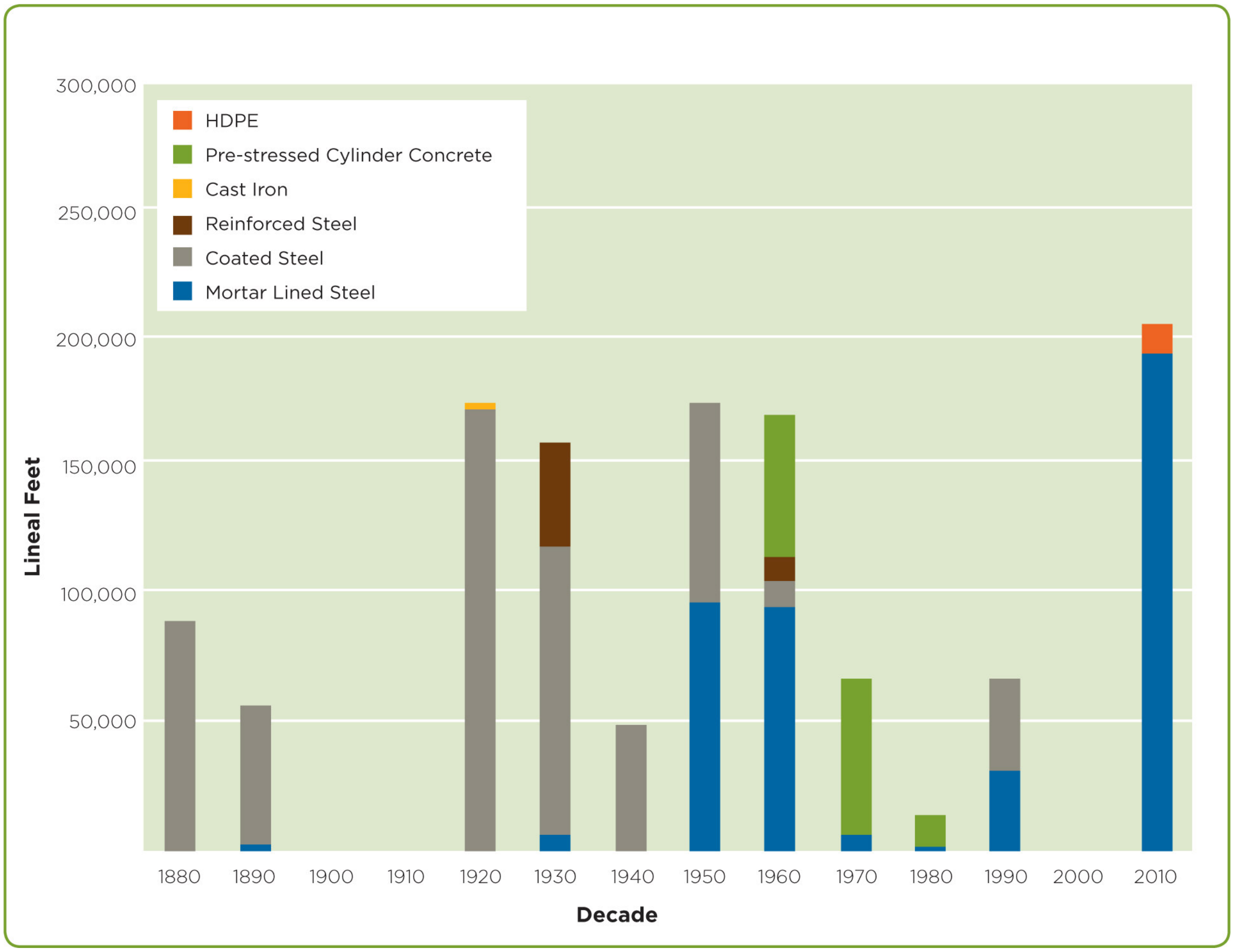
Also during the 1930s reinforced concrete cylinder pipe (RCP) was developed: a steel cylinder with high-strength concrete is cast on both sides of the cylinder. Reinforcing steel bars are embedded in the concrete outside the cylinder. Portions of Bay Division Pipeline Nos. 2 and 3 and the upstream portion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

Pre-stressed concrete cylinder pipe (PCCP) was developed in the 1950s. The concept was to use less steel in pipe: high-strength wire was wound to high tension around a concrete core to develop compressive strength in the pipe. In the 1960s, SFWD began to offer PCCP as an option to bidders for pipeline construction. Two sections of Bay Division Pipeline No. 4, Alameda Siphon No. 3, portions of Crystal Springs No. 3, and the Crystal Springs By-Pass Pipeline were constructed with PCCP, for a total of 28 miles by 1988. Because PCCP can fail catastrophically, SFPUC no longer offers PCCP as an option for new pipelines.

Appendix B contains a table listing the inventory and condition of regional water system (active) pipelines and tunnels. The table provides information about pipeline material, lining and coatings as wells as leak history and summarized results from inspections, construction modifications, cathodic protection and maintenance. A significant part of the maintenance program is dedicated to pipeline and tunnel inspection and repair (see Section 6.2). Additionally, the regional water system 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.

Table A-5 also provides other pipeline and tunnel specifications including length, capacity, and installation date. In addition to this report, the SFPUC’s “Data Book” provides extensive detail on pipelines and tunnels and is being updated in 2010. A graphical inventory of pipelines with pipeline material and installation date is shown in Figure 2-3.

Figure 2-3: Lineal Feet of Regional Water System Pipelines by Material and Installation Decade



The WSIP includes five additional conveyance facilities: Alameda Siphon No. 4, New Irvington Tunnel, Bay Division No. 5, New Crystal Springs By-Pass Tunnel, and San Andreas No. 3 (plus San Joaquin Pipeline No. 4 within the Hetch Hetchy Division). Additionally, 16 sections of Crystal Springs Pipeline No. 2 will be repaired. While these improvements are significant, most of the transmission upgrades will allow necessary maintenance and repair of existing conveyance facilities as opposed to completely rehabilitating/replacing existing aging assets. The CIP includes placeholder repair and replacement pipeline projects that will be initiated following WSIP. To date, these projects include additional repairs to Crystal Springs Pipeline No. 2 not covered under WSIP, repair or replacement of Bay Division No. 4, sections A and D (PCCP sections). Also, based on the last inspection in the winter of 2010, repairs to the interior cement mortar lining of Bay Division Pipeline No. 4, Section B, will be about $2 million. Repairs will likely span the full length of Bay Division Pipeline No. 4, Section B, about 47,400 feet with roughly 15,000 square feet of affected area.

Pump Stations

Each major pump station in the Regional Water System is being partially or totally re-built as part of WSIP. Crystal Springs Pump Station will be completely rebuilt by 2012. Scope for the project includes upgraded seismic performance, modern switchgear and starters, and variable speed pumps. Collectively, the operational upgrades will permit more off-peak pumping and will lower electrical costs. Baden Pump Station is undergoing a variety of improvements including installation of variable speed pumps, installation of a new pressure-reducing valve to allow water Harry Tracy WTP (high-pressure zone) to supply the low-pressure supply 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 will be replaced and stabilizing slope improvements will be completed at the Pulgas Tunnel Air Shaft site.

Under the WSIP, the San Antonio Pump Station is being partially re-built. Improvements include replacement of the 1,000-horsepower electrical pumps, addition of two 1.5-megawatt emergency generators, and a seismic retrofit to ensure operator safety. A seismic retrofit of the pump station itself to ensure continuous post-seismic operation as well as replacement of diesel engines may be included as a future CIP project.

Lake Merced Pump Station is presently being rebuilt under WSIP. The new pump station will be designed to resist fire, seismic and other catastrophic events. Modern, energy-efficient pumps and controls will replace the existing ones, and new emergency backup generators will ensure continuous station operation in case of a power outage.

Valves and Valve Lots

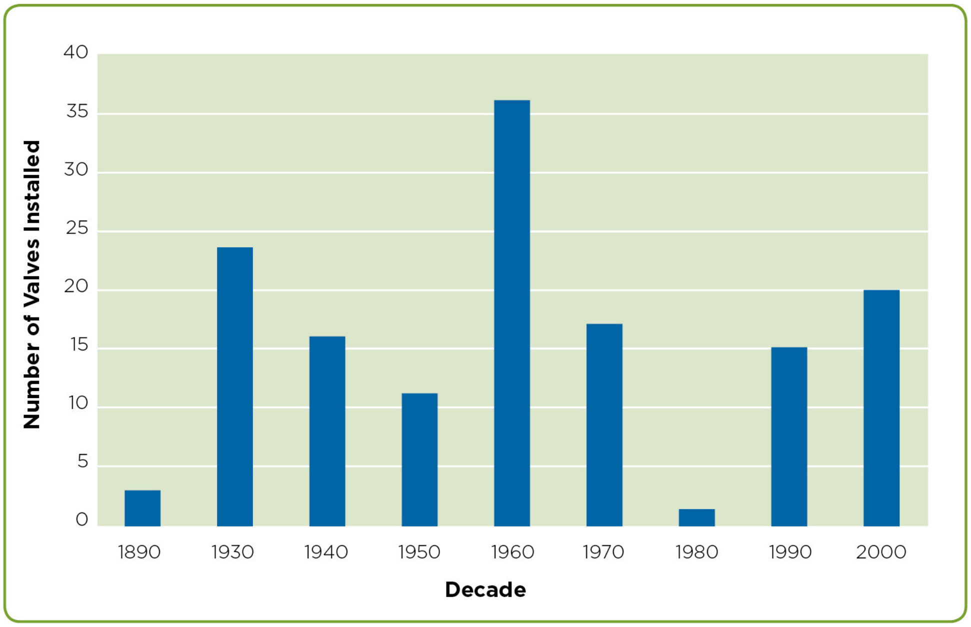
The Regional Water System includes over 300 valves of various sizes, types, functions and periods of installation. A complete 2010 inventory of main-line valves of the transmission system is shown in Table A.7. By-pass valves and service connection valves are not included. Approximately 40 major valves are being added under WSIP. Figure 2-4 shows the installation dates for valves in the system, 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 within WSIP, including the cross-over valve lots on Bay Division pipelines Nos. 3 and 4 where a total of six facilities will be built by 2012. 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 support emergency earthquake recovery by enabling the system to be isolated on either side of the Hayward Fault. The facilities include turnouts quick installation of temporarily piping to span the fault zone.

In the San Pedro Valve Lot an existing capital project is underway to seismically retrofit two valve vaults, modify electric valve operators, install a new air valve, and to perform miscellaneous site drainage improvements. Elsewhere under WSIP a variety of valves are being replaced as they are identified. In most cases, replacement valves are needed to allow a construction zone to be isolated. In other cases, valves are replaced because they are known to be faulty.

The valve exercising and maintenance program has recently been enhanced to extend the life of installed valves. 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 mis-operation, poor maintenance, and improper valve material specification.

Figure 2-4: Number of Valves Installed by Decade



Interties

The Regional Water System has an intertie with the EBMUD in Hayward and with SCVWD in Milpitas offering access to other regional water suppliers in emergencies or during planned maintenance. Both interties have been thoroughly tested and are relatively new; the EBMUD intertie was operational in 2007 and the SCVWD intertie was operational in 2004. Maintenance requirements are developed each year for the interties. The only significant planned capital expenditure is to replace the generators at the SCVWD to comply with air quality standards.

There is also a temporary intertie with the State Water Project in the Sunol Valley and a one-way (to SFPUC) tie-in at the San Antonio Reservoir. The State Department of Water Resources and the SFPUC are actively working to develop the capital upgrades and long-term maintenance requirements for these interties. Pipelines on the SFPUC-side of Sunol Valley intertie will be replaced and re-located as part of WSIP.

Distribution Systems

Aside from a small number of individual residential and commercial customers outside of San Francisco, the Regional Water System owns and operates the Town of Sunol's distribution system. This system requires costly flushing and water quality monitoring and adjustments due to the high residence time of the potable system. A capital improvement project that will lower operational costs, improve water quality and improve fire suppression service to the community is currently in the planning phase.

The SFPUC is presently negotiating with the Golden Gate Primitive Baptist Church in Alameda County to transfer full ownership and operational responsibility of this small system to the private owners. The distribution system for the Castlewood community is managed by California Water Service Company.

2.3.3 Water Treatment Facilities

The Regional Water System utilizes three major treatment facilities including two filtered water treatment plants which treat local watershed water and a nearly operational water treatment plant at the Coast Range Tunnel inlet which employs UV irradiation and disinfection for Hetch Hetchy supplies. These facilities are listed in Table 2-1 and include: Harry Tracy Water Treatment Plant (WTP), Sunol Valley WTP, and Tesla Treatment Facility. Both the Harry Tracy WTP and Sunol Valley WTP are presently being modified under the WSIP.

Table 2-1: Regional Water System Major Treatment Facilities

Facility	Primary Processes	Capacity	Location
Harry Tracy WTP	Filtered Water, Ozonination	150 mgd	San Mateo County
Sunol Valley WTP	Filtered Water, chlorination	150 mgd	Alameda County
Tesla Treatment Facility	UV, chlorination	350 mgd	San Joaquin County

Harry Tracy WTP, located in San Bruno, supplies the "high zone" customers on the Upper Peninsula and San Francisco. Local water is pumped from the Crystal Springs Reservoir to San Andreas Reservoir, where it enters Harry Tracy WTP. 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, the water is pH corrected and fluoridated before leaving the plant and entering the transmission system for public consumption. In order to meet the level of service goals established under WSIP (Section 4.3.1) the plant will be greatly modified. Five new filters will be added, chemical tanks relocated and, due to seismic concerns, the treated water reservoirs will be safely relocated to more stable grounds. The conveyance structures that bring water from San Andreas Reservoir to Harry Tracy WTP will be rebuilt to present seismic code.

The Sunol Valley WTP 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. Water leaving the plant is chlorinated and pH corrected before entering the Alameda Creek Siphons near the Sunol Valley Chloramines Facility (SVCF). 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 plant remodel will re-build all of the existing filters at Sunol Valley WTP. Additionally, a treated water reservoir will be added. These upgrades will greatly improve the plants reliable capacity and correct deficiencies associated with not having a treated water reservoir.

Four other major field treatment facilities are part of the Regional Water System. The Tesla Portal Chlorination Facility (TPCF) presently provides primary disinfection for unfiltered Hetch Hetchy supplies (beginning in December 2010, this function will be provided by the new nearby Tesla Treatment Facility). Flows of up to 315 Million Gallons a Day (MGD) are treated with Sodium Hypochlorite at the facility. Uninterrupted chemical dosing is critical for public health and to maintain our operating permit with the California Department of Public Health. Should there be a failure of the chemical feed equipment at the 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 Coast Range tunnel. As the water passes through the Sunol Valley further treatment is performed at the Sunol Valley Chloramines Facility (SVCF). The chlorine residual is trimmed, ammonia is added to form chloramines, the water is pH corrected and fluoridated. Last, the Pulgas Dechlormaination 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 a necessary relief when system hydraulics change and pipelines become pressurized.

2.3.4 Building and Watershed Facilities

The inventory of watershed lands, non-operations related structures and buildings, corporation yards, and quarries are listed in Tables A.10, A.11, A.12, and A.13, respectively. A significant portion of the CIP is dedicated to the re-development of the Sunol Corporation Yard and the Millbrae Corporation Yard. Redevelopment will modernize the facilities, including the water quality laboratory in Millbrae. Improvements for watershed residential cottages (under-funded for years) are now underway and included in the CIP.

Detail on watershed road inventory (miles of road, type, and location) and planned expenditures is limited and will be improved during the update of this report. In general, approximately $10M is reserved in the CIP for road repair, bridge construction, and other maintenance activities such as fencing repair.

Assets for the regional water system also include thousands of acres of property outside of the watershed used for various infrastructure, most notably pipelines and valve lots. The SFPUC expends significant effort managing both watershed and right-of-way based property. These expenditures will be integrated into future reports.

2.3.5 Rolling Stock

The Regional Water System has an extensive inventory of rolling (and floating) stock summarized in Table A-14 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, CalFire, and the East Bay Regional Park District in emergencies.

3. Regional Water System Maintenance, Repair, and Replacement

This section provides a summary of completed projects in FY10 and planned projects in FY11 and FY12. Generalized descriptions of the programs are offered in subsequent sections.

3.1 Completed FY10 Maintenance, Repair, and Replacement

3.1.1 Condition Assessment

An extensive condition assessment program was initiated in FY09 to establish baseline data and will be active through FY11. The program establishes and inspects assets considered vital to the operation of the regional water system. Assets and equipment are evaluated by maintenance experts, technicians, and engineering staff. Asset condition is recorded, deficiencies identified, and corrective maintenance is initiated. The condition assessments also provided an opportunity to correct existing records and preventative maintenance procedures.

Accomplishments in FY10 include:

- Completed assessment of all Tier 1 assets and equipment;
- Confirmed current assets through field verification and cross-referenced with assets indicated in Computerized Maintenance Management System (CMMS); the CMMS database is adjusted as appropriate;
- Standardized and completed review by engineers of existing preventative maintenance procedures; and,
- Identified and performed prioritized corrective maintenance.

3.1.2 Pipeline Maintenance

The program identifies, initiates, and performs critical corrective and preventative maintenance on the pipelines within the Regional Water System. The program also improves corrosion control and valve maintenance. Accomplishments are indicated below.

<u>Pipeline Inspection and Repair Accomplishments</u>

- Conducted visual interior pipeline inspections and appurtenance replacement, taking advantage of WSIP shutdowns that included:
  - Bay Division Pipeline No. 4, Section B: Systematic pipe appurtenance replacement; interior inspection
  - Bay Division Pipeline No. 3, Section B: Systematic pipe appurtenance replacement; interior inspection; interior mortar lining repairs
  - San Mateo Tunnel #1: Interior inspection of 1,000 feet.

<u>Corrosion Protection Accomplishments</u>

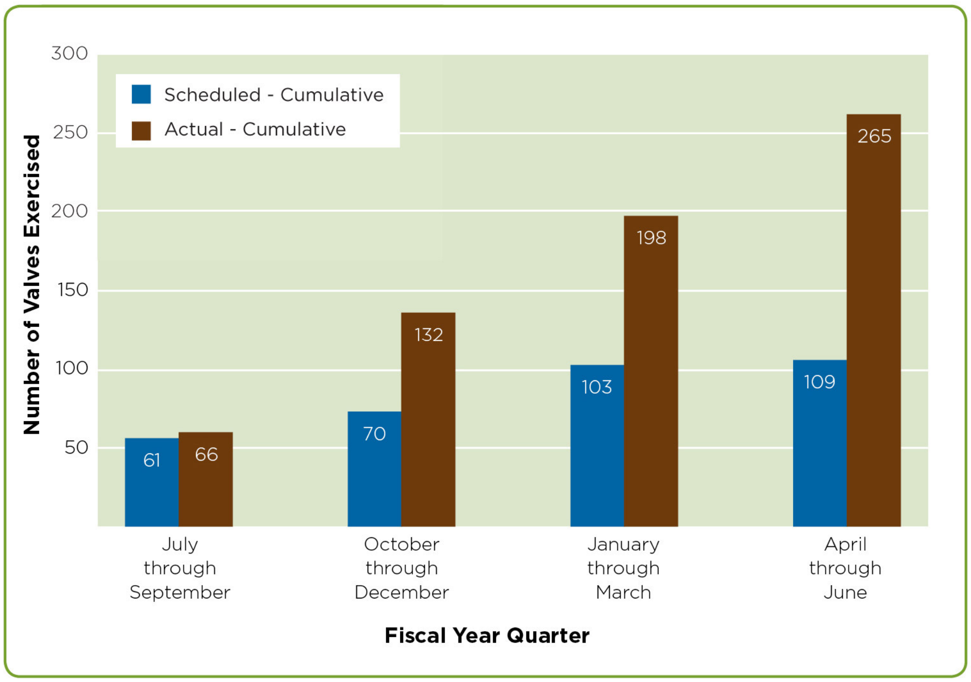
- Assessed the corrosion potential on all pipelines within the Regional Water System and developed a master plan to implement projects as a result of assessment;

- Gathered comprehensive inventory of field appurtenances, and located each with GPS; and,
- Repaired and replaced test stations on Crystal Springs No. 3 pipeline.

Valve Exercising Program Progress

Valve exercising continued to increase at higher rates in FY10 compared to FY09 and all years prior. The objective of the program was initially established to exercise all main line valves at least once per year until the back log had been clear. Figure 5 below indicates the actual performance compared to objectives.

Figure 3-1: Number of Valves Exercised Quarterly in FY10, Scheduled versus Actual



Exercising for the year fell short of the objective starting in the second quarter of fiscal year 2010 due to focused efforts for WSIP support. Greater priority will be given to valve exercising efforts as required WSIP support diminishes.

3.1.3 Repair and Replacement

Upgrades were performed at the Harry Tracy Water Treatment Plant and the Sunol Valley Water Treatment Plant as part of the WSIP or as R&R projects. The accomplishments at these locations are discussed below.

Harry Tracy Water Treatment Plant

The following upgrades were completed as part of either the Harry Tracy Water Treatment Plant Short-Term Improvements Project (WSIP) or as R&R projects:

- Installation of new flash mix system including three vertical turbine pumps and flow meters;
- Structurally modified flocculation basins for seismic strengthening and installation of eleven vertical-shaft turbine flocculators for mechanical mixing;
- Installation of new chemical nozzles and chemical dilution system in both channels for the coagulation chemical injection system;
- Replaced level instrument in channel in the Settled Water Channel;
- Structurally modified ten filters for seismic strengthening and completed new underdrains, filter media, and washwater troughs;
- Completion of new filter-to-waste system with pipes, modulating valves, isolation valves, and flow meters;
- Installation of new dechlorination system for the plant discharges from the clarifiers to the San Andreas Reservoir (new online monitors for pH and chlorine were also installed);
- Upgraded existing chlorine and pH analyzers at clarifier units;
- Replaced two washwater actuator pumps and installed an electric actuator to control wash-water tank discharge valve;
- Completed SCADA/Wonderware upgrade and migration;
- Replaced major plumbing and electrical equipment on the pilot plant, including installation of new turbidity meters and level sensors;
- Added redundant network switch to Raw Water Program Logic Controller network;
- Replaced the Uninterruptible Power Supply for all critical equipment; and,
- Completed plant effluent pipeline seismic valve shutdown system.

Sunol Valley Water Treatment Plant

The following upgrades were completed at the Sunol Valley Water Treatment Plant:

- Partial replacement of chemical piping from the plant headworks to the chemical injection pumps, including all double-containment piping;
- Relined three chemical storage tanks;
- Completed plant DCS software upgrade and migration;
- Replaced several obsolete main power distribution control panels;
- Upgraded instrumentation for collecting and evaluating disinfection credit;
- Removed several obsolete and retired pieces of equipment;
- Rehabilitated valve V-40;
- Performed valve and vault improvements on valves V41 and V43; and,
- Installed algal monitoring instrumentation on the Calaveras and San Antonio Pipelines.

3.1.4 WSIP Support

A significant amount of effort was spent supporting WSIP during FY10. Activities include preparing and shutting down facilities to support construction and continuous other on-site support during construction. Specific accomplishments include:

- Concentrated efforts on corrective maintenance at Sunol Valley WTP in preparation of the Coast Range Tunnel shutdown – work resulted in no unplanned outages during the shutdown.
- Concentrated efforts on corrective maintenance at Harry Tracy WTP in preparation for the New Crystal Springs Bypass Tunnel Shutdown to reduce probability of unplanned outages in January 2011.
- Coordinated multiple shutdowns of the Alameda Siphons, San Andreas No. 3, San Andreas No. 2, Sunset Supply Pipeline, San Antonio Pipeline, and Bay Divisions Pipelines No. 3 and 4.

3.1.5 Dam Monitoring

All annual field inspections were completed in FY10 for DSOD-jurisdictional dams as indicated in Table 3-1.

Table 3-1: DSOD-Jurisdictional Dam Field Inspections

Dam	DSOD Inspection Date
San Andreas	December 2, 2009
Lower Crystal Springs	December 2, 2009
Pilarcitos	December 2, 2009
Calaveras	March 16, 2010
San Antonio (Turner Dam)	March 17, 2010

3.2 Planned FY11 and FY12 Maintenance, Repair, and Replacement

3.2.1 Condition Assessment

Condition assessments for Tier 2 facilities will be completed in FY11; specific facilities are listed in Appendix B. Tier 3 facilities will be assessed in FY12. Data in the CMMS will continue to be refined and improved after the upgrade to MAXIMO 7.1 (anticipated in October 2010) is completed. Engineering review of existing preventative maintenance procedures and prioritized corrective maintenance on the Harry Tracy WTP prior to the WSIP shutdown of the Crystal Springs By-Pass Tunnel in January 2011 will be completed by December 2010.

3.2.2 Pipeline Maintenance

Pipeline Inspection and Repair

Similar to FY10, anticipated work in FY11 and FY12 will be coordinated with WSIP construction. Inspection and minor repairs are anticipated are planned for:

- Alameda Siphon No. 1
- Bay Division Pipeline No. 2, Section D
- Bay Division Pipeline No. 3, Sections C and D
- Bay Division Pipeline No. 4, Sections C and D
- Crystal Springs Bypass Tunnel
- Crystal Springs Pipeline No. 3

Corrosion Protection

Engineering and management meetings will be held in October to prioritize projects for FY11 and FY12 with an estimated $5M in expected expenditures over the next three fiscal years. These projects will be chosen from the 2010 Master Plan update. Project prioritization will depend on compatibility with WSIP, operational criticality of the pipeline, surface liability, cost, vulnerability of pipeline to other modes of failure (liquefaction, proximity to faults, etc.).

Valve Exercising

The objective of exercising once per year will be maintained during FY11 until the backlog is cleared before being lowered to every main-line valve every two years, to match the current industry standard.

3.2.3 Repair and Replacement (R&R)

Harry Tracy Water Treatment Plant

During FY11 and FY12, the SFPUC will continue to pursue plant performance optimization at the Harry Tracy WTP prior to the January 2011 shutdown of the Crystal Springs By-Pass Tunnel. Planned work includes:

- Replacement/upgrade of all programmable logic controllers to enable on-line redundancy;
- Upgrade of the air conditioning in the ozone server room;
- Replacement of the ferric chloride and cationic polymer chemical feed pumps; and,
- Upgrade of the plant discharge monitoring system, including new UPS, redundant water quality monitoring instrumentation, and new sample pumps.

Sunol Valley Water Treatment Plant

During FY11 and FY12, the Sunol Valley WTP will be undergoing major improvements under WSIP. The scope of the WSIP project includes a fifth pre-treatment train (flocculation and sedimentation basins), upgrades of all existing filters to deep-bed dual media filters, a 3 MG baffled chlorine contact basin to facilitate compliance with inactivation requirements, addition of ammonia injection to minimize disinfection by-products formation, a 17.5 MG treated water reservoir, and a fourth washwater recovery basin. Much of the planned R&R work will be performed by the mobilized WSIP contractor; work includes:

- Replacement of chemical storage tanks and feed lines for aluminum sulfate, cationic polymer, and sodium hypochlorite;
- Identify and replace obsolete electrical panels and upgrade existing intercom system to improve response to plant alarms; and,
- Installation of new streaming current detector monitors for each source of supply and installation of new particle counters on all twelve individual filters and on the combined filter effluent.

Regional Water Transmission System

With the workload required to support WSIP, and with many projects being completed by WSIP contractors with R&R funding, relatively few R&R projects are planned outside of WSIP. Still, some work will be completed during FY11 and FY12. This work is highlighted below:

- Reconstruction of actuator rebuild and electrical service replacement at gate G20 in the existing Crystal Springs Bypass Tunnel;
- Purchase additional mitigation credits to increase the operating level of Crystal Springs Reservoir consist with the WSIP project (but not funded by WSIP);
- Miscellaneous tenant improvements within the existing Millbrae Administration Building (along with completion of design and environmental phases to the redevelopment of the Millbrae and Sunol Corporation Yards);
- Various vault upgrades and improvements to water metering;
- Ongoing pipeline appurtenance (combination air/vacuum valves, blow-offs, etc.) replacement; and,
- Upgrades to several watershed cottages, including complete re-build of the Tesla cottage.

3.2.4 WSIP Support

The following is an anticipated list of work occurring in FY11 and FY12:

- Continue concentrated efforts on corrective maintenance at HTWTP in preparation for the New Crystal Springs Bypass Tunnel Shutdown so no unplanned outages occur during the shutdown.
- Continue coordinating multiple shutdowns of the Alameda Siphons, San Andreas Pipeline 3, Crystal Springs Pipeline 2, Sunset Supply Pipeline, and Bay Division Pipelines Nos. 1, 2, 3 and 4.

3.2.5 Dam Monitoring

All annual field inspections are expected to be completed in FY11 for DSOD-jurisdictional dams. In FY12, due to WSIP construction involving replacement of Calaveras Dam, inspections may involve interim construction progress on the new dam rather than on the existing dam.

4. Asset Management Program Overview

Asset management 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. A comprehensive asset management program includes accurate data on assets (number, type, and condition), assesses replacement costs, minimizes costs by clearly defining repair and replacement needs, and develops strategic operations and maintenance programs to extend the useful life of critical facilities.

4.1 Asset Management Processes

Many processes are integrated to collectively create an asset management program:

- **Levels of Service:** Regular review and adoption of the expected Levels of Service (LOS);
- **Asset Inventory and Condition:** Regular condition assessment of assets and determination of actual performance as related to the LOS;
- **Planning:** Planning tasks that help identify performance shortcomings and result in the creation of operating programs and capital programs that eliminate the performance gap; and,
- **Budgeting:** Coordination with the budget processes to ensure financing for the programs and projects.

Figure 4-1 diagrams how these programs work together.

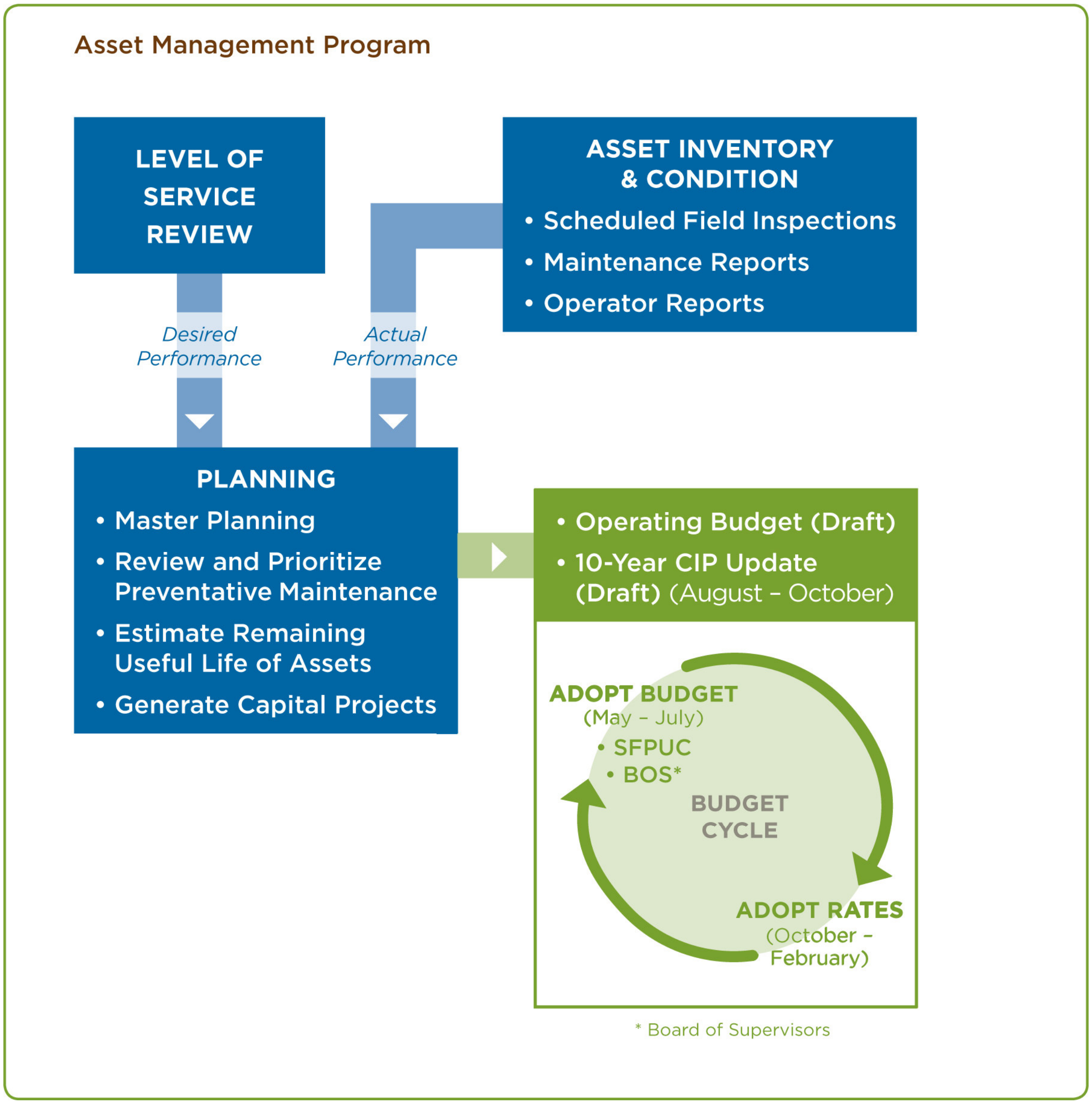
4.1.1 Levels of Service

The adopted Levels of Service represent the desired and expected performance of the assets – what rate payers think they are getting and what they are paying for. For the Regional Water System, Levels of Service were formally defined through the WSIP in four areas described in detail in Section 4.3:

- Water quality,
- Seismic reliability,
- Delivery reliability, and;
- Water supply.

The Levels of Service are formally adopted by the SFPUC in conjunction with the budget process as the two (desired performance and resulting cost) are necessarily related. Levels of Service can change for a variety of reasons including changes to regulatory requirements, system demand, and adoption of new reliability standards.

Figure 4-1: Asset Management Program Processes



4.1.2 Asset Inventory and Condition

The assets in the Regional Water System are cataloged in a systematic asset hierarchy within the MAXIMO computerized maintenance management system (CMMS) software. The CMMS allows thousands of pieces of equipment over four counties to be compiled in a simple, searchable inventory. The CMMS includes a complete description of each asset along with installation date and performance history; most assets are also geo-located in the CMMS and in GIS. A single Regional Water System schematic shows all major facilities for quick reference.

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.

4.1.3 Planning

Comparing and reconciling desired performance (LOS) and actual performance is the general objective of the planning process. When asset conditions are known, informed decisions can be made to either repair or replace certain assets, let others run to fail, or initiate a new capital project.

Investment decisions on many assets and facilities are compiled within the various master plan updates of the Regional Water System. Master plans are unique to a facility class (such as valve vaults or pre-stressed pipelines), or function (such as corrosion protection). The master plans review LOS objectives and asset condition, and then refine or adjust existing maintenance programs or create new capital projects. Individual master plans are updated every 5 to 7 years, with 1 or 2 updated each year. WSIP and other recent capital projects have significantly documented current asset condition making several master planning updates relatively easy in FY09, FY10 and FY11. Additionally, the 2002 CIP and supporting vulnerability studies that were used to generate most of the WSIP scope, identified additional capital projects that were deferred to later years and not included in WSIP. (These projects are discussed below in the CIP section.)

Maintenance programs are also reviewed as condition data increases and becomes more reliable. These programs are described in detail in Section 5.

4.1.4 Budgeting

The draft operating budget and draft updated 10-year CIP are prepared during the second quarter of the fiscal year based on the best available data from the planning process. A critical iterative step occurs when initial rate projections are calculated based on these preliminary draft expenditure plans. At this point, the operating budget, capital budget, acceptable rates, or even LOS are adjusted by the SFPUC until the budget matches forecasted expenses. Following various rate and budget hearings, rates are adopted and new year budgets are finalized at the staff level. Towards the end of the fiscal year, next year budgets are adopted by the SFPUC and later by the Board of Supervisors.

4.2 Asset Management Databases and Tools

Three primary databases support asset management processes by tracking the value of assets, asset maintenance activities and capital improvements, and geographic location. These databases are the Fixed Asset Accounting System (FAACS), the CMMS (MAXIMO), and the geographical information system (GIS). With the software upgrade to MAXUIMO 7.1 in October 2010, the SFPUC will effectively link the CMMS to GIS, that is, geographic data for assets will be directly available within the CMMS.

4.2.1 Fixed Asset Accounting System (FAACS)

FAACS is used to compute the present value of facilities or groups of assets net of depreciation, which is usually assumed to be linearly projected over a length of time unique to each class of asset. Each facility, which comprises many individual and groups of assets, is given a unique identification number and tracked FAACS. All new facilities or groups of assets are entered into FAACS following the accompanying capital project close-out. There are roughly 150 individual facilities in the regional water system that are depreciated based on capital upgrades, not including individual rolling stock.

4.2.2 MAXIMO CMMS

The MAXIMO CMMS operates at a level immediately below FAACS picking up all of the related assets and components that are maintained to support a given facility. There are thousands of assets in the CMMS and each has data recorded in the CMMS related condition, performance history, expenditures on maintenance, and types of maintenance performed. Condition assessment and performance data are an important linkage between data in the CMMS and data in FAACS; that is, when investments are made in preventative maintenance, the assumed depreciation in FAACS is ideally modified.

A consistent index system is presently being developed between the capital planning, FAACS, and CMMS so that the capital project management, financial accounting, and long-term maintenance functions for an asset can be consistently referenced.

4.2.3 Geographical Information System

Nearly all assets are recorded within various GIS libraries including pipeline alignment, drawings (plan and profile as-builts), 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, location of known earthquake faults. Planning and maintenance work will be enhanced after the conversion to MAXIMO 7.1 is completed.

4.3 Adopted Levels of Service

As discussed above, the adopted LOS drives the present capital program (WSIP). Following the completion of WSIP, LOS will drive the operating programs and additional CIP projects necessary to maintain the adopted LOS. Although the final WSIP project will be completed in 2015, many capital projects are already operational and subject to any number of maintenance programs required to keep the facility and assets in good working order. In this regard, the Regional Water System has essentially two LOS standards; one generalized LOS associated with the completion of the capital program (WSIP), and a more detailed one associated with maintaining the assets which will be applicable over a much longer period. All details of LOS should be memorialized and disclosed in the CIP and operating budgets. This allows convenient reference between the expected service and the projected cost for that service.

4.3.1 Programmatic Level – WSIP LOS

The WSIP LOS was developed during the WSIP and generally refers to the completion of various capital projects with defined scope and time-certain delivery. The WSIP LOS goals address four areas for improvement: water quality, seismic reliability, delivery reliability, and water supply. These goals are copied below for reference.

Water Quality LOS

The LOS goals for water quality are to:

- Provide a high quality water supply that reliably meets current and foreseeable local, state and federal drinking water standards.
- Implement watershed protection through land acquisition and management projects. (This service criterion will be achieved in a companion program to the WSIP but is stated here to set forth a comprehensive water quality plan.)

Seismic Reliability LOS

The LOS goals for seismic reliability are to:

- Deliver minimum system demand (winter-month demand) within 24 hours after a major earthquake. Minimum winter-month demand is estimated at 215 mgd in 2030. In general, minimum winter-month demand represents indoor residential, commercial and industrial use; it excludes landscape water and certain air conditioning uses.
- Deliver minimum system demand equally to three regions within the service area to the extent possible. These regions include: (1) the East and South Bay Area, (2) the Peninsula, and (3) City of San Francisco. At least 70 percent of the turnouts within each region should receive flow to achieve minimum-month demand for the region. Estimated 2030 minimum-month demands for the three regions noted above are 96 mgd, 37 mgd, and 82 mgd, respectively.
- Restore facilities to meet the established seismic upgrade criteria. This includes delivering average daily demand (ADD) to each customer group within 30 days, assuming resources and infrastructure are available. Various levels of hardening will be required for different components of the system, depending upon site-specific conditions and system functions.

Delivery Reliability LOS

The LOS goals for delivery reliability are to:

- Deliver the average annual demand under the condition of one unplanned outage concurrent with one planned outage of major facilities[2]. Average annual demand in 2030 is estimated at 300 mgd.

[2] This criterion is defined as a planned outage along with and unplanned outage of any one segment (i.e., a reach of pipeline spanning between isolation valves) of the Bay Division Pipelines or the San Joaquin Pipelines. This assumption is documented in the WSIP System Assessment for Levels of Service Objectives (Parsons, November 22, 2006). It is also documented in the WSIP PEIR.

- Provide redundancy to enable maintenance on a schedule required for reliable water delivery.
- Provide system capacity to replenish local area reservoirs as needed to maintain reliable water deliveries.

Water Supply LOS

The LOS goals for water supply are to:

- Accommodate a target delivery reduction during a design drought of 8.5 years that is time-phased. During the first 3 years, the average reduction is anticipated at 3.3 percent. During the second 3 years, the average reduction is anticipated at 13.3 percent (six years is historically the longest drought experienced.) For the last 2.5 years of the design drought, the average reduction is anticipated at 20 percent. This represents an increase in firm yield from 226 mgd to 254 mgd. (A water service utility does not know it is in a drought until it is already a year or two into the period, and precipitation has shown a decline over time.)
- Increase long-term water supply for drought management through a combination of conservation, recycling, groundwater storage, and transfers.
- Set forth long-term supply options for evaluation and review to occur concurrently with implementation of projects required for seismic reliability delivery reliability and meeting water quality requirements.

4.3.2 Asset Management LOS

As mentioned previously, another more defined layer of LOS applies to maintenance of assets which lies below and directly supports the overlying generalized LOS adopted through the WSIP. The so-called asset management LOS guides much of the maintenance programs outlined in detail elsewhere in this report.

These commitments are to:

- Develop and maintain a detailed asset inventory;
- Regularly complete asset condition assessments;
- Use a CMMS to centralize all asset data;
- Prioritize corrective maintenance to increase system reliability;
- Perform preventive or predictive maintenance only where cost-effective or when system risks to unplanned outages warrant increased costs;
- Update the 10-year CIP and annual operating budget by integrating data from condition assessments, estimates of remaining useful life, failure analyses, replacement costs, and master planning;
- Maintain delivered water quality at or above applicable state and federal drinking water standards;
- Plan facility maintenance to minimize risk to customers; and,
- Maintain emergency response plans (listed in Appendix C).

5. Maintenance Program

5.1 General Maintenance Approach

The general maintenance strategy is to reduce the number and/or severity of unplanned outages by properly maintaining system equipment and assets, including all new equipment and assets that are being constructed and/or installed as part of the Water System Improvement Program. To accomplish this, maintenance for the Regional Water System is systemized to comprehensively identify, track, plan, prioritize, schedule and perform maintenance.

5.1.1 Types of Maintenance Performed

Within the Regional Water System, there are several types of work that are performed by operations and maintenance staff. These are categorized in the maintenance system database for tracking purposes as:

- Preventative Maintenance (PM) - Any work on a specific asset that is interval based. Besides traditional preventive maintenance, PMs in the CMMS include, but are not limited to, compliance items, diagnostic testing, overhauls, renewals of licenses, and scheduled inspections. Only assets have associated PMs.
- Corrective Maintenance (CM) - Any unforeseen failure or reduced performance on a specific asset that is discovered by field observations/condition assessment, reported by an operator or by SCADA alarm.
- Administration (AD) -This work type is for operations and maintenance staff performing any indirect work due to administrative activities such as completion of timecards (eTime), training, tailgate meetings, etc.
- System Operations (OPS) – Any work directly supporting operations, but not including maintenance-related work.
- Capital Support (i.e., WSIP) – This maintenance work type is in direct support of the Water System Improvement Program. This includes activities such as taking pipelines in and out of service to support construction. This work is distinguished from R&R to accurately account for charges under WSIP.
- Renewal and Replacements (R&R) – This maintenance work type is in direct support of other capital projects that are non-WSIP related. This includes activities such as internal pipeline inspection and repair.
- Other – This is miscellaneous operational or maintenance work that does not fit the categories indicated above.

In practice, the fundamental Reliability Centered Maintenance (RCM) concept is utilized in that maintenance efforts within the Regional Water System are focused on maintaining reliability of critical assets. All work is screened through the maintenance planning group (as described below) and reviewed by the Operations and Maintenance Manager to ensure that work on critical assets is prioritized prior to being scheduled and disseminated to the maintenance staff to perform.

Generally, all operations and maintenance work types can be classified as either planned or unplanned work.

- **Planned work** usually results from equipment deficiencies discovered as a result of asset monitoring/inspection, or as a result of a time-based PM. These are prioritized based on criticality to the daily operations of the Regional Water System, which is variable depending on daily demand and system configuration. As a result, planned work orders are continuously reviewed and their respective priorities adjusted as necessary to minimize impacts to system operation.

- **Unplanned work** is usually associated with emergency maintenance resulting from an unexpected or unforeseen asset or equipment failure (a facility is not considered to fail unless there is major structural problem). This type of work is prioritized above all other work as it usually has immediate impact to system operations.

5.2 Maintenance Systems

5.2.1 Maintenance Planning Group

The core function of the Maintenance Planning Group is to collect all maintenance work requests, evaluate each request for conformance with existing WSTD policy and procedures, coordinate with Maintenance Engineering for review of technical components of each work request, plan and schedule all approved work, and ensure that all field data collected during completion of the work is appropriately captured with the CMMS. Ancillary duties also include serving as data stewards for the data currently residing in the CMMS.

Error! Reference source not found. exhibits the hierarchy for the Maintenance Planning Group. Table 5-1 on the following page describes the specific roles and responsibilities for each classification within the Maintenance Planning Group.

Figure 5-1: Maintenance Planning Group Organizational Chart

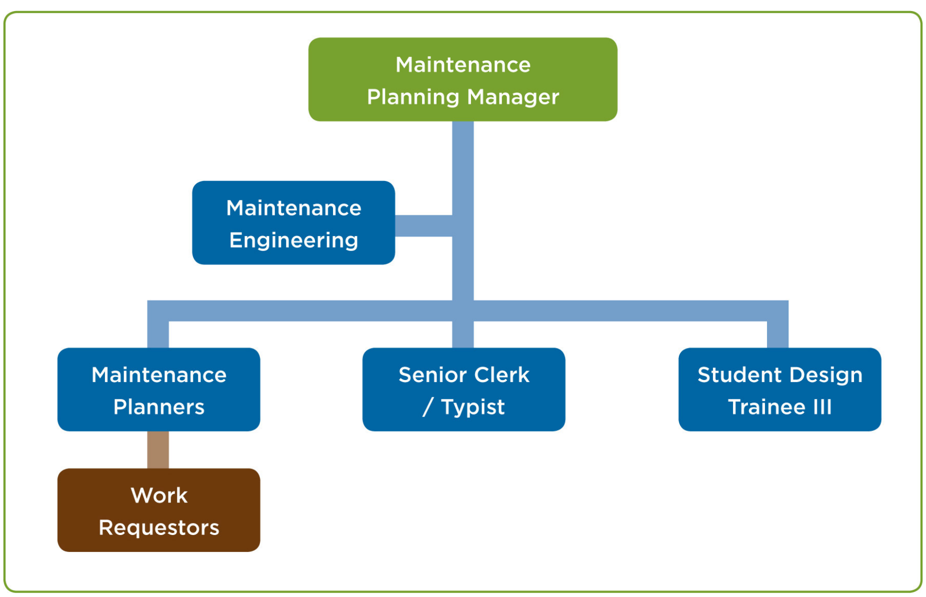


Table 5-1: Maintenance Planning Group Roles and Responsibilities

Classification	Primary Roles and Responsibilities
Maintenance Planning Manager (1 Position)	• Manage and oversee all operations of the Maintenance Planning Group, including personnel issues as well as subordinate staff performance and evaluation • Schedule and ensure performance of field equipment conditions assessments, reporting results to O&M Manager • Coordinate directly with Maintenance Engineering in development and maintenance of preventative maintenance program • Develop, maintain and provide quarterly reports on Division's maintenance status to Section Manager • Identify and implement potential maintenance cost savings by combining routine maintenance activities during planned shutdowns for WSIP, pipe inspections, or other scheduled work normally requiring a shutdown • Supervise management of CMMS database • Assist O&M Manager in enforcing Divisional purchasing protocols • Implement and manage weekly work order scheduling and approval process as described in CMMS business practices SOP • Coordinate with Natural Resources Division Liaison weekly on all work scheduled to be performed in watershed
Maintenance Planner (2 Positions)	• In conjunction with review and input from Maintenance Engineering, review and schedule appropriate preventative maintenance program • Provide requested data reports supported by CMMS database • Ensure CMMS database use is consistent, comprehensive and utilizes the full power of the software • Review daily work requests, correct and modify as needed, creating and scheduling work orders as appropriate • Assist Maintenance Engineering staff in conducting site assessments on all critical equipment, review Condition Assessment Report recommendations from Maintenance Engineering staff and develop work orders of recommended corrective maintenance, and create purchase requisitions for recommended spare parts for critical equipment • Ensure collected field equipment data is regularly inputted into CMMS database, including mechanical and electrical equipment specifications, field maintenance history, manufacturer's recommended maintenance, as-built drawings, and associated costs for repair • Ensure all field equipment, including newly installed equipment, is assigned a unique CMMS identifier consistent with the Division's asset hierarchy, for use in tracking purchasing and

Classification	Primary Roles and Responsibilities
	maintenance costs of the asset
Senior Clerk Typist (1 Position)	• Provide administrative support to Maintenance Planning Manager • Assist in inputting field data into CMMS database • Assist in completion of weekly O&M work order schedules • Assist in generating quarterly maintenance progress reports to the O&M Manager
5382 - Student Design Trainee III (1 Position)	• Assist Maintenance Engineering staff in conducting site assessments on all critical equipment by collecting and recording field equipment data, including mechanical and electrical equipment specifications, geospatial location of equipment, equipment field maintenance histories, manufacturer's recommended maintenance, and as-built drawings • Assist in inputting field data into CMMS database • Assist in development and review of preventative maintenance program with Maintenance Engineering • Serve as data steward of all data within CMMS database, and develop standard database queries for the purposes of tracking key performance indicators and preparing status
Maintenance Engineering Group (5 Positions)	• Assist Maintenance Planning staff in conducting site assessments on all critical equipment by collecting and recording field equipment data, including mechanical and electrical equipment specifications, geospatial location of equipment, equipment field maintenance histories, manufacturer's recommended maintenance, and as-built drawings • Develop and review preventative maintenance program • Assist Maintenance Planners to create and populate standard equipment templates to capture basic information on equipment (serial numbers, ratings, installation date, etc.) • Maintain an equipment/asset library by providing all design specifications, design drawings, as-build drawings, design reports, and final design cost estimates in hard copy form for the library, or in electronic form with linkages to corresponding equipment in MAXIMO • Coordinate with Purchaser and O&M Section Manager and provide engineering review prior to purchase of any equipment greater than $5,000 to ensure standardization of similar functioning equipment; obtain performance history, design specifications/drawings and other technical data demonstrating the appropriateness of process design for in-kind equipment replacement • Perform life-cycle cost analyses for equipment requiring over of $20,000 in annualized maintenance • Maintain standardized general equipment specifications,

Classification	Primary Roles and Responsibilities
	including a list of recommended compliant vendors, for groups of critical equipment • Provide failure review on corrective maintenance to all assets and provide engineering recommendations for repair/replacement as well as review the equipment within the context of the process to ensure it is appropriate
Work Requestors	• Identify work needing to be performed, coordinate with appropriate crew leaders to develop job and safety plans on all work requests in MAXIMO, enter the work requests in MAXIMO, assist planners in scheduling work, log staff time spent on work orders, prepare purchase requests

5.2.2 Work Order System

Work Order (WO) Initiation

A WO is required for all work, including any and all emergency work. A WO can be generated by any staff member such as maintenance staff, operator or engineer. The first step is to complete a WO request in the CMMS. After the WO is initiated it is labeled as a work request (WREQ) for subsequent processing. It is the work initiator's responsibility to ensure the WREQ contains all pertinent information, included but not limited to:

- Short Work Description: The initiator provides as much detail as possible to assist the maintenance planning staff in locating the problem and determining the appropriate action.
- Work Type: Correctly identify the work type (see above) as CM, PM, AD, OPS, WSIP, or R&R.
- Priority Code: Priority codes are used to assist in prioritizing the work for scheduling purposes. These codes include:
  - ***Priority Code 9 – Emergency***. This is any work for a situation in which an unscheduled shutdown or failure of critical equipment has occurred or in which an imminent threat to the environment or personal health and safety exists. Work is imperative and cannot be formally planned or scheduled, but it will be given all resources that can be effectively utilized. Section or Division Manager approval is required before using this priority code.
  - ***Priority Code 3 – High***. This is work on any equipment that if not performed is likely to result in system failure or produce safety and/or environmental-related concerns. This includes CM or PM on critical equipment or WSIP/R&R work related to a scheduled shutdown.
  - ***Priority Code 2 – Normal***. This is work on all non-critical equipment or reoccurring work that enhances system reliability and/or efficiency. This includes CM or PM on non-critical equipment, routine inspections, or minor safety related issues. This also includes scheduled training.
  - ***Priority Code 1 – Low.*** This is work not directly related to system reliability and/or efficiency and not safety related.
- Job Plan: This plan details the work to be performed and includes the appropriate equipment number (if applicable), the location code where the work is to be performed, the work initiator's name and contact information, and safety plan for the work to be performed.

- Failure Report: Details the failure class and problem code for the equipment to be repaired or replaced.

WO Initial Review

Planning staff query the CMMS daily for all initiated WOs and review them for accuracy and completeness. The planning staff also begin to assign and organize resources required for the WO based on the associated availability. In addition, the planning staff provide additional administration functions such as ensuring that the WO is appropriate and not part of an existing child or parent WO, whether the WO has been assigned an appropriate index code so the appropriate funding source is identified correctly, whether the WO has been assigned an appropriate priority code, and whether any regulatory or safety-based restrictions apply.

- **Child Work Order:** The lower of two levels of work orders. Child work orders are usually assigned to an individual task or trade working on a larger project under a parent work order. Each child work order can be planned and scheduled individually. Estimated vs. actual costs are accrued by each child work order and then rolled up into the parent work order.
- **Parent Work Order:** The higher of two levels of work orders. Parent work orders are usually assigned to an overall project with one or more child work orders under the parent work order assigned to various tasks or trades required for the project.

WO Scheduling

Weekly schedules are produced and widely posted by Friday at noon for the subsequent work week. In order to produce the schedule by Friday at noon, preparation begins Monday when Maintenance planning staff assigns all new WOs created during the previous week to a scheduling category. On Tuesday, Maintenance planning staff submits the draft schedule to the Planning Manager for review. Any work on the draft schedule that requires review by engineering staff are flagged to ensure review prior to Friday. On Wednesday, comments from the Planning Manager are returned to the maintenance planning staff for processing. On Thursdays, the draft schedule is circulated to all WSTD supervisors for review. Comments from the WSTD supervisors are submitted at this time. On Friday, noon, the work schedule for the following week becomes final and no changes can be made without permission by the O&M, SysOps or Division Manager.

WO Closeout

All blanket WOs are automatically closed at the end of every fiscal year. Once the site work for a non-blanket WO has been completed, the responsible supervisor fills out, prints, signs as complete, and returns the completed work order form to maintenance planning staff. All supervisors query in MAXIMO on a daily basis to determine which approved WOs are assigned to their crew. Upon receipt, the maintenance planning staff shall change the status of the WO in CMMS to complete. Once all materials invoices for each WO have been received and paid, then maintenance planning staff close the WO. More detail can be found in the Division's *CMMS Business Practices Policy*.

5.3 Maintenance Prioritization

The following describes the general process used to prioritize work orders for the Regional Water System. Prioritization is required due to the volume of potential work that could be performed. A small percentage of work orders should never be performed because it is not cost-effective or required to maintain system reliability.

5.3.1 WO Approval and Scheduling

Once the WO is deemed complete, accurate 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 it until the WO has been closed, cancelled or completed. Blanket POs are usually approved at the beginning of the fiscal year.

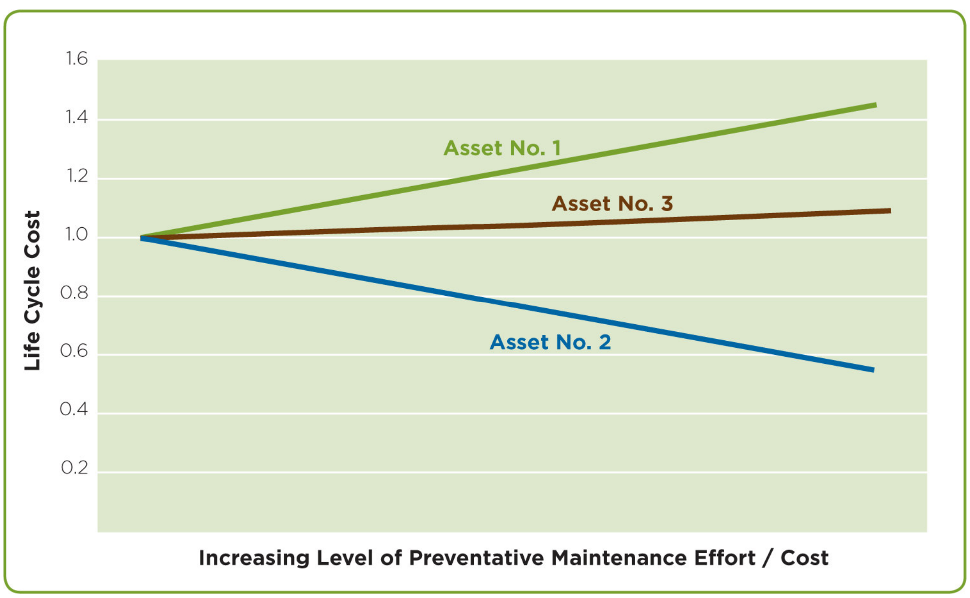
- **Blanket work orders** cover only three types of work: 1) general tasks to be completed at a treatment facility by operations staff only; 2) indirect administrative work for supervisors; and 3) staff training. This type of work order is entered into the CMMS through the work request or the work order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

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.

CM 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 may involve in-kind replacement, an upgrade, repair, or demolition and site remediation when the asset is no longer needed.

The decision on whether to perform PM and/or when to perform PM is based on two objectives which at times may be compete: minimize unplanned outages and minimize life-cycle costs. Figure 8 below illustrates the decision process. The first decision relates to the value of PM relative to the reduction in life-cycle cost for an asset. Higher levels of PM could result in any number of life-cycle cost scenarios depending on the particular asset as the three hypothetical examples below illustrate.

Table 5-2: Preventative Maintenance Prioritization Methodology



For Asset No. 1, investment in regular PM activities only increasingly adds to the overall life-cycle cost due to its low replacement value. The maintenance strategy employed in this case is "run to fail".

Examples include off-the-shelf electronics and sensors, as well as inexpensive pumps or motors which require little or no preventative maintenance.

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

For Asset No. 3, PM slightly increases overall life-cycle costs. Although the goal of any preventative 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 no 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.

Once PM is determined to be appropriate, the completion prioritization generally uses the same logic. That is, the first PM activities to be scheduled are those that reduce the most life-cycle cost and those that most increase system reliability.

5.3.2 Maintenance Backlog Management

The maintenance backlog is defined simply as work orders that have been submitted and approved, but are awaiting work initiation. 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 can also consist of deferred preventative maintenance.

On a weekly basis, all work within the backlog is reviewed for potential scheduling. 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.

5.4 Valve Exercise Program

The valve exercising program is designed to ensure that all valves in the regional transmission system are exercised at least once per year. There are a total number of 265 valves within the regional transmission system, and the objective is to exercise at least 5 valves per week. If full operation of the valve will not disrupt system operations, the valve to be exercised will be fully opened and closed. If full operation of the valve is not possible due to operational constraints, the valve to be exercised will be "bumped", i.e. opened (or closed, if already open) at approximately 5%, then closed (or returned to fully open). As discussed above, the first two years of the valve exercise program adopted a higher than standard rate (once per year) to reduce the backlog of valves that have not been exercised in years. In FY11 and FY12, the objective is reduced to once every other year consistent with industry standards now that most valves have been addressed. Greater priority will be given to valve exercising efforts as required WSIP support diminishes.

5.5 Vision for Maintenance Program

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

Implementing this vision requires acceptance of ownership and associated responsibilities of all new assets constructed and/or installed within the Regional Water System as part of WSIP. Once these new assets are put into service, they cannot be neglected or be subjected to deferred maintenance. Doing so significantly reduces their overall usable life and as such significantly increases their life-cycle costs. Preventative 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 more accurately record total maintenance and R&R costs of assets within the Regional Water System. At present, maintenance functions are performed by multiple divisions and groups and totalizing costs by asset or program is not simple.

6. Condition Assessment Program

The assets in the Regional Water System are regularly inspected through a variety of programs. Most assets are inspected on a facility–by-facility basis where all assets within a facility, such as a pump station or treatment plant, are assessed for efficiency. Facility inspections are prioritized and repeated every three to seven years depending on each facility's importance in meeting LOS. For linear assets (pipelines), a separate inspection scheduling system is used relying on pipeline condition, potential liabilities, operational problems associated with pipeline failures, corrosion conditions, and the rates of change observed. The Regional Water System's dams, particularly the earthen dams, use a third and very conservative type of inspection and monitoring system due to the high liability associated with dam operation in urban areas and the importance to the region's water supply. Each of these programs is essentially a risk-based assessment program. Condition assessment data is compiled in the CMMS at the asset level. Pipeline and dam condition data are generally housed in separate databases.

6.1 Risk-Based Assessment

Asset condition assessments can be triggered by many events and available information such as: asset age, installation date, current performance compared to established levels of service, compliance with codes and regulations, failure/performance history, operator experience, and/or other applicable criteria.

At present the regional water system relies on a risk-based assessment process. A risk-based approach recognizes two key risk criteria: severity and probability.

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

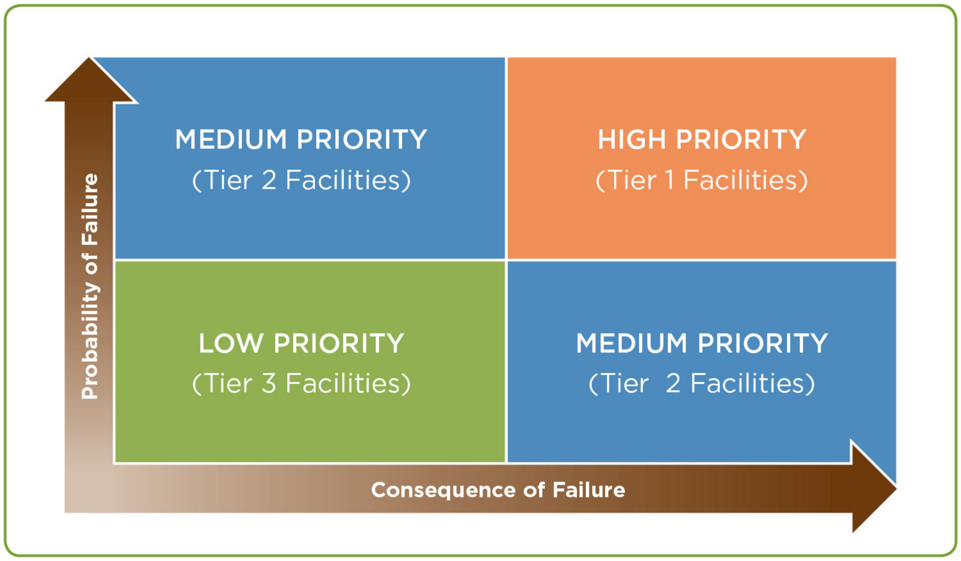
There are many types of risk for the Regional Water System that are considered to some degree when quantifying overall risk:

- **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 (and the accompanying fines and lower public opinion).
- **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.

In general however, facilities are deemed high risk when there is a relatively high probability of failure and failure would lead to major operational consequences – i.e., water supply and/or water quality. It is important to note that this assignment of risk occurs at the facility level (such as Harry Tracy WTP) and not at the asset level (such as an individual pump at Harry Tracy WTP).

High-risk facilities (denoted as Tier 1) are assessed every three (3) years. CM and PM generated for a high-risk facility are also given highest priority. Medium risk facilities (Tier 2) are assessed every five (5) while Tier 3 facilities are generally assessed every seven (7) years. Inspection schedules for facilities in Tiers 1, 2 and 3, in addition to dams, linear assets, and new assets are listed in Appendix B.

Figure 6-1: Matrix of Site Assessment Priorities



Assessment of Tier 1 facilities began in 2009, assessment of Tier 2 facilities began August 2010 and is scheduled for completion in December 2010. Appendix B details the existing non-linear and linear asset inspection schedule. Facilities completed under WSIP will be added to the appropriate condition assessment scheduling tables as required. Adding inspection schedules for new linear assets such as pipelines, tunnels and, in particular, the specialized coatings and liners that must be inspected within the applicable warranty period will also be added to the table with the accompanying shutdown scheduled as needed. Inspection of the Coast Range Tunnel, existing Irvington Tunnel and Crystal Springs By-Pass Tunnel are presently being scheduled.

6.1.1 Pre-Assessment Planning

Prior to conducting any condition assessment, all records of maintenance performed since the previous assessment are reviewed by the Maintenance Engineering staff. This includes, but is not limited to: corrective maintenance logs, preventative maintenance logs, O&M manuals, standard equipment templates, relevant installation or as-built drawings, and relevant equipment specifications or technical data sheets.

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 Section Managers as appropriate.

6.1.2 Field Assessment

Assets are assessed in the field using standard asset condition assessment forms unique to the asset category (e.g. mechanical, electrical, or structural). The assessment team consists of: an operator, plumber or stationary engineer, as appropriate; a maintenance planner; a maintenance engineer; and any specialty tradesperson, as appropriate. For each assessed asset, the assessment team verifies that all asset details have been recorded on the standard equipment template. If any information is missing, it is recorded on the 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.

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. Each piece of equipment is operated to the maximum extent possible and the level of operation is recorded. Field observations or observed failures are recorded on the standard asset condition assessment form. Any corrective action or remedy is identified and recorded.

Other details recorded 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.

6.1.3 Post-Assessment Analysis

Following completion of all assets within a tier, Maintenance Engineering reviews all data collected during the assessment, design records and maintenance history records, 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 part/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.

6.2 Linear Asset Inspection Program

The linear assets of the regional water system include pipelines and watershed roads. This section addresses pipeline inspection (mostly internal) as roads are not formally inspected. The pipeline inspection program began in 1990 with the hire of two engineers dedicated to that task. During the early 1990s utility plumbing crews were expanded to prepare pipelines for interior inspections, to support the inspections, and carry out remedial work.

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

6.2.1 Visual Inspections

Most inspections of pipelines use visual methods to detect flaws. The most common category of pipeline is welded steel pipe (WSP), 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. Reinforced concrete cylinder pipe (RCP) is also inspected visually, but presents unique features. Steel "lockbar" pipeline develops flaws similar to that of WSP. Due to the liabilities associated with pre-stressed concrete cylinder pipe (PCCP) and the prevalence of this pipe in water systems, special technologies have been developed to inspect and detect the unique flaws that can develop in PCCP and are discussed below.

Welded Steel Pipe (WSP)

Inspection of WSP is largely visual. An experienced engineer or inspector can detect cement mortar lining (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 Bay Division No. 3 and Alameda Siphon No. 4.

A remarkable structural flaw was discovered on Bay Division 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 Bay Division No. 4 at the same location but no conclusions were drawn at the time. The finding in Bay Division 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 Crystal Springs Pipeline 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 Crystal Springs Pipeline No. 2, however, has had more general wear of lining that will be repaired during shutdowns for WSIP rehabilitation.

In 2003, inspection of Crystal Springs Pipeline 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.

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.

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.

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 our 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 Bay Division Pipeline 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.

6.3 Dam Monitoring Program

The regional water system has five dams in the Bay Area under the jurisdiction of the State Department of Water Resources, Division of Safety of Dams (DSOD). As discussed above, the system also includes several other smaller, non-jurisdictional dams. The earthen Upper Crystal Springs Dam is relatively large in terms of storage volume by comparison to other non-jurisdictional dams but only impounds water three to ten feet above the adjacent Lower Crystal Springs Reservoir.

Of the five jurisdictional dams in the system, four are earth-filled dams, and one (Lower Crystal Springs Dam) is a concrete gravity dam. The four earth-filled dams are Calaveras Dam and Turner Dam located in Alameda County and San Andreas Dam and Pilarcitos Dam located in San Mateo County. Lower Crystal Springs Dam is located in San Mateo County. All of the dams, except Tuner Dam, were built in the late 1800s and early 1900s by the Spring Valley Water Company. Turner dam was built in 1965 by the SFPUC.

A comprehensive monitoring program was established to adequately maintain these assets and ensure public safety downstream of the jurisdictional dams. This program is conservative and extends beyond the minimum requirements of the DSOD outlined in the California Water, Code Division 3 – Dams and Reservoirs. The program is managed by SFPUC Land Engineering staff in Millbrae.

The major components of the program consist of regular inspection, maintenance and repair, instrumentation monitoring and reporting, stability studies, and inundation map updates. Peer review is added through participation in the Bay Area Dam Owners Group meetings, a local collaborative effort with Santa Clara Valley Water District, Contra Costa Water District, Marin Municipal Water District, North Marin Water District, San Jose Water Company, and the East Bay Municipal Utility District in addition to the SFPUC. General technical assistance is also provided by URS, the same engineering company assisting the WSIP projects related to dams. The Group meets once or twice per year to share information on topics such as dam safety and monitoring, environmental permits for dam maintenance, emergency preparedness, seismic stability analyses, and operation restrictions.

Field Inspections

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 dam inspectors and engineering survey crews. The dam inspector conducts a monthly inspection by taking readings on piezometers and seepage drain points, and 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.

Annual inspections are conducted in coordination with DSOD. The SFPUC dam inspector accompanies the DSOD inspector during comprehensive visual inspections on dam facilities include piezometers, upstream and downstream faces of dam, crest and toe area of dam, groins, seepage points, spillway and basin, outlet structures, tunnels, valves, piping, and metalwork. DSOD mandates that outlet valves are exercised annually. The DSOD inspector witnesses the exercising every three to five years. DSOD issues a report to the SFPUC after each annual inspection.

Episodic inspections and engineering surveys are required following an earthquake depending on the magnitude and proximity of the earthquake to the dam. The criteria are specified in the Emergency Action Plan (EAP). These surveys are conducted immediately or during the next available daylight period.

Maintenance & Repair

Maintenance and repair consists annual flushing of piezometer piping and follow repairs noted during inspections. The flushing of hydraulic piezometer piping is required in order to maintain proper operation. The most common repair and maintenance tasks include vegetation clearing, rodent control, minor spillway repair, and repair of seepage measuring devices. These activities are included in the operating budget.

Instrumentation Monitoring and Reporting

Monitoring data are collected manually during the routine monthly inspection and the bi-annual engineering survey. The monitoring data include piezometer readings, seepage flow, survey readings, reservoir level, 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 at the end of February each year.

Stability Studies

Seismic stability studies and analyses were conducted for Lower Crystal Springs Dam, 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 embankment and foundation. Although updates to these stability studies are not generally required by DSOD, the SFPUC plans to update them approximately every 10 years to incorporate any new findings on subsurface materials or new seismic criteria. In FY11 an updated stability analysis for Lower Crystal Springs Dam will be initiated.

Inundation Map Updates

The inundation maps for all of the dams were last updated in the 1970s as required by the State Department Office of Emergency Services. The maps show areas of potential flooding in the event of catastrophic and total failure of the dam. The maps should be updated every 10 to 20 years as downstream land use changes. An updated inundation map will be provided for the Lower Crystal Springs Dam in FY11. An update for San Andreas Dam is not an immediate priority as the inundation area following a failure of San Andreas Dam, being upstream of Lower Crystal Springs Dam, would essentially be a sub-area of inundation associated with a Lower Crystal Springs Dam failure. A study of the inundation area for a combined failure of the two is under consideration for FY12. During FY14, the inundation map will be updated for San Antonio Dam. The inundation map for Calaveras Dam was updated in FY2010 as part of the WSIP project.

Turner Dam Instrumentation Upgrade

During FY09 and FY10, significant upgrades were completed to the piezometers on Turner Dam which were the original equipment installed in 1965 during construction. Vibrating wire piezometers were installed in Turner Dam to supplement existing piezometers and other dated equipment (observation wells, Casagrande type open standpipe piezometers, and hydraulic piezometers). These new piezometers are reliable and reduce labor related to data collection. The new piezometers also have wireless data collection ability. Collection can now be centralized at a single data logger at the dam or uploaded into SCADA. This same network design is being implemented for the new Calaveras Dam.

Instrumentation design for the new Calaveras Dam utilizes the latest industry practices and will broaden the types of data used to track dam performance. The devices include open standpipe piezometers, vibrating wire piezometers, in-situ survey monument, inclinometers, accelerographs, vibrating wire buoyant weight transducers, and a weather station. The array of new instruments will provide data on embankment internal movement, ground acceleration during an earthquake, seepage flow, and meteorological information. These are additional measurements to the internal water pressure and ground surface movement measurements that are currently collected on the existing dam. Instruments for the most part will be connected to a local data collection system and/or SCADA. Remote monitoring and logging will greatly shorten condition assessments of dams following earthquakes.

6.4 Corrosion Monitoring / Maintenance Program

In 2009, an update to the Corrosion Protection Master Plan for the Regional Water System was initiated to support capital planning and to ensure maintenance programs remain well focused and prioritized. The primary objectives of the effort were to update the state of the corrosion protection system and corrosion potential for buried assets in the Regional Water System. The updated plan was completed in August 2010 through the extensive field work of SFPUC staff and M.J. Schiff and Associates and is referred to as the 2010 SFPUC Regional Water System Corrosion Protection Master Plan or 2010 Plan for short.

The 2010 Plan assessed 230 miles of transmission pipelines and included:

1. Identified corrosion potential and vulnerability due to local environment (corrosive soil, stray current, etc.);
2. Determined the adequacy of the existing corrosion protect system; and, based on the results of No. 1 and No. 2,
3. 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.

The consultant provided report indicates that the recent corrosion assessment determined the existing cathodic protection (CP) system on the SFPUC transmission lines is 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 and stray current interference.

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

The report also indicated that the bulk of the pipelines alignments were installed in the severely corrosive soils. The soil corrosivity is of concern due the age of the infrastructure and specifically the fact that as pipeline coatings age they begin to become dilapidated exposing pipeline steel at which point corrosion is likely to occur. The more corrosive the soil, the higher the corrosion rate will likely be resulting in exacerbated metal loss, or the 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 the 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 our transmission system to an ideal protected state against corrosion. The total estimated installation costs ranged from $18M to $22M (not including soft costs).

Information from planning efforts such as internal pipeline inspections, review of liquefaction conditions, location of earthquake fault zones, criticality of particular pipelines to the Regional Water System delivery capacity, adopted levels of service, 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 2010 Plan to guide and prioritize maintenance, renewal and replacement and capital planning.

Implementation of corrosion protection projects also requires knowledge of any 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 several miles of Bay Division Pipelines Nos. 1 and 2.

Table 6-1 shows the different categories of corrosion projects along with the percentage of the total costs of these projects by category.

Table 6-1: Percentage of Total Cost of Planned Corrosion Projects by Category

Category	Percentage of Cost
Electrical Isolation	26%
Pipeline Continuity	5%
Corrosion Test Stations (cts)	16%
Remote Monitoring Unit (RMU)	2%
Other	1%
Repair Existing Corrosion Protection (CP) System	16%
Additional Corrosion Protection (CP) Systems	12%
Stray Current Interference Mitigation	22%

Table 6-2 shows the percentage of cost each corrosion project relative to the total cost of all corrosion projects.

Table 6-2: Percentage of Total Cost of Planned Corrosion Projects by Project

Facility	Percentage of Cost
Alameda Siphon Nos. 1 - 3	1%
Bay Division Pipeline No. 1	28%
Bay Division Pipeline No. 2	9%
Bay Division Pipeline No. 3	10%
Bay Division Pipeline No. 4	6%
Calaveras Pipeline	1%
Crystal Springs No. 1	6%
Crystal Springs No. 3	2%
Crystal Springs Bypass Pipeline	0%
Palo Alto Pipeline	3%
San Andreas No. 1	10%
San Andreas No. 2	7%
San Andreas No. 3	5%
San Antonio Pipeline	1%
Sunol Pump Station (36″)	1%
Sunset Supply Pipeline	9%
Sunol Valley Water Treatment Plant 78″ & 66″	1%

7. Capital Improvement Program

As discussed above, maintaining LOS requires a combination of maintenance programs which more or less are on-going and capital projects which are implemented as and when required. A third funding source is the Facilities Maintenance Fund which resides within the capital budget and is usually cash funded. The use of each of these funding sources by various projects is outlined below.

Operating Fund: Used for expenditures that generally occur each year, are largely predictable, and are related to operations and maintenance. Projects are initiated under work orders and are generally smaller than $50,000.

Facilities Maintenance Fund: Used for expenditures and projects that are **maintenance-related** (in-kind replacement of worn parts or facilities) and that occur less frequently (e.g., once every 3 to 5 years) or are otherwise difficult to budget and predict. This fund is used for larger expenditures; i.e., more than $50,000, but can also be used for jobs smaller than this amount. These projects are not initiated until a *Project Request Form* is completed.

Capital Projects Fund (CUW 262, 263, and 264): Used for expenditures and projects that involve a **capital upgrades;** that is, projects that enhance performance or levels of service. Usually these projects are in excess of $100,000. These projects should be identified in the budget process and must have an approved *Project Request Form* prior to initiation.

The CIP consists of the projects in the Facilities Maintenance Fund and Capital Projects Fund. In general, projects in the CIP are generated from the planning process which analyzes the cost-effectiveness of replacement, rehabilitation, and capital upgrade options.

7.1 10-Year CIP Update: FY 2012 – FY 2021

In general, projects in the CIP are generated from the planning process which analyzes the cost-effectiveness of replacement, rehabilitation, and capital upgrade options. Projects in the 10-Year FY 2012 - FY 2021 Updated CIP (or "FY2012 CIP") total approximately $255M. Even though WSIP construction will continue through 2015, WSIP projects are not included in the FY2012 CIP because all WSIP appropriations are complete.

Between the mid 1990's and 2004, various condition assessment and vulnerability studies were completed along with an intensive effort to define and adopt a LOS to guide the capital program. Much of the scope that would become the WSIP largely documented in the 2002 CIP was derived from these efforts. However, many capital projects identified in these early planning studies were not 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.

The FY2012 CIP is updated for post-WSIP conditions. Previously identified "deferrable" scope or scope not included in WSIP are actively considered. The FY2012 CIP can generally be divided into three 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; and, necessary capital upgrades to administrative and field support facilities. For reference a short summary of each project expected to be included in the FY2012 CIP is listed below (the CIP will be reviewed by the SFPUC later this year during the budget process). Details on timing, cash flow and project budgets can be found in the CIP and are not included here.

7.1.1 Reservoir Structures Upgrades

The WSIP program will replace the Lower Crystal Springs Reservoir spillway, parapet wall and stilling basin to comply with the 1982 DSOD order. The WSIP project will provide a new operating elevation of 287.8' (NGVD 1929) as a minimum contribution to meeting supply and emergency response LOS goals. This project will fund additional environmental mitigation that will be needed to utilize storage above 287.8' on a temporary basis.

7.1.2 Treatment Upgrades

Expenditures in this project consist of major upgrades to the Harry Tracy WTP, Sunol Valley WTP, and Tesla Treatment Facility to achieve a higher level of performance. Projects include upgrades of chemical dosage, flow monitoring, valve and pump replacement, chemical handling upgrades, power upgrades, discharge control to maintain compliance with permits, communications, process control equipment to meet more stringent drinking water regulations, seismic improvements, and upgrades to control software. Numerous small projects are under construction and will be completed by June 2011, these include: improvements to HTWTP wash water dechlorination, uninterruptible power supply upgrades to HTWTP and SVWTP, and replacement of PLCs at HTWTP. Approximately $6 M is reserved for additional upgrades at the SVWTP in conjunction with (but outside of the scope of) the WSIP project and include: re-construction of six filters, new boiler, and new chemical piping.

7.1.3 Pump Station Replacement Program

Program would fund replacement or major overhaul of existing pump stations such as Baden Pump Station, Crystal Springs Pump Station, and San Antonio Pump Station. No work is needed until out years in this CIP, well after WSIP is completed. Placeholder funding assumes three existing relatively old and inefficient diesel driven pumps (overall capacity of 90 to 100 mgd) are replaced with three electric pumps with the same capacity. Three other new electrically-driven pumps (with backup power provided by engine generators) are being installed at SAPS as part of the WSIP. They have an overall capacity of 90 to 100 mgd. Back-up power upgrades may also be needed.

7.1.4 Calaveras Pipeline Microturbine

There is over a 300-ft difference in the maximum water surface elevation in the Calaveras Reservoir and the SVWTP. This relatively large head difference is not dissipated in the relatively short length of the Calaveras Pipeline. At the SVWTP this head is dissipated via sleeve valves V-41 and V-43. Energy is presently dissipated through a pressure reducing valve which cannot also act as an isolation valve. Consideration should be given to installing a low-head hydro-generator at the inlet to the SVWTP that will convert the hydraulic head to electrical power. The cost-benefit of this facility will be, in part, dependent on the amount of time each year that the Calaveras Pipeline is running at the different rates.

7.1.5 Pipeline Improvement Program

Unlike other types of steel pipelines which typically leak when a structural flaw occurs, pre-stressed cylindrical pipe (PCCP) fails violently and catastrophically, often with little warning and usually with significant damage to surface features above the pipeline. All pipelines are regularly inspected to detect damage and wear, special technology is used to inspect PCCP. Besides PCCP, other pipelines have suffered significant corrosion and will require modification (replacement or slip-lining) in the next ten years in order to continue meeting LOS. The construction of Bay Division No. 5 and other transmission improvements under WSIP allow the Regional Water System to conduct these repairs without impacting conveyance capacity. The scope of the improvements includes replacing or slip-lining up to 10 miles of pipeline in densely populated areas which affect constructability.

Additionally, portions of BDPL Nos. 1 through 4 that are located near Edgewood Road in Redwood City are supported on relatively old wooden trestles. The trestles pose security and seismic vulnerability concerns. Following a condition assessment and alternatives analysis, construction and retrofitting may be necessary. The submarine, trestle and caisson portions of BDPL Nos. 1 and 2 between the City of Hayward connection and the Ravenswood Valve Lot are being abandoned in-place. The trestle and caisson portions may become structurally unsound and subject to failure. Work on these sections of the two pipelines is complicated because they are located in an environmentally sensitive area. Preliminary evaluations have been conducted to determine acceptable methods for demolition and removal of the pipe and support structure.

7.1.6 Pipeline Inspection & Repair Program

This project funds inspection (including shutting down, de-watering, and disinfection of pipelines) and minor rehabilitation and repair of pipelines that follow the inspection. Repairs can usually be made in weeks or 1-2 months. Appurtenances such as blow-off valves and air valves are replaced and often times mortal lining or polyurethane lining can be repaired in short stretches. Inspections in FY 2010 included Bay Divisions No. 3 and 4, Sunset Supply Pipeline, Alameda Siphon No. 2, and San Andreas No. 2 Pipeline. In FY 2011, the expected inspections include the San Mateo Pipeline, Crystal Springs Pipeline No. 2, Bay Divisions No. 1 and 2, Alameda Siphon No. 1, and Crystal Springs Pipeline No. 3. A long-term schedule is developed to outline inspections for the next 10 years – in general though inspections are not committed to more than 1 year in advance while real-time conditions including WSIP construction shutdown opportunities are known. Specific known repairs include approximately 10,000 linear feet of damaged mortar on Bay Division No. 4 which was documented during an inspection in 2010.

7.1.7 Seismic Monitoring Upgrades

The project will upgrade and replace existing seismic monitoring equipment at Turner Dam. These improvements were recommended by URS and are over and above DSOD requirements. The permanent manifold system installation is part of the dam maintenance to upkeep the existing equipment and replace outdated equipment. The permanent seepage collection system is to provide reliable data of the internal data seepage to assess the dam's long-term performance and safety. The project is largely completed and no expenditures are planned after FY11.

7.1.8 Treatment Facilities Maintenance

Expenditures in this project consist of maintenance-related activities repairs and replacement/upgrade of elements of Harry Tracy WTP, Sunol Valley WTP, Tesla TP, and field facilities. There are nearly 2,000 pieces of equipment including mechanical, hydraulic, electrical, software, and structural. Repair projects require approximately $1.5 M each year and typically involve three or four projects. Projects are typically generated following condition assessments or through operator requests following a failure or predicted failure.

7.1.9 Pipeline Corrosion Control Program

Appropriate corrosion control is essential to extending the life of buried structures such as pipelines. The 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 provided funding for maintenance of existing systems such as rectifiers repairs and sacrificial anode replacements, active systems with impressed current, isolating structures, and enhanced monitoring.

7.1.10 Geotechnical Improvements

This project involves the additional geotechnical monitoring at Pilarcitos Dam to comply with DSOD requirements. The project includes a $10M placeholder for assumed capital upgrades in later years as directed by DSOD and the near-term studies.

7.1.11 Watershed Maintenance

There are 20 watershed structures that are either occupied as residences for watershed keepers or used for monitoring or office work. These structures cost approximately $20,000 each to maintain each year. Additional expenditures include road and culvert repair (about $300,000 per year).

7.1.12 Town of Sunol Fire Suppression System

The project will upgrade the existing inadequate fire suppression system within the Town of Sunol which presently has too few hydrants and inadequate pressure. The project will also improve water quality in the potable system and will reduce maintenance and flushing expenses.

7.1.13 Bay Area Watersheds and ROW Management and Protection Program

The purpose of this program is to support 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. One existing bridge must be replaced due to unsafe conditions for existing loading. Up to two additional bridges may be constructed to improve maintenance reliability and access while reducing environmental impacts.

7.1.14 Sunol Yard Upgrade

The project includes replacing existing structure, demolishing others, and creating many new facilities. Replacement structures will be constructed for existing maintenance shops and equipment storage. New structures to be built include a fueling center, an 8,500 square feet administration building, four new pre-fabricated shop buildings, approximately 40,000 of covered storage for vehicles and materials, a re-surfaced area for vehicle traffic. To create space and lower maintenance costs, 6 existing dilapidated structures will be demolished. New the Sunol Water Temple, a 4,200 square foot interpretative center will be constructed. Additionally, new landscaping will be included between the main gate and the Sunol Water Temple.

7.1.15 Millbrae Yard Upgrade

Project includes a new 75,000 square-foot administration building to replace leased property and possible replacement laboratory space from the Southeast WWTP, plus a new 20,000 square-foot maintenance shop building and equipment storage, new parking lot, new vehicle wash site, reconfigured entrance off El Camino, and internal improvements to the main administration building (relocate dispatch center, lab rehabilitation, upgraded lighting). Re-development and construction concepts will be reviewed with City of Millbrae.

7.2 Master Plan Schedule

As discussed above, an essential planning function is provided by regular updates of master plans that cover certain facility classes such as water treatment plants or geographic locations such as low-pressure zone pipelines. The plans are updated in a staggered schedule with one or two completed each year to smooth workload and facilitate integration into the CIP. The scope and purpose of master plans is to extend 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 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 a review of the preventative 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 analysis 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.

Table 7-1: Region Water System Master Plan Schedules

Program	FY - Budget	FY Completion
Corrosion Protection (completed)	2009	2010
Bay Divisions Nos. 3 and 4	2011	2012
Low Pressure Zone Pipelines	2012	2013
High Pressure Zone Pipelines	2014	2015
Alameda Siphons, Calaveras Pipeline, San Antonio Pipeline, San Antonio Back-up Pipeline	2016	2017
Bay Divisions No. 1, 2, and 5	2017	2018
Harry Tracy WTP	2018	2019
Sunol Valley WTP	2019	2020
Vaults, pump stations, chemical systems, storage tanks, field equipment, etc.	On-going 3-yr or 5 yr condition assessment cycle.	

7.3 Water System Improvement Program

Approximately $1 billion in WSIP construction is active during the summer of 2010. In addition to the significant construction and construction management effort, activities in the summer of 2010 are highlighted by final design work on the Calaveras Dam Replacement Project and Harry Tracy WTP Long-Term Improvements Project, bidding of Lower Crystal Springs Dam Improvements and Crystal Springs-San Andreas Transmission Upgrades, additional high-level engineering work on the Bay Division No. 3 and 4 seismic upgrade, and on-going design work on the San Antonio Back-up Pipeline Project and Upper Alameda Creek Filtration Gallery. Table 7-2 lists the current status of the WISP projects.

Table 7-2: Current Status of Water System Improvement Program (WISP) Projects

Project	Status
San Joaquin Pipeline System	Project in Multiple Phases
Rehabilitation of Existing San Joaquin Pipelines	Project in Multiple Phases
Tesla Treatment Facility	Construction
Lawrence Livermore Water Quality Improvement Facility	Construction
Calaveras Dam Replacement	Design
San Antonio Backup Pipeline	Design
New Irvington Tunnel	Construction
SVWTP Expansion & Treated Water Reservoir	Construction
Alameda Siphon #4	Construction
San Antonio Pump Station Upgrade	Construction
Seismic Upgrade of BDPL Nos. 3 & 4	Design
BDPL Reliability Upgrade - Tunnel	Construction
BDPL Reliability Upgrade - Pipeline (East Bay)	Construction
BDPL Reliability Upgrade - Pipeline (Peninsula)	Construction
BDPL Reliability Upgrade - Relocation of BDPL 1 & 2	Construction
SCADA System - II	Construction
System Security Upgrades	Project in Multiple Phases
BDPL Nos. 3 & 4 Crossovers	Construction
BDPL No. 4 Cond. Assessment PCCP Sections	Completed-Planning Only
SFPUC / EBMUD Intertie	Close Out
BDPL Nos. 3 & 4 Crossover / Isolation Valves	Completed
Pulgas Balancing - Structural Rehabilitation and Roof Replacement	Construction
Pulgas Balancing - Modifications of the Existing Dechloramination Facility	Bid & Award
Crystal Springs / San Andreas Transmission System	Bid & Award
Baden and San Pedro Valve Lots Improvements	Construction

Project	Status
HTWTP Long Term Improvements	Design
New Crystal Springs Bypass Tunnel	Construction
Lower Crystal Springs Dam Improvements	Design
Crystal Spring Pipeline No. 2 Replacement	Design
San Andreas Pipeline No. 3 Installation	Construction
Peninsula Pipelines Seismic Upgrade	Planning
Sunset Reservoir – North Basin	Close Out
University Mound – North Basin	Construction
Regional Groundwater Storage and Recovery Project	Design
HTWTP Short Term Improvements - Coagulation & Flocculation	Close Out
Pulgas Balancing - Discharge Channel Modifications	Close Out
Cross Connection Controls	Completed
HTWTP Short-Term Improvements - Demo Filters	Completed
Adit Leak Repair - Crystal Springs / Calaveras	Completed
Capuchino Valve Lot Improvements	Completed
Pulgas Balancing - Inlet/Outlet Work	Completed
Standby Power Facilities - Various Locations	Construction

7.4 Seismic Improvements

Significant seismic improvements have been made for many assets and facilities in the Regional Water System through the maintenance, small capital projects and through WSIP. General items include additional emergency generators installed at many locations, adoption of new seismic design standards for a new construction, new groundwater wells and improved communication systems. Other specific improvements are listed in Table A.15 moving 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.15 unless completed, add additional seismic improvements because all new construction uses higher seismic design specifications.

8. Expenditures

The focus of the asset management program during FY09 and FY10 was to first create, then re-direct field personnel into, organized maintenance programs that prioritized expenditures based on established management strategies – i.e., maintain LOS, reduce life-cycle cost and reduce unplanned outages. The second step, largely initiated in FY10 and continuing through FY11, was to align the asset inventory and associated cost centers with budget and expense reporting to facilitate performance tracking by management. Considering the software systems in place for housing labor, materials and capital costs (e.g., MAXIMO, e-time, and FAMIS) and the many groups within the SFPUC with budget pertaining to a particular program, this second step will take the remainder of FY11 to complete. The most notable improvement expected in FY11 is the conversion of the CMMS to the next version of MAXIMO (October 2011); this will improve the completeness of the asset database, including condition, location, performance history and maintenance costs.

Although the SFPUC can delineate between joint and retail-only costs to ensure accurate cost allocation pursuant to the wholesale water supply agreement among the SFPUC and its wholesale water customers, determining total maintenance costs for a particular facility or asset was not directly possible in FY10.

8.1 FY10 Maintenance and Repair and Replacement Work Order Expenditures

The tables below capture the FY10 maintenance and R&R work order expenditures associated with the Regional Water System documented by the CMMS as a basic step towards establishing total cost data by function and by facility class.

Table 8-1: Labor and Material Costs in FY10, by Work Type

Work Type	Labor Costs	Material Costs
Administration	$ 834,484	$ 239,063
System Operations	$ 3,313,860	$ 6,873,614
Corrective Maintenance	$ 2,215,265	$ 359,747
Preventative Maintenance	$ 2,169,281	$ 128,565
WSIP Support	$ 1,574,802	$ 149,195
R&R	$ 684,464	$ 107,959
Other	$ 38,853	$ 50,396
Totals =	**$ 10,831,009**	**$ 7,908,539**

Table 8-2: Labor and Material Costs in FY10, by Asset Category

Asset Category	Labor Costs	Material Costs
Water Storage	$ 14,617	$ -
Water Transmission	$ 4,328,162	$ 217,579
Water Treatment	$ 2,038,452	$ 6,831,776
Buildings and Watersheds	$ 3,206,286	$ 375,663
Equipment	$ 409,008	$ 244,458
Administration	$ 834,484	$ 239,063
Totals =	**$ 10,831,009**	**$ 7,908,539**

To date, the CMMS contains only those work orders completed by the Water Supply & Treatment Division, the group within the SFPUC that operates the system and maintains most aspects of it. For this reason, the costs outlined below are a subset (albeit the largest share by far) of actual expenses. Also note that labor costs in these tables do not include fringe costs. All SFPUC work orders, and specifically those completed by IT, Natural Resources, Security, and Water Quality staff, will be integrated into these summary tables in subsequent updates to these tables beginning in September 2012.

Even with only the Water Supply & Treatment Division's costs included in Table 8-1 and Table 8-2, some important inferences can be drawn.

1. Approximately 35% of all operations and maintenance labor, and 63% of maintenance labor is consumed by corrective work orders and WSIP support as shown in Table xx. By FY13, WSIP support and the back-log of corrective work orders will decrease allowing a significantly larger percentage of maintenance to be preventative based. Also note that at present many activities that are initiated as preventative maintenance work orders include corrective maintenance making the below approximations for preventative maintenance in Table xx artificially high.
2. Chemical costs for water treatment in Table xx are significant and represent most of materials cost for operations and maintenance. Minimizing flow over the Pulgas weir into Crystal Springs Reservoir is one way of reducing chemical costs as these overflows involve additional chemicals to adjust chlorine and pH levels prior to discharge and then re-treatment at Harry Tracy WTP to make water potable again.
3. R&R expenses shown in the Table yy only reflect those aspects of work that are performed by WSTD staff and therefore captured within the CMMS. Significant amounts of work performed by contractors and other city departments (DPW, Infrastructure, etc.) are not captured because there is presently not a way to enter this financial data directly into the CMMS. This includes work on corrosion protection, pipeline repair, and dam instrumentation repair. To capture these costs the data in Table yy must be supplemented using other non-CMMS financial reports.
4. Approximately 40% of labor costs shown in Table yy support water transmission activities including pipeline repair, pipeline inspection, and pipeline right-of-way maintenance. An additional 30% of maintenance labor relates to work within the watersheds including road repair, public facility maintenance (Pulgas Water Temple and Sunol Water Temple), and vegetation management. Approximately 8% of maintenance labor is consumed by

administrative activities – this cost center will increase as more work is appropriately billed to administrative codes established for activities such as medical exams and training.

8.2 Sustainable Funding Level

Prior capital appropriations by the SFPUC for the WSIP provided enough funding to support adopted LOS. The WSIP projects and LOS were developed together and by design implementation of WSIP ensures LOS is met. The question then becomes what is the appropriate sustainable funding level for maintenance, R&R, and capital after the WSIP to ensure that assets are maintained and that the appropriate capital improvements are implemented on schedule to maintain the adopted LOS.

Conditions to completely answer this question may not manifest themselves until the FY14 budget cycle because future maintenance costs for new WSIP assets, although estimated, may not be fully known until that time. Additionally, the benefits from improved asset management and more efficient and cost-effective preventative maintenance cannot be expected to be realized in the near term. Also, future regulatory and safety requirements which affect water production and pipeline inspection costs can only be approximated.

Certainly capital costs will significantly decrease for foreseeable budget cycles because of the massive prior investment encompassed by WSIP; the present 10-year CIP is approximately $254M compared to $4.5 B for WSIP. Operating expenses will also likely remain more or less fixed for the next three years at least because available opportunities for major maintenance projects are limited due to WSIP construction – that is, additional shutdowns are nearly impossible (progress for many WSIP projects are themselves shutdown-limited).

By FY14 enough detail on future maintenance program costs and the efficiencies gained by instituting a regular, industry-standard asset management program will allow an accurate prediction of a sustainable investment level in capital, operations and maintenance.

Appendix A: Asset Inventory Tables

Table A-1: Dams

Asset	Dam Type	Location	Completion Date
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 #1	Earth	San Mateo County	1898
San Mateo Creek Dam #2	Earth	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

Table A-2: Groundwater Wells

Asset	Number of Wellheads	Location	Capacity (mgd)
Pleasanton Well Field	2	Pleasanton	< 1 mgd
Peninsula Conjunctive Use Wells (2012)	11	Various	7 mgd

Table A-3: Supply Reservoirs

Asset	Capacity of Reservoir (ac-ft)	Reservoir Surface Area (sq. mi)	Location
Calaveras Reservoir	96,800	2.2	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
San Antonio Reservoir	50,500	1.3	Alameda County

Table A-4: Treated Water Storage

Asset	Capacity (MG)	Location
Town of Sunol (4 tanks)	0.032, 0.032, 0.097, and 0.097	Sunol
Niles Reservoir	De-commissioned	Niles
Castlewood Reservoir	0.4	Pleasanton
Pulgas Balancing Reservoir	60.0	San Mateo
Merced Manor	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

Table A-5: Water Transmission – Pipelines and Tunnels

Asset	Size	Length (mi)	Capacity (mgd)	Installation Date
Alameda Siphon #1	69″	0.6	67	1934
Alameda Siphon #2	91″	0.6	134	1953
Alameda Siphon #3	96″	0.6	152	1967
San Antonio Pipeline	60″	2.1	230	1967
Calaveras Pipeline	44- - 72″	6.0	80	1965/1992
Irvington Tunnel	10.7′	3.5	400	1934
Bay Division Pipeline #1	60″	21.2	46	1925/1933
Bay Division Pipeline #2	66″	21.2	59	1935/1936
Bay Division Pipeline #3	72″	34	80	1952
Bay Division Pipeline #4	90″	34	80	1965/1967 1973
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
Sunset Supply Pipeline	60″	13.4	111	1948-1958
Crystal Springs Pipeline #1	44″	17.1	10	1885/1956
Crystal Springs Pipeline #2	60″	19.3	52	1937/1956
Crystal Springs Pipeline #3	60″	3.6	60	1971/1987
San Andreas Pipeline #1	44″	12.5	22	1870-1939
San Andreas Pipeline #2	54″	12.3	37	1927-1928
San Andreas Pipeline #3	60″ – 66″	6.6	65	1992/1993
Sunset Branch Pipeline	60″	1.1	65	1947
Crystal Springs-San Andreas Forcemain	61″	4.7	90	1898-1932 1968
Stone Dam Tunnel #1	4′-6″ x 4′-9″	0.1	45	1872-1948
Stone Dam Tunnel #2	3′-6″ x 4′-4″	0.61	45	1872-1948
San Mateo Tunnel #1	3′-6″ x 5′-1″	0.65	40	1868
San Mateo Tunnel #2	4′-4″ x 4′-6″	0.67	45	1898

Table A-6: Water Transmission – Pump Stations

Asset	Number of Pumps	Total Capacity (mgd)	Location
Lake Merced Pump Station	4	50	San Francisco
Baden Pump Station	3	45	San Bruno
Crystal Springs Pump Station	6	50	San Mateo
Pulgas Pump Station	5	185	San Mateo
San Antonio Pump Station	7 (electric) 3 (diesel)	160	Sunol

Table A-7: Water Transmission – Valve Lots

Asset	Valves	Valve Size (in)	Pipeline	Location
Alameda East Portal	X10 X20 X30 X32 X50	72 72 60 60 60	AS2 AS3 AS1 AS1 AS4	Sunol
Alameda West Portal	X15 X24 X25 X35	72 72 72 60	AS2 AS3 AS1 AS1	Sunol
Bellevue and Pepper Valve Lot	M30 M31 M32K M33L M34 L30	42 36 36 36 12 42	SSPL SSPL CS2/SSPL CS3/SSPL SSPL CS3	Hillsborough
Caisson Valve House	A40 A41 A41B A42B B40 B41	36 48 36 42 36 48	BD1 BD1 BD1/BD2 BD1/BD2 BD2 BD2	SF Bay
Calaveras Boulevard Valve Lot	C20 C22 C220 C230 D20	66 8 48 4 72	BD3 BD3 BD3/BD4 BD3/BD4 BD4	Milpitas
Capuchino Valve Lot	M41 M41A M41B M43 M43A M43B	24 24 24 14 14 14	SS Branch SS Branch SS Branch SS Branch SS Branch SS Branch	San Bruno
Crawford Valve Lot	C17 C171 C172 C173 D17 D171 D172 C18D C19 C191 C192 C193	78 16 16 16 78 16 16 42 78 16 16 16	BD3 BD3/BD4 BD3/BD4 BD3/BD4 BD4 BD3/BD4 BD3/BD4 BD3/BD4 BD3 BD3/BD4 BD3/BD4 BD3/BD4	Fremont

Asset	Valves	Valve Size (in)	Pipeline	Location
	D19 D191 D192	78 16 16	BD4 BD3/BD4 BD3/BD4	
Crystal Springs and El Cerrito Valve Lot	K20	48	CS2	Hillsborough
Dumbarton Valve House	A30 A31 A32B A33B A34B B30 B31	48 36 42 36 42 42 36	BD2 BD2 BD1/BD2 BD1/BD2 BD1/BD2 BD1 BD1	Newark
Edgewood Road Valve Lot	A64D B65D B66C	24 24 20	BD1/BD4 BD2/BD4 BD2/BD3	San Mateo
El Camino and Bellevue Valve Lot	J30 J31 J32K J33K J34K K30	30 20 30 16 16 36	CS1 CS1 CS1 CS1 CS1 CS2	Burlingame
El Camino Real/Millbrae Yard Valve Lot	K38P K39P K40 K40P K41P J40 J41K	16 16 30 12 12 30 16	CS2/CS3 CS2/CS3 CS2 CS2/CS1 CS2/CS1 CS1 CS2/CS1	Millbrae
Grimmer Shutoff Station	A17 A18 A19B A191 B17 B18	66 66 36 36 60 60	BD2 BD2 BD2 BD1/BD2 BD1 BD1	Hayward
Guadalupe Valve Lot	C24 C26 C250 D24 D26	72 72 42 90 90	BD3 BD3 BD3/BD4 BD4 BD4	Santa Clara
Hillsborough Valve Lot	J20 M21K M22J	12 36 36	CS1 CS2/SSPL CS1/SSPL	Hillsborough
Irvington Portal	A09 A10 A11.1 B10	16 66 16 60	Hayward Serv. BD2 Hayward Serv. BD1	Hayward

Asset	Valves	Valve Size (in)	Pipeline	Location
	B12 C10 D10 D10.1	16 60 72 12	Hayward Serv. BD3 BD4 BD4	
Mountain View/Alviso Valve Lot	C30 C31D C32D D30	42 48 48 72	BD3 BD3/BD4 BD3/BD4 BD4	Mountain View
Newark Valve Lot	A20 A21B A22B B20	48 30 36 42	BD2 BD1/BD2 BD1/BD2 BD1	Newark
Paseo Padre Shutoff Station	A14 A15 A161 A16B B14 B15	66 66 36 36 60 60	BD2 BD2 BD2 BD1/BD2 BD1 BD1	Hayward
Polhemus Valve Lot	G43	96	CSBP	San Mateo
Pulgas Valve Lot	A68 A69 A70 A71 B68 B69 B70 B71 C68 C69 C70 C71 D68 D69 D70	42 18 42 24 42 18 42 24 48 18 48 18 72 18 72	BD1 BD1 BD1 BD1 BD2 BD2 BD2 BD2 BD3 BD3 BD3 BD3 BD4 BD4 BD4	San Mateo
Ravenswood Valve Lot	A50 A51B A52	42 30 12	BD1 BD1/BD2 BD1	East Palo Alto
Redwood City Valve Lot	A60 A61B A62B B60 F05 F06 F10 F20 F25	42 30 30 48 24 24 20 20 24	BD1 BD1/BD2 BD1/BD2 BD2 BD1/BD2 Palo Alto PL Palo Alto PL Palo Alto PL Palo Alto PL	Redwood City

Asset	Valves	Valve Size (in)	Pipeline	Location
	F30	30	Palo Alto PL	
San Antonio Pump Station Valve Lot	X11	20	SVWTP Eff.	Sunol
	X111	20	SVWTP Eff.	
	X112	20	SVWTP Eff.	
	X12	60	SVWTP Eff.	
	X13	24	Sunol Serv.	
	X14	66	AS2	
	X22	60	SVWTP Eff.	
	X31	16	San Ant. PL	
	W09	10	Nursery Serv.	
	W11	54	San Ant. PL	
	W12	66	San Ant. PL	
	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 Pedro Valve Lot	M60	42	SSPL	Colma
	P60	30	BMPL	
	P61M	12	BMPL	
	P62M	12	BMPL	
	P68M	12	BMPL	
	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	
	R61	8	SA2	
	R62	8	SA2	
	R63	8	SA2	
Stanford East Portal	C40	48	BD3	Palo Alto
	D40	72	BD4	
Stanford West Portal	C50	48	BD3	Palo Alto
	D50	72	BD4	
Tissiack Valve Lot	C14	78	BD3	Fremont
	C141	16	BD3/BD4	
	C142	16	BD3/BD4	
	C143	16	BD3/BD4	
	D14	78	BD4	
	D141	16	BD3/BD4	
	D142	16	BD3/BD4	
	C15D	42	BD3/BD4	

Asset	Valves	Valve Size (in)	Pipeline	Location
	C16	78	BD3	
	C161	16	BD3/BD4	
	C162	16	BD3/BD4	
	C163	16	BD3/BD4	
	D16	78	BD4	
	D161	16	BD3/BD4	
	D162	16	BD3/BD4	

Table A-8: Water Transmission - Interties

Asset	Capacity (mgd)	Location
East Bay Municipal Utilities District Intertie	35	Hayward
Santa Clara Valley Water District Intertie	35	Milpitas

Table A-9: Water Transmission – Town of Sunol Distribution System

Asset	Size (in)	Total Length (mi)	Capacity (mgd)
Town of Sunol Distribution System			

Table A-10: Buildings and Watersheds – Watersheds

Asset	Size of Watershed (sq. mi)	Location
Calaveras Watershed	35	Alameda and Santa Clara County
Crystal Springs Watershed	23	San Mateo County
Pilarcitos Watershed	3.8	San Mateo County
San Andreas Watershed	4.4	San Mateo County
San Antonio Watershed	40	Alameda County

Table A-11: Buildings and Watersheds – Structures (Non-Operations)

Asset	Type	Location
North San Andreas Cottage	Watershed Keeper Residence	San Mateo County
San Andreas Cottage	Watershed Keeper Residence	San Mateo County
Sawyer Camp Cottage	Watershed Keeper Residence	San Mateo County
Pilarcitos Cottage	Watershed Keeper Residence	San Mateo County
Davis Tunnel Cottage	Watershed Keeper Residence	San Mateo County
Lower Crystal Springs Cottage	Watershed Keeper Residence	San Mateo County
Cypress Work Center	Watershed Keeper Residence	San Mateo County
Upper Crystal Springs Cottage	Watershed Keeper Residence	San Mateo County
Crystal Springs Cottage	Watershed Keeper Residence	San Mateo County
Niles Cottage	Watershed Keeper Residence	Alameda County
Sunol Yard Cottage	Watershed Keeper Residence	Alameda County
Irvington Cottage	Watershed Keeper Residence	Alameda County
San Antonio Cottage	Watershed Keeper Residence	Alameda County
Alameda East Cottage	Watershed Keeper Residence	Alameda County
Calaveras #1 Cottage	Watershed Keeper Residence	Alameda County
Calaveras #2 Cottage	Watershed Keeper Residence	Alameda County
Polhemus Fluoride Building	Emergency Supply Stockpile and Staging Site	San Mateo County
Mt. Allison	Radio Repeater Site	San Mateo County
Sawyer Ridge	Radio Repeater Site	Alameda County
Pulgas Water Temple	Public Grounds	San Mateo County
Sunol Water Temple	Public Grounds	Alameda County

Table A-12: Buildings and Watersheds – Corporation Yards

Asset	Size (ac)	Location
Millbrae Corporation Yard	10	Millbrae
Sunol Corporation Yard	25	Sunol

Table A-13: Buildings and Watersheds – Quarries

Asset	Size (ac)	Location	Purpose
Casey Quarry		San Mateo County	
Skyline Quarry	15	San Mateo County	Emergency Supply Stockpile and Staging
Donovan Quarry	66	Redwood City	Emergency Supply Stockpile

Table A-14: Rolling Stock

Asset	Quantity
Passenger Cars	28
Light Duty Trucks	192
Heavy Equipment	111
Trailer Equipment	87
Other Equipment	36
Boats	23

Table A-15: Seismic Upgrades

Facility	Seismic Upgrade
San Joaquin Pipelines:	Crossover facilities to add flexibility. Additional pipeline (San Joaquin No. 4)
Tesla Portal	New chemical feed facilities.
Thomas Shaft Chlorination Facility	Built to recent seismic standards, with SCADA remote control. New vent structure.
Alameda East Portal	Seismically upgraded portal with new Alameda Siphon Nos. 2, 3, and 4 connections. New Coast Range Tunnel ventilation system. New overflow pipeline.
Alameda Siphons	New seismically upgraded siphon (No. 4). Seismically upgraded siphons from mixing chamber to Alameda West Portal. Seismically activated isolation valves.
Sunol Valley WTP	Structural and worker safety upgrades and seismic closure valves on all chemical tanks. New emergency generator and fuel tank.
Sunol Yard	Pipe rolling facility for emergency pipeline repair.
San Antonio Pump Station	Seismic upgrades for worker safety. Emergency generator for electric pumps.
San Antonio Reservoir	SCADA controlled reservoir outlet closure system.
Calaveras Reservoir	New Dam, outlet structure and spillway.
New Irvington Tunnel	Remote controlled valve actuators. Emergency generator.
Bay Division Pipelines	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). Interties between Nos. 3 and 4 at Fremont, Guadalupe River and Mountain View.
EBMUD Intertie	– including emergency generator.
SCVWD Intertie	– including emergency generator.
Pulgas Valve Lot	Secondary line valves with SCADA remote control.
Pulgas Reservoir / Pump Station	Redundant discharge valve.
Pulgas Discharge Channel	Seismic upgrade.
Facility	Seismic Upgrade

Pulgas Balancing Reservoir	Seismic upgrade to walls and roof.
Harry Tracy WTP	Chemical tank seismic closure valves. Seismic structural upgrades to filters Employee safety seismic upgrades
New Crystal Springs Bypass Tunnel	New tunnel under fault slip and landslide zone.
Capuchino Valve Lot	High pressure zone supply to low pressure zone.
Baden Valve Lot /Pump Station	Emergency generators
Millbrae Corporation Yard and Lab	Emergency generator and seismic upgrade.
San Pedro Valve Lot	Seismic upgrade
Baden Valve Lot/Pump Station	Seismic upgrades.
Baden Valve Lot/Pump Station	Redundant High Pressure zone to Low Pressure zone supply.
Sunset Reservoir North Basin	Seismic upgrade of north basin.
University Mound North Reservoir	Seismic upgrade of north basin

Appendix B: Condition Assessment Tables

Table B–1: Inventory of Active Pipelines

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
Bay Division 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 during 1956-60; cathodic protection was begun 1953, expanded 1973, overhauled 1988; isolation valves installed with new pipelines constructed, both sides of Hayward Fault in Fremont, Bay Division Nos. 1 and 2 (2001).
Bay Division 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 Bay Division No. 1).	Cement mortar lining placed over original coal tar lining during 1956-60; protected by the same corrosion protection described for Bay Division No. 1; no corrosion leaks since 1955.
Bay Division No. 3 Sec. A	RCP	Concrete	Concrete	No documented leaks	Axial slip joint constructed across Hayward Fault in 1994; isolation valves installed both sides of Hayward Fault (2006)
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 (1993-4). Valve C20 replaced (2005).
Sec. C	Welded steel	Cement	Cement	No documented leaks	San Tomas River crossing relocated on bridge above river (1963).
Stanford Tunnel	Welded steel pipe in tunnel	Cement Grout	Cement Mortar	No documented leaks	None
Sec. D	RCP	Concrete	Concrete	No documented leaks	Added flow control valve C68 (2004)
Bay Division No. 4 Sec A	PCCP	Cement	Concrete	No documented leaks	Axial slip joint constructed across Hayward Fault in 1994; isolation valves installed both sides of Hayward Fault (2005); pre-stress wire tests in 2005 confirmed results from electromagnetic survey.
Sec. B	Welded steel	Coal tar	Cement	No leaks, corrosion protection installed 1973	Relocated beneath Guadalupe River and lowered pipeline for Coyote Creek flood channel by SCVWD (1993-4).
Sec. C	Welded steel	Coal tar	Cement	No documented leaks	None
Sec. D	PCCP	Cement	Concrete	One leak (1991): separation of bell ring from steel cylinder	One distressed section replaced with steel (1991); one distressed section reinforced (2007); prestress wire tests confirmed results from 2007 electromagnetic survey; installed flow control valve D68 (2004).

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
Submarine Pipelines	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.
Alameda Ck Siphon No. 1	RCP	Cement	Concrete	No documented leaks	Valve X32 installed to back up valve X30 (2005).
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)
No. 3	PCCP	Cement	Concrete	No documented leaks	Valve X24 installed to back up valve X25 (2003); valve X20 replaced (2001).
Pulgas Tunnel	Concrete	Tunnel	Concrete	No documented leaks	None
Crystal Springs Bypass Tunnel	Concrete	Tunnel	Concrete	No documented leaks	None
Crystal Springs Bypass Pipeline	PCCP	Cement	Concrete	No documented leaks	Landslide material removed above pipeline after inspection showed minimal deflections.
Crystal Springs Pipeline No. 1	Welded steel	Coal tar	Cement	No documented leaks	Replaced originial 44" section; other segments were replaced in Brisbane in 1980s.
Crystal Springs Pipeline No. 2 Sec. A	Welded steel	Coal tar	Coal tar	Five leak repairs found with inspection.	K10 to G42 connection became stagnant leg after 1970 with Crystal Springs Bypass tunnel & pipeline; cathodic protection installed Crystal Springs Pump Station to El Cerrito Road.
Sec. B	Welded steel	Coal tar	Coal tar	Cluster of 6 leak repairs found	Original gate valves K30 and K31 replaced with K30 (2006); added valve K20.
Sec. C	Riveted wrt stl	Coal tar	Cement	No leak repairs since 1962	Original coal tar lining replaced with cement mortar (1962).
Sec. D	Welded steel	Coal tar	Coal tar	4 leaks reported	No significant contract work has been identified.
Sec. E	Welded steel	Coal tar	Coal tar	23 leak repairs found with inspection; all leaks predate 1990.	About 50% of leak repairs located near top of Randolph Ave; rebuilt 163 feet beneath Colma Creek (1980)
Sec. F	Welded steel	Coal tar	Coal tar with some cement	17 leak repairs found with inspection; most leaks in Brisbane within 1000' of Main St. predate 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); cathodic protection installed Main St to Geneva Ave, Brisbane to Daly City (1959)

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
Crystal Springs Pipeline 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)
Crystal Springs Pipeline 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 installed 60 ft downstream of G41 (2010).
Sec. B	Welded steel	Cement	Cement	No documented leaks	New turnout and line valve L30 connected to Crystal Springs No. 3 (1970).
Sec. C	Welded steel pipe in tunnel	concrete	Cement	No documented leaks	None
Sec. D	Welded steel	Coal tar	Coal tar	3 documented leaks	None
Sec. E	Welded steel	Coal tar	Coal tar	3 leaks 1990s, Helen Drive	Original valve M41 replaced by PRVs M41, M41A, M41B (late 1990s).
Sec. F	Welded steel	Coal tar	Coal tar	1 leak repair found with inspection	None
Sec. G	Welded steel	Coal tar	Coal tar	No documented leaks	Short sections relocated by BART at Colma and SSF stations (late 1990s).
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)
San Andreas No. 1	Riveted steel (wrought)	Coal tar	Cement	10 documented leaks 1956 thru 1988	Original pipeline delivered water from San Andreas Lake to SF; ca late 1950s: N. of Orange Ave, So. San Francisco taken out of service; ~5,500' replaced in Millbrae west of El Camino Real; ~800 feet was lowered along ECR in millbrae (1962); cement mortar lining applied in Millbrae to So. San Francisco (1977).
San Andreas No. 2	Steel (lockbar) riveted joints	Coal tar	Cement	17 documented leaks 1953-81; no leaks after 1984	Cement mortar lining applied, San Bruno to Daly City (1984); relocations, various sections for highway construction in San Bruno, So. San Francisco, and Daly City (1960s).
San Andreas No. 3	Welded steel	Cement	Cement	1990: 1 leak followed by a major pipeline failure	Originally constructed as PCCP, faulty prestress 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.

Pipeline	Structural Material	Coating	Lining	Leak History	Rehabilitation or Relocation
Palo Alto	Welded steel	Coal tar	Coal tar	1960s: 2 leaks;1990: major lead, Menlo Park	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 Bay Division Nos. 1 and 2 (2002).
Crystal Springs to San Andreas Pipeline	Welded steel	Coal tar	Cement	No documented leaks	Major rehabilitation under WSIP (complete in 2012).
San Mateo Tunnel No. 2	Concrete	Concrete	Concrete	No documented leaks	No major work has been identified
San Mateo Pipeline No. 2	Concrete	Concrete	Concrete	No documented leaks	Connection to Crystal Springs to San Andreas Pipeline and golf course was reconstructed (2000).
San Antonio	PCCP	Cement	Concrete	2003: 1 pipe burst	~300 ft of pipe replaced with WSP for joint separation from Calaveras Fault (1998); 3 pipe segments replaced with WSP to repair damage from the pipe burst (2003).
Calaveras	Welded steel	Cement	Cement	No documented leaks	Original 1924 pipeline reconstructed from Calaveras Dam to Sunol Valley WTP in 1992.
Sunol Valley WTP Effluent	Welded steel	Coal tar	Cement	No documented leaks	No major work has been done.

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	Notes
1	Pulgas Dechloramination Facility	Field Facility	June, 2009	June, 2012	
1	San Antonio Dechlorination Facility	Field Facility	June, 2009	June, 2012	
1	Sunol Valley Chloramination Facility	Field Facility	January, 2009	January, 2012	
1	Pulgas Pump Station	Pump Station	June, 2009	June, 2012	
1	San Antonio Pump Station	Pump Station	June, 2009	June, 2012	Significant upgrades performed under WSIP
1	Harry Tracy Water Treatment Plant	Treatment Plant	March, 2009	March, 2012	Significant upgrades performed under WSIP
1	Sunol Valley Water Treatment Plant	Treatment Plant	July, 2009	July, 2012	Significant upgrades performed under WSIP
1	Alameda East Portal	Tunnel/ Pipeline	June, 2009	June, 2012	
1	Alameda West Portal	Tunnel/ Pipeline	June, 2009	June, 2012	
1	Baden Valve Lot	Valve Lot	November, 2008	November, 2011	
2	Millbrae Yard	Corporation Yard	July, 2009	Not currently scheduled	
2	Sunol Yard	Corporation Yard	July, 2009	Not currently scheduled	
2	Alameda Creek Diversion Dam	Dam	-----	Not currently scheduled	
2	Calaveras Dam	Dam	July, 2010	July, 2011	Dam scheduled to be replaced under WSIP
2	Crystal Springs Dam	Dam	July, 2010	July, 2011	Significant upgrades performed under

Non-Linear Asset Tier	Asset Name	Asset Class	Completion Date of Last Assessment	Scheduled Date of Next Assessment	Notes
					WSIP
2	Pilarcitos Dam	Dam	July, 2010	July, 2011	Annual inspection, per DSOD
2	San Andreas Dam	Dam	July, 2010	July, 2011	Annual inspection, per DSOD
2	Stone Dam	Dam	July, 2010	July, 2011	Annual inspection, per DSOD
2	Turner Dam	Dam	July, 2010	July, 2011	Annual inspection, per DSOD
2	Lawrence Livermore Lab Site 300 Treatment Facility	Field Facility	May, 2010	May, 2015	
2	Thomas Shaft	Field Facility	May, 2010	May, 2015	
2	EBMUD Intertie	Intertie	May, 2010	May, 2015	
2	SCVWD Intertie	Intertie	May, 2010	May, 2015	
2	Baden Pump Station	Pump Station	November, 2008	November, 2013	Significant upgrades performed under WSIP
2	Calaveras Reservoir	Reservoir	-----	-----	Daily inspections by watershed staff
2	Lower Crystal Springs Reservoir	Reservoir	-----	-----	Daily inspections by watershed staff
2	Pilarcitos Reservoir	Reservoir	-----	-----	Daily inspections by watershed staff
2	Pulgas Balancing Reservoir	Reservoir	-----	-----	Significant upgrades performed under WSIP
2	San Andreas Reservoir	Reservoir	-----	-----	Daily inspections by watershed staff
2	San Antonio Reservoir	Reservoir	-----	-----	Daily inspections by watershed staff
2	Upper Crystal	Reservoir	-----	-----	Daily inspections

Non-Linear Asset Tier	Asset Name	Asset Class	Completion Date of Last Assessment	Scheduled Date of Next Assessment	Notes
	Springs Reservoir				by watershed staff
2	Mount Allison Radio Station	Structure (non op)	August, 2010	August, 2015	
2	Sawyer Ridge Radio Station	Structure (non op)	August, 2010	August, 2015	
2	Bellevue & Pepper Valve Lot	Valve Lot	August, 2010	August, 2015	
2	Caisson	Valve Lot	August, 2010	August, 2015	
2	Calaveras Valve Lot	Valve Lot	August, 2010	August, 2015	
2	Capuchino Valve Lot	Valve Lot	August, 2010	August, 2015	
2	Crawford Valve Lot	Valve Lot	August, 2010	August, 2015	
2	Dumbarton Valve Lot	Valve Lot	August, 2010	August, 2015	
2	Edgewood Road Valve Lot	Valve Lot	No documented inspection	September, 2010	
2	Geneva Valve Lot	Valve Lot	No documented inspection	September, 2010	
2	Grimmer Shutoff Station	Valve Lot	No documented inspection	September, 2010	
2	Mountain View/Alviso Valve Lot	Valve Lot	No documented inspection	September, 2010	
2	Newark Tunnel Shaft	Valve Lot	No documented inspection	September, 2010	
2	Newark Valve Lot	Valve Lot	No documented inspection	September, 2010	
2	Paseo Padre Shutoff Station	Valve Lot	No documented inspection	September, 2010	
2	Polhemus Valve Lot	Valve Lot	No documented inspection	October, 2010	
2	Pulgas Valve Lot	Valve Lot	June, 2009	June, 2014	
2	Ravenswood Tunnel Shaft	Valve Lot	No documented inspection	October, 2010	
2	Ravenswood Valve Lot	Valve Lot	No documented inspection	October, 2010	
2	Redwood City Valve Lot	Valve Lot	No documented inspection	October, 2010	
2	San Pedro Valve Lot	Valve Lot	November, 2008	November, 2013	Significant upgrades performed under WSIP
2	Tissiack Valve Lot	Valve Lot	No documented	October, 2010	

Non-Linear Asset Tier	Asset Name	Asset Class	Completion Date of Last Assessment	Scheduled Date of Next Assessment	Notes
			inspection		
3	San Mateo Creek Dam No. 1 (Mud Dam No. 1)	Dam	No documented inspection	Not currently scheduled	
3	San Mateo Creek Dam No. 2 (Mud Dam No. 2)	Dam	No documented inspection	Not currently scheduled	
3	Casey Quarry	Quarry	-----	-----	
3	Skyline Quarry	Quarry	-----	-----	
3	Castlewood Reservoir	Reservoir	No documented inspection	-----	
3	Niles Reservoir	Reservoir	No documented inspection	-----	Plan for demolition
3	Town of Sunol Distribution System	Town of Sunol	June, 2010	June, 2013	
3	Crystal Springs/El Cerrito Valve Lot	Valve Lot	No documented inspection	June, 2011	
3	El Camino Real/Bellview Valve Lot	Valve Lot	No documented inspection	June, 2011	
3	El Camino Real/Millbrae Yard Valve Lot	Valve Lot	No documented inspection	June, 2011	
3	Hillsborough Valve Lot	Valve Lot	No documented inspection	June, 2011	
3	Mission and Palm Avenue Valve Lot	Valve Lot	No documented inspection	June, 2011	
3	Sneath Lane Valve Lot	Valve Lot	No documented inspection	June, 2011	
3	Southwest Corner Valve Lot (Stanford Tunnel)	Valve Lot	No documented inspection	June, 2011	
3	Taylor Field Valve Lot	Valve Lot	No documented inspection	June, 2011	
3	West Valve House (Stanford Tunnel)	Valve Lot	No documented inspection	June, 2011	
3	East Bay Wells	Well	No documented inspection	June, 2011	
-----	Alameda Siphon No. 1	Tunnel/ Pipeline	September, 2001	February, 2011	
-----	Alameda Siphon No. 2	Tunnel/ Pipeline	February, 2003	Mid-2015	
-----	Alameda Siphon No. 3	Tunnel/ Pipeline	July , 2008	May, 2014	

Non-Linear Asset Tier	Asset Name	Asset Class	Completion Date of Last Assessment	Scheduled Date of Next Assessment	Notes
-----	Bay Division Pipeline No. 1, Section A	Tunnel/ Pipeline	July, 2002	November, 2014	
-----	Bay Division Pipeline No. 1, Section B	Tunnel/ Pipeline	April, 1991	August, 2014	Confirm section will not be abandoned upon completion of BD5
-----	Bay Division Pipeline No. 1, Section C	Tunnel/ Pipeline	April, 1996	No inspection scheduled; BDPL1C to be taken out of service upon completion of BDPL5.	
-----	Bay Division Pipeline No. 1, Section D	Tunnel/ Pipeline	March, 2009	Year 2019	
-----	Bay Division Pipeline No. 1, Section E	Tunnel/ Pipeline	October, 2001	Year 2019	
-----	Bay Division Pipeline No. 2, Section A	Tunnel/ Pipeline	April, 2002	November, 2010	
-----	Bay Division Pipeline No. 2, Section B	Tunnel/ Pipeline	January, 1997	No inspection scheduled; BDPL2B to be taken out of service upon completion of BDPL5 under WSIP.	
-----	Bay Division Pipeline No. 2, Section C	Tunnel/ Pipeline	April, 1998	October, 2014	Confirm section will not be abandoned upon completion of BD5
-----	Bay Division Pipeline No. 2, Section D	Tunnel/ Pipeline	No documented inspection	October, 2012	
-----	Bay Division Pipeline No. 3, Section A	Tunnel/ Pipeline	March, 2007	January, 2017	
-----	Bay Division Pipeline No. 3,	Tunnel/ Pipeline	February, 2010	February, 2030	

Non-Linear Asset Tier	Asset Name	Asset Class	Completion Date of Last Assessment	Scheduled Date of Next Assessment	Notes
	Section B				
-----	Bay Division Pipeline No. 3, Section C	Tunnel/ Pipeline	No documented inspection	January, 2012	
-----	Bay Division Pipeline No. 3, Section D	Tunnel/ Pipeline	No documented inspection	January, 2012	
-----	Bay Division Pipeline No. 4, Section A	Tunnel/ Pipeline	December, 2004	January, 2015	
-----	Bay Division Pipeline No. 4, Section B	Tunnel/ Pipeline	November, 2009	November, 2015	
-----	Bay Division Pipeline No. 4, Section C	Tunnel/ Pipeline	June, 1996	March, 2012	
-----	Bay Division Pipeline No. 4, Section D	Tunnel/ Pipeline	May, 2007	March, 2012	
-----	Calaveras Pipeline	Tunnel/ Pipeline	No documented inspection	July, 2014	
-----	Crystal Springs Bypass Pipeline	Tunnel/ Pipeline	January, 1999	February, 2013	
-----	Crystal Springs Bypass Tunnel No. 1 (old)	Tunnel/ Pipeline	No documented inspection	January, 2011	
-----	Crystal Springs Pipeline No. 1	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	Crystal Springs Pipeline No. 2, K10 to K20	Tunnel/ Pipeline	November, 2000	April, 2013	Significant upgrades performed under WSIP
-----	Crystal Springs Pipeline No. 2, K20 to K30	Tunnel/ Pipeline	November, 2006	No inspection is scheduled until after WSIP rehabilitation.	Significant upgrades performed under WSIP
-----	Crystal Springs Pipeline No. 2, K30 to K40	Tunnel/ Pipeline	December, 2006	No inspection is scheduled until after WSIP rehabilitation.	Significant upgrades performed under WSIP
-----	Crystal Springs Pipeline No. 2, K40 to K50	Tunnel/ Pipeline	No documented inspection	July, 2010	

Non-Linear Asset Tier	Asset Name	Asset Class	Completion Date of Last Assessment	Scheduled Date of Next Assessment	Notes
-----	Crystal Springs Pipeline No. 2, K50 to K60	Tunnel/ Pipeline	May, 2003	Not currently scheduled	
-----	Crystal Springs Pipeline No. 2, K60 to K70	Tunnel/ Pipeline	August, 2002	No inspection is scheduled until after WSIP rehabilitation.	Significant upgrades performed under WSIP
-----	Crystal Springs Pipeline No. 3, L30 to L41K	Tunnel/ Pipeline	April, 2006	May, 2011	
-----	Crystal Springs Pipeline No. 3, P48 to L59K	Tunnel/ Pipeline	July, 2008	August, 2012	
-----	Crystal Springs-San Andreas Pipeline	Tunnel/ Pipeline	March, 2005	No inspection is scheduled until after WSIP rehabilitation.	Significant upgrades performed under WSIP
-----	Irvington Portal	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	Irvington Tunnel No. 1 (old)	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	Palo Alto Pipeline	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	Pleasanton Wells Pipeline	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	Pulgas Tunnel	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	San Andreas Pipeline No. 1	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	San Andreas Pipeline No. 2, R12 to R60	Tunnel/ Pipeline	No documented inspection	No inspection is scheduled until after WSIP rehabilitation at HTWTP.	
-----	San Andreas Pipeline No. 2, R60 to Sunset Reservoir	Tunnel/ Pipeline	No documented inspection	October, 2013	
-----	San Andreas Pipeline No. 3, T11 to T50	Tunnel/ Pipeline	July, 2003	Not currently scheduled	
-----	San Andreas Pipeline No. 3, T50	Tunnel/ Pipeline	April, 1997	Not currently scheduled	

Non-Linear Asset Tier	Asset Name	Asset Class	Completion Date of Last Assessment	Scheduled Date of Next Assessment	Notes
	to T60				
-----	San Antonio Pipeline	Tunnel/ Pipeline	July, 2008	April, 2014	
-----	San Mateo Tunnel No. 1	Tunnel/ Pipeline	July, 2009	Not currently scheduled	
-----	San Mateo Tunnel No. 2	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	Stanford Tunnel	Tunnel/ Pipeline	1972	Not currently scheduled	
-----	Stone Dam Tunnel	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	Sunol Valley Water Treatment Plant Effluent Pipeline	Tunnel/ Pipeline	June, 1992	April, 2012	
-----	Sunset Branch Pipeline	Tunnel/ Pipeline	No documented inspection	May, 2013	
-----	Sunset Supply Pipeline, M10 to M20	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
-----	Sunset Supply Pipeline, M30 to M40	Tunnel/ Pipeline	No documented inspection	April, 2015	
-----	Sunset Supply Pipeline, M40 to M50	Tunnel/ Pipeline	November, 2007	Not currently scheduled	
-----	Sunset Supply Pipeline, M50 to M60	Tunnel/ Pipeline	April, 1999	October, 2010	
-----	Sunset Supply Pipeline, M60 to Lake Merced	Tunnel/ Pipeline	No documented inspection	Not currently scheduled	
New Asset	Calaveras Dam	Dam	Under Construction	TBD	
New Asset	Tesla Treatment Facility	Field Facility	Under Construction	TBD	
New Asset	Crystal Springs Pump Station	Pump Station	Under Construction	TBD	
New Asset	Alameda Siphon No. 4	Tunnel/ Pipeline	Under Construction	TBD	
New Asset	Bay Division Pipeline No. 5	Tunnel/ Pipeline	Under Construction	TBD	
New Asset	Crystal Springs Bypass Tunnel No. 2 (new)	Tunnel/ Pipeline	Under Construction	TBD	

Non-Linear Asset Tier	Asset Name	Asset Class	Completion Date of Last Assessment	Scheduled Date of Next Assessment	Notes
New Asset	Irvington Tunnel No. 2 (new)	Tunnel/ Pipeline	Under Construction	TBD	
New Asset	San Andreas Pipeline No. 3, T60 to Merced Manor	Tunnel/ Pipeline	Under Construction	TBD	
New Asset	San Antonio Backup Pipeline	Tunnel/ Pipeline	Under Construction	TBD	
New Asset	Barron Creek Valve Lot	Valve Lot	Under Construction	TBD	
New Asset	Bear Gulch Valve Lot	Valve Lot	Under Construction	TBD	
New Asset	Guadalupe Valve Lot	Valve Lot	Under Construction	TBD	

Appendix D: Emergency Response and Preparedness Plans