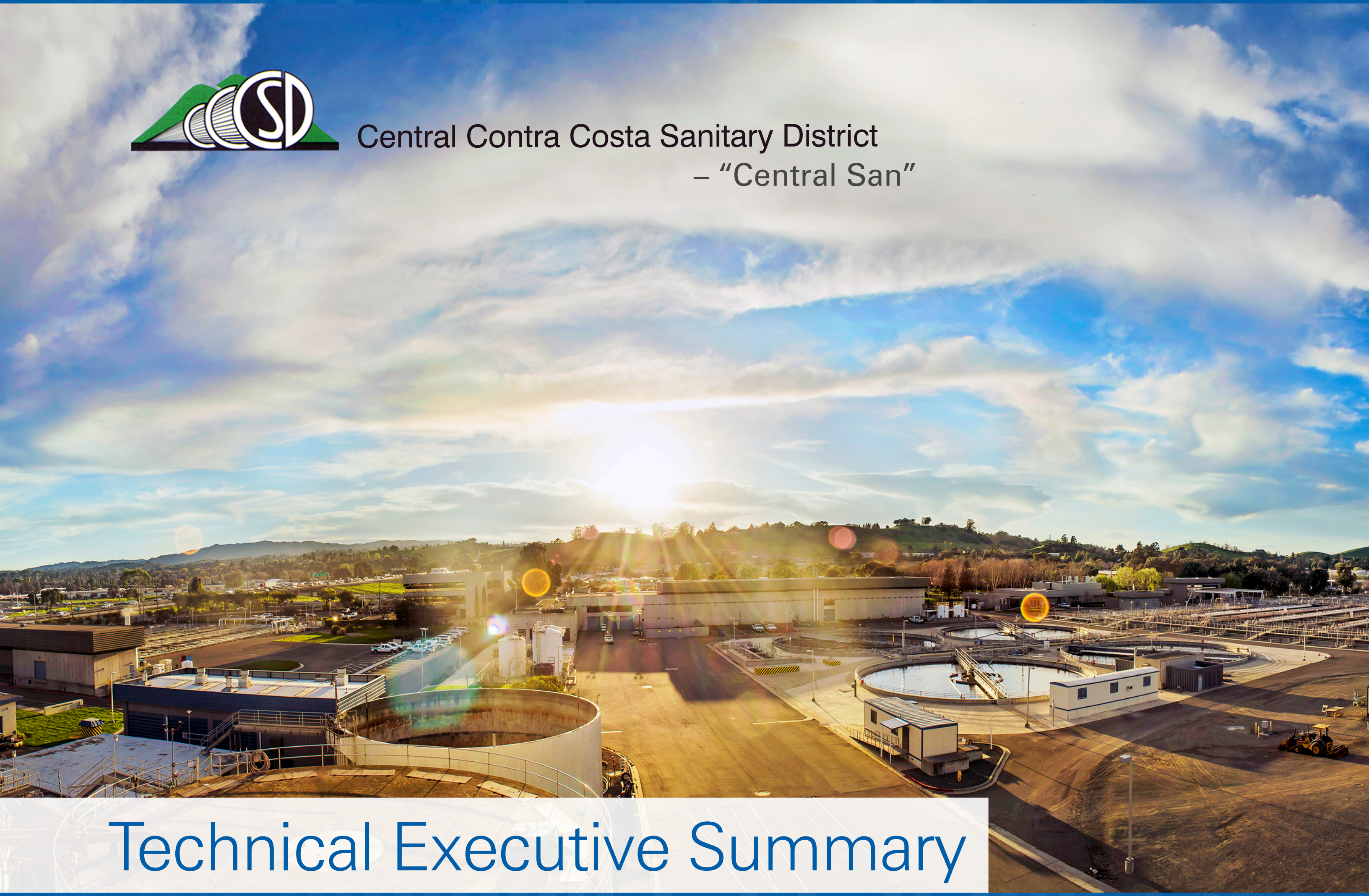

Central Contra Costa Sanitary District
– "Central San"

Technical Executive Summary

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

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JUNE 2017

1. EMBARKING ON A COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

Mission

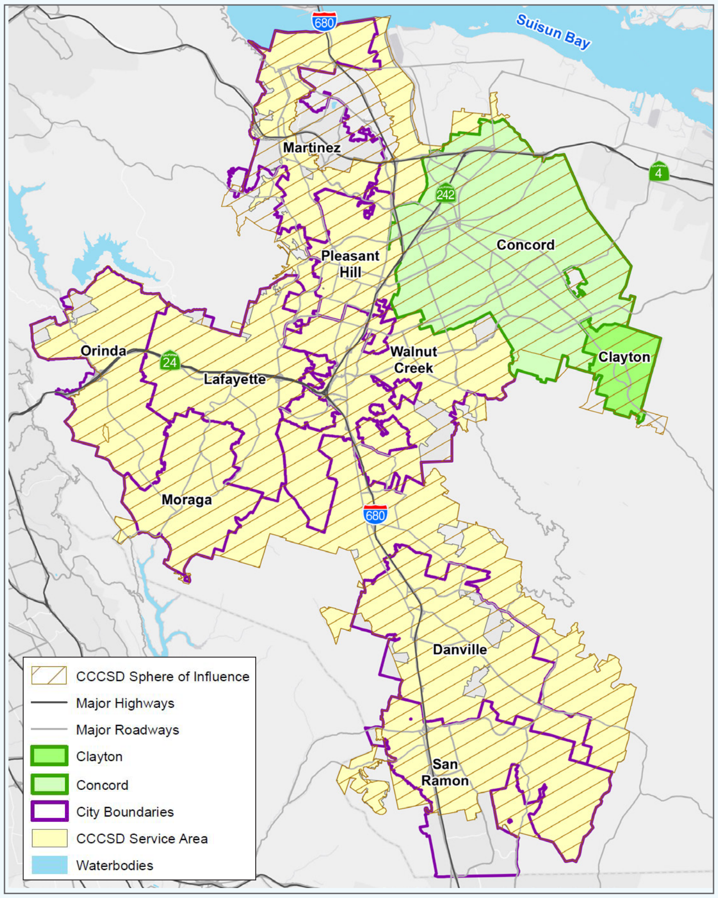
Central San's core mission is to protect public health and the environment by reliably collecting and treating wastewater from over 480,000 residents and approximately 3,000 businesses it serves. In addition to collecting and treating wastewater, Central San provides recycled water for parks, medians, school fields, and golf courses and manages both commercial and residential recycled water pick-up programs. Central San also operates a household hazardous waste collection facility and a sophisticated water quality laboratory.

Central San's service area is complex and widespread. It covers 147 square miles in central Contra Costa County and spans a variety of microclimates and terrain. Central San's treatment plant, located at the intersection of Interstate 680 and State Route 4 in Martinez, processes about 32 million gallons of wastewater per day and has managed peak flows as high as 230 million gallons per day during an extreme winter storm. Central San has successfully managed and treated flows, maintaining 100 percent effluent permit compliance for the last 18+ consecutive years.

Central San uses over 1,500 miles of piping with over 35,000 manholes and 19 pump stations to convey wastewater to the treatment plant in Martinez. The average age of the collection system pipes is approximately 40 years. Some pipe segments are over 100 years old, and some of the most critical pump stations are over 55 years old.

Since its original construction in 1948, the treatment plant has been modified through successive projects, including a major expansion to secondary treatment in the 1970s. Although other improvements have been made since then, most of the treatment plant remains unchanged.

Together, the collection system and treatment plant have an estimated replacement value of over $4 billion. Despite their age, both are generally in good condition. However, repairs and upgrades are required to maintain reliable operation and protect Central San's assets.



Central Contra Costa Sanitary District Service Area

Challenges and Opportunities

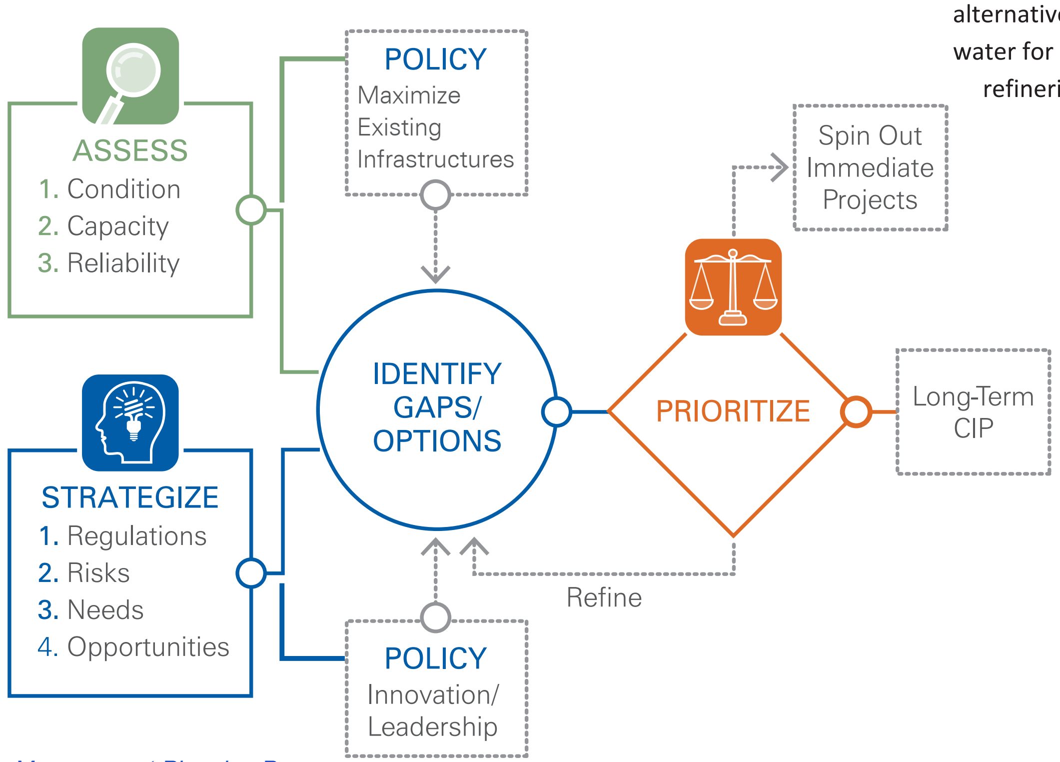
In the future, increasing regulatory requirements may require Central San to upgrade its treatment plant. In addition, potentially more extreme flows during high and sustained storm events, enhanced by climate change, may test the capacities of the collection system and the treatment plant. Along with potentially more restrictive regulations, aging infrastructure, and capacity challenges, several opportunities are available to reduce costs through improved efficiencies, resource recovery such as recycled water and energy recovery, and renewable energy production.

Central San manages a significant amount of infrastructure with thousands of mechanical and electrical equipment, structures, instruments, and other assets. Most of its 4,000+ assets were constructed in the 1970s and funded by federal grants offered after the passing of the EPA Clean Water Act that required facilities to provide secondary treatment.

Although Central San's robust maintenance practices have extended the lives of many assets, eventual rehabilitation or replacement is needed. Nevertheless, replacing them is a significant undertaking that will incur significant cost and investment from ratepayers since the federal grants offered in the 1970s are no longer available. Recognizing the importance of protecting its assets, public health, and the environment, Central San commissioned the Comprehensive Wastewater Management Plan (CWMP) to build on previous planning efforts. Planning objectives include the following:

Planning Objectives

- Preserve, maintain, or replace assets for the collection system and treatment plant.
- Meet increasingly stringent regulatory requirements for treated effluent, solids management, and air emissions.
- Provide reliable capacity for managing and treating all wastewater flows and loads, including during peak wet weather conditions.
- Achieve sustainability goals by optimizing energy recovery and consumption while minimizing greenhouse gas emissions.
- Increase recycled water production for new customers, such as the Concord Community Reuse Project Development. Explore new wholesale recycled water opportunities and evaluate alternatives to supply recycled water for the neighboring refineries.



Management Planning Process

The CWMP's primary objective is to develop a structured plan that addresses these objectives and provides a basis for orderly expenditures as other needs develop. Because Central San already completed extensive analyses, condition assessments, and inspections for the collection system and treatment facilities, their efforts were the CWMP's foundation.

Recommendations from the CWMP are incorporated into a capital improvement plan (CIP), which provides a prioritized list of future improvements and ongoing renovations and is the basis for the capital improvement budget (CIB).

Early in the project, the CWMP team identified the following four key "drivers," which are issues and goals that provide direction for the CWMP:

Aging Infrastructure

The existing wastewater assets, such as pipes, pumps, buildings, tanks, and process equipment, will continue to deteriorate with age. Some will reach the end of their useful life within the planning period. To maintain its high standard of service, Central San will prioritize repairing and replacing critical assets. The repair and replacement program will protect current investments in infrastructure and extend its useful life.

Sustainability/Optimization

By using sustainable practices, Central San can minimize operating and maintenance costs and increase the facilities' resiliency to withstand natural disasters. Projects in this category include optimizing the existing treatment processes, energy efficiency improvements, reliability improvements, improvements to bolster resiliency against manmade or natural disasters, and increasing recycled water production.

For recycled water, recent drought conditions might persist, meaning water purveyors need a sustainable, alternative water supply in the near future. By providing high-quality recycled water, combined with other effluent management approaches, the District may be able to achieve a long-term goal of zero discharge.

Regulatory

The District must comply with many permits and policies that govern the operation of its facilities. In the coming years, regulations for air and effluent discharges will likely be more restrictive. Stricter nutrient limits for effluent discharges to Suisun Bay may trigger the need for new treatment processes. Changing regulations for air quality and greenhouse gas emissions may create the need for new energy technologies. In addition, some improvements will be required to comply with current permit requirements during severe wet weather conditions.

Capacity

Projects to expand capacity are needed to accommodate wet weather wastewater flows and loads. Population growth within the service area will increase wastewater flows and loadings; however no capacity projects are included in the CIP to address or facilitate population growth.

Technician Welding - Ongoing maintenance has helped extend the life of piping and equipment.

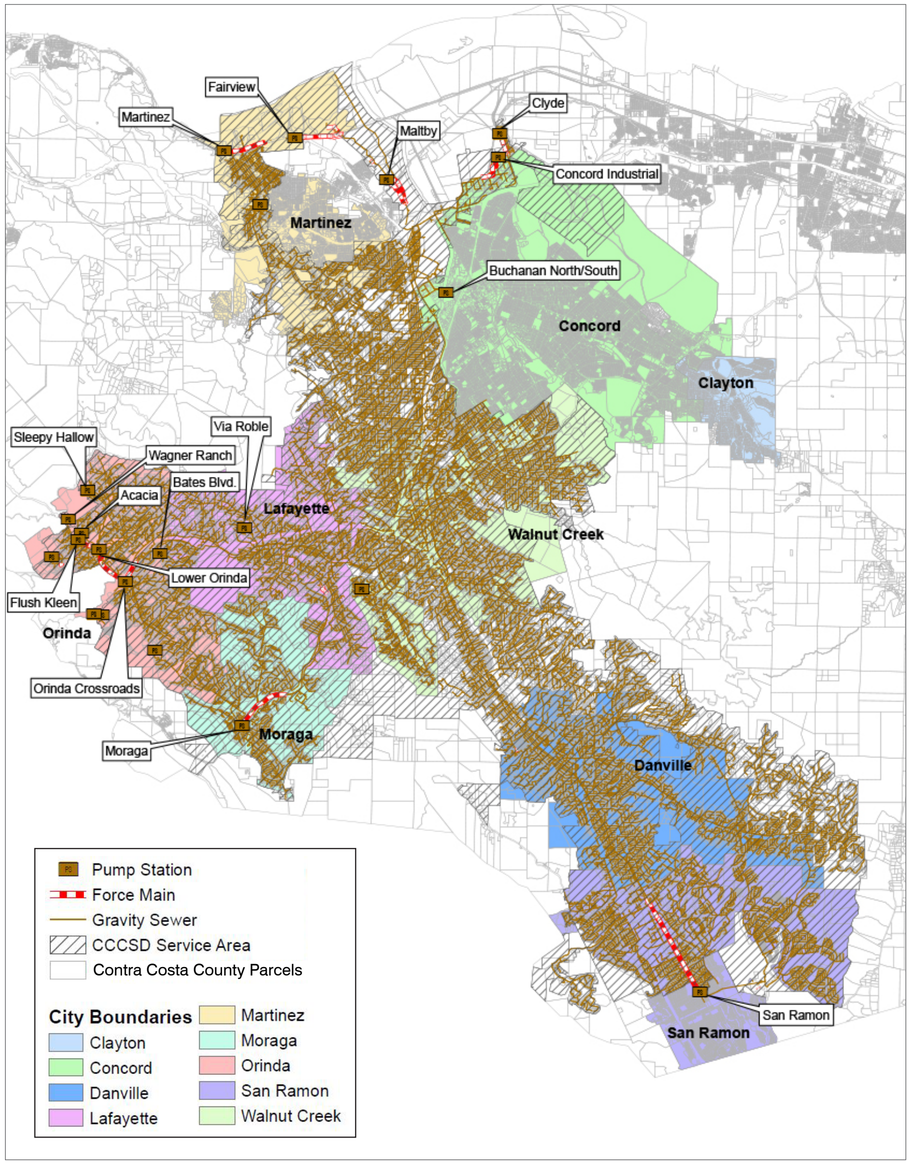
2. CENTRAL SAN AT A GLANCE

Collection System

Central San's service area comprises 147 square miles that include the cities of Danville, Lafayette, Moraga, Orinda, Pleasant Hill, Walnut Creek, portions of Martinez and San Ramon, and several unincorporated communities in Alamo and Pacheco.

The collection system has 1,500 miles of gravity sewer pipes, over 22 miles of force mains, 19 pumping stations, and roughly 35,000 manholes. Central San owns and operates the collection systems for Alamo, Blackhawk, Clyde, Danville, Diablo, Lafayette, Martinez, Moraga, Orinda, Pacheco, Pleasant Hill, Rossmoor, San Ramon, and Walnut Creek.

Central San also provides wastewater treatment for the City of Concord and the Town of Clayton. The City of Concord operates its own collection system, which also serves the Town of Clayton, while Central San owns and manages a small portion of the collection system in north Concord.



Existing Collection System

Central San works to ensure that wastewater is reliably collected and conveyed to its treatment plant. To reduce the chance of sewer system overflows (SSOs), Central San cleans and inspects pipes throughout its service area and works routinely on sewer renovation projects to rehabilitate or replace pipes in poor condition. Throughout the year, Central San crews clean over 800 miles of pipe, and over 150 miles of pipe is inspected using closed circuit television (CCTV) cameras. This combined approach of robust maintenance and routine pipe renovation has maintained an SSO rate less than 3.0 per 100 miles (e.g. 2.65 per 100 miles in 2016), less than both national and California averages.

Central San Collection System Crew

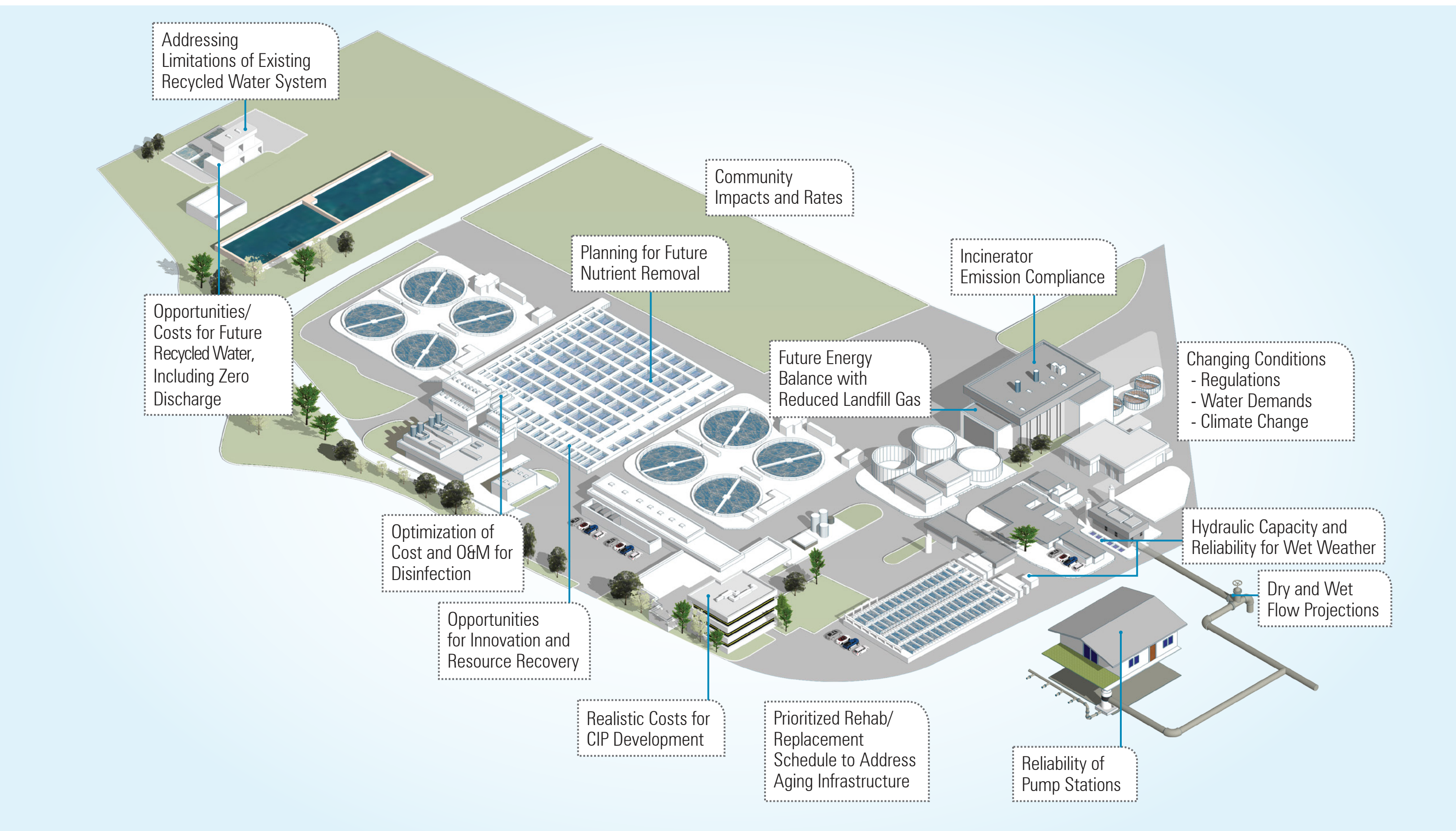
Treatment Plant

The treatment plant is a conventional air-activated sludge facility that provides secondary treatment. Final treated effluent is disinfected and then conveyed by a 3.5-mile underground outfall pipeline to the Suisun Bay shoreline. At the shoreline, the pipeline transitions to a submerged outfall that extends 1,600 feet into the Bay. Solids removed are dewatered and then conveyed to one of two multiple hearth furnaces. The furnaces reduce the solids to ash, which is beneficially reused as a fertilizer amendment by a third party. Waste heat from the furnaces is recovered and converted to steam energy used to drive aeration blowers that supply air for the activated sludge biological process.

Liquid Stream Processes

The liquid stream processes include influent bar screens, screenings removal, influent pumping, aerated grit removal, primary sedimentation, primary effluent pumping, secondary treatment with a conventional activated sludge process with secondary clarifiers, and ultra violet (UV) disinfection. A portion of the final disinfected effluent is then further treated to produce recycled water, and the remaining flow is sent to Suisun Bay through the outfall. Dry weather season flows (when minimal stormwater contributes to the flow) currently average around 32 million gallons per day (mgd). During the wet season, peak hourly flows can exceed 200 mgd.

Treatment Plant Operator



Existing Treatment Facilities

Recycled Water

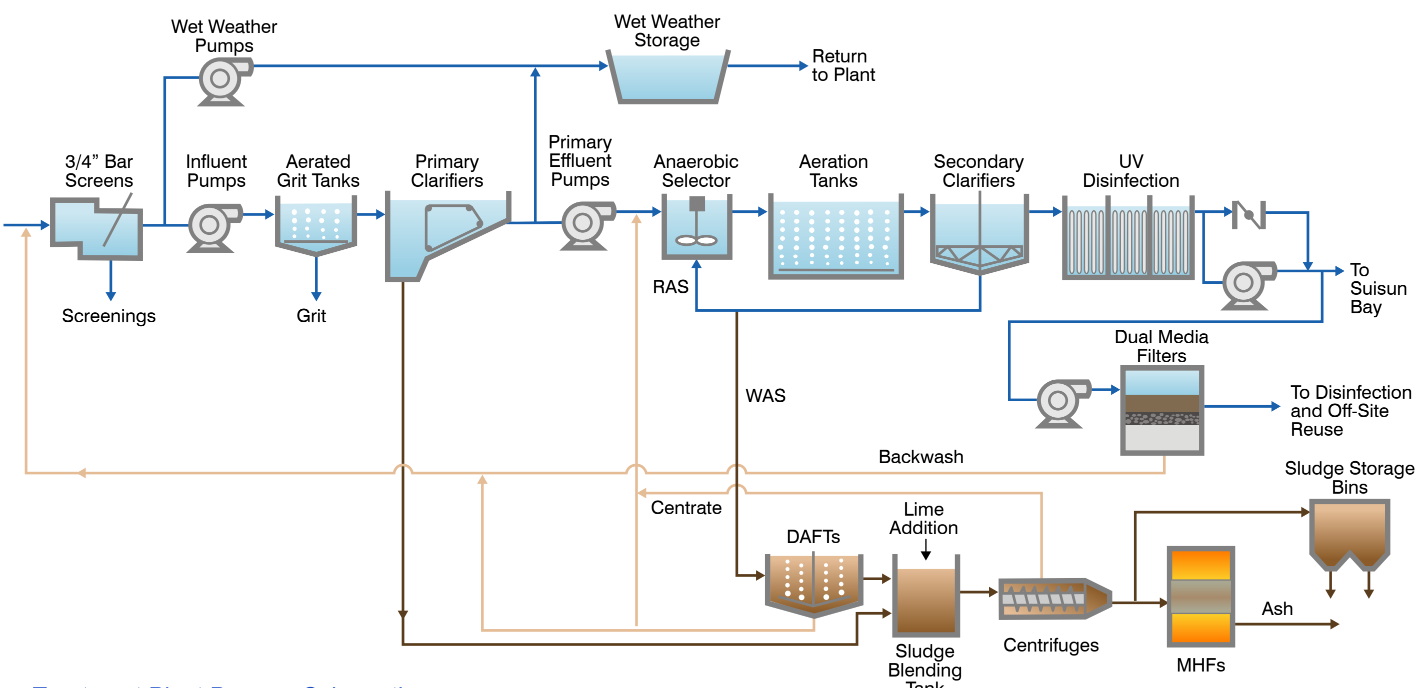
Around 550 million gallons per year of recycled water is produced for off-site customers through the purple pipe recycled water distribution system, and for residential and commercial recycled water pickup programs. Off-site customers use recycled water for landscape irrigation at schools, parks, businesses, golf courses, medians, and for commercial applications such as truck washing, concrete manufacturing, dust control, and toilet flushing.

The recycled water process includes dual-media sand filters followed by disinfection with sodium hypochlorite (bleach) to meet tertiary-treated Title 22 recycled water quality standards. The recycled water is then stored in a reservoir prior to distribution (referred to as the Clearwell). Of the 550 million gallons of water reused each year, around 1 mgd is used on-site for processes and landscape irrigation and over 0.5 mgd is used by customers.

Recycled Water Pipes

Solids Stream Processes and Energy System

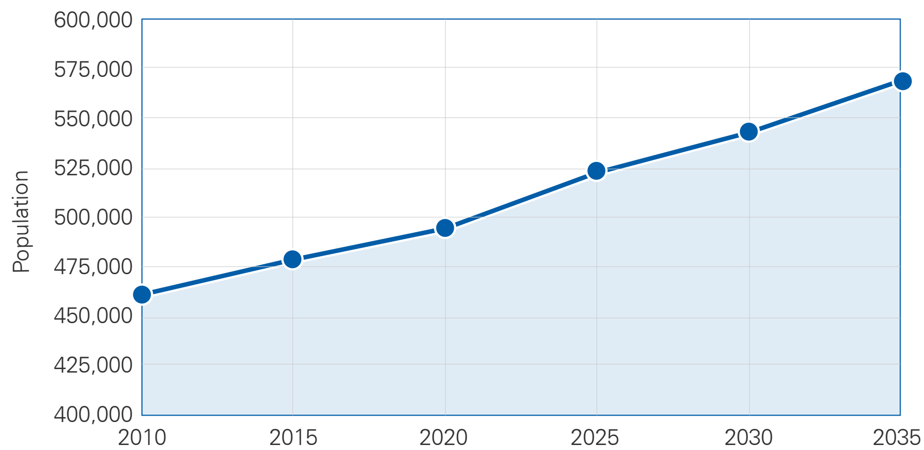
The solids processing and energy systems consist of dissolved air flotation thickeners to concentrate the waste activated sludge (WAS), centrifuges to dewater a blend of primary sludge and thickened WAS, and multiple hearth furnaces to incinerate the dewatered sludge, typically operated using locally available landfill gas. Around 95 percent of the treatment plant power demand is satisfied with a natural gas turbine cogeneration system. The remaining power needs are supplied with electricity purchased from PG&E. Waste heat recovered from the incinerator and cogeneration turbine generates about 80 percent of the treatment plant's steam demand, of which 90 percent is needed to drive the aeration blowers. The remaining steam demand is supplied by auxiliary boilers that can run on either natural gas or landfill gas.



Treatment Plant Process Schematic

3. PLANNING FOR COMMUNITY GROWTH

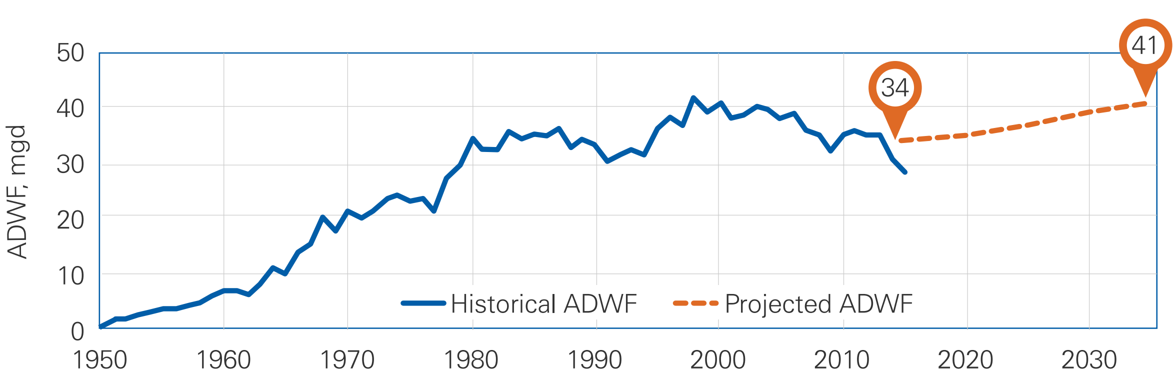
To evaluate Central San's capacity to accommodate planned growth over the next 20 years, Central San and its consultants contacted the cities, towns, and Contra Costa County for the latest General Plan and other development information. Population projections and corresponding projections of wastewater flows and loads (wastewater strength) were developed and later compared to the treatment plant's flow and load capacity. Future flows and loads were estimated by applying historical per-capita flows and loads to the projected population. Population projections were based on the General Plans and development information, and the Association of Bay Area Governments' (ABAG) population projections for communities in the service area.



Service Area Population Projections

For the most part, influent flows and loads have increased steadily since the District's inception in 1946. However, in three periods, flows declined from drought and economic conditions, such as during the late '70s and early '90s. Starting in 2008, the District experienced an unprecedented long-term reduction in dry weather flows that lasted through 2015. This reduction was caused by the recession, a persistent drought, and water conservation measures. In 2016, the flows rebounded slightly (from 29 mgd to 32 mgd) but not yet to the pre-drought flows of around 35 mgd.

Historically, flows have returned to near pre-drought conditions when normal rainfall patterns resumed and water usage increased after drought restrictions are lifted. However, a full rebound may never occur this time, because water conservation measures and investments from residences and businesses may permanently reduce water consumption and wastewater flows. The CWMP assumed flows would rebound to approximately 34 mgd and would steadily increase at an average rate less of less than 1 percent per year for the next 20 years. No projects are included in the CIP to address or facilitate population growth.



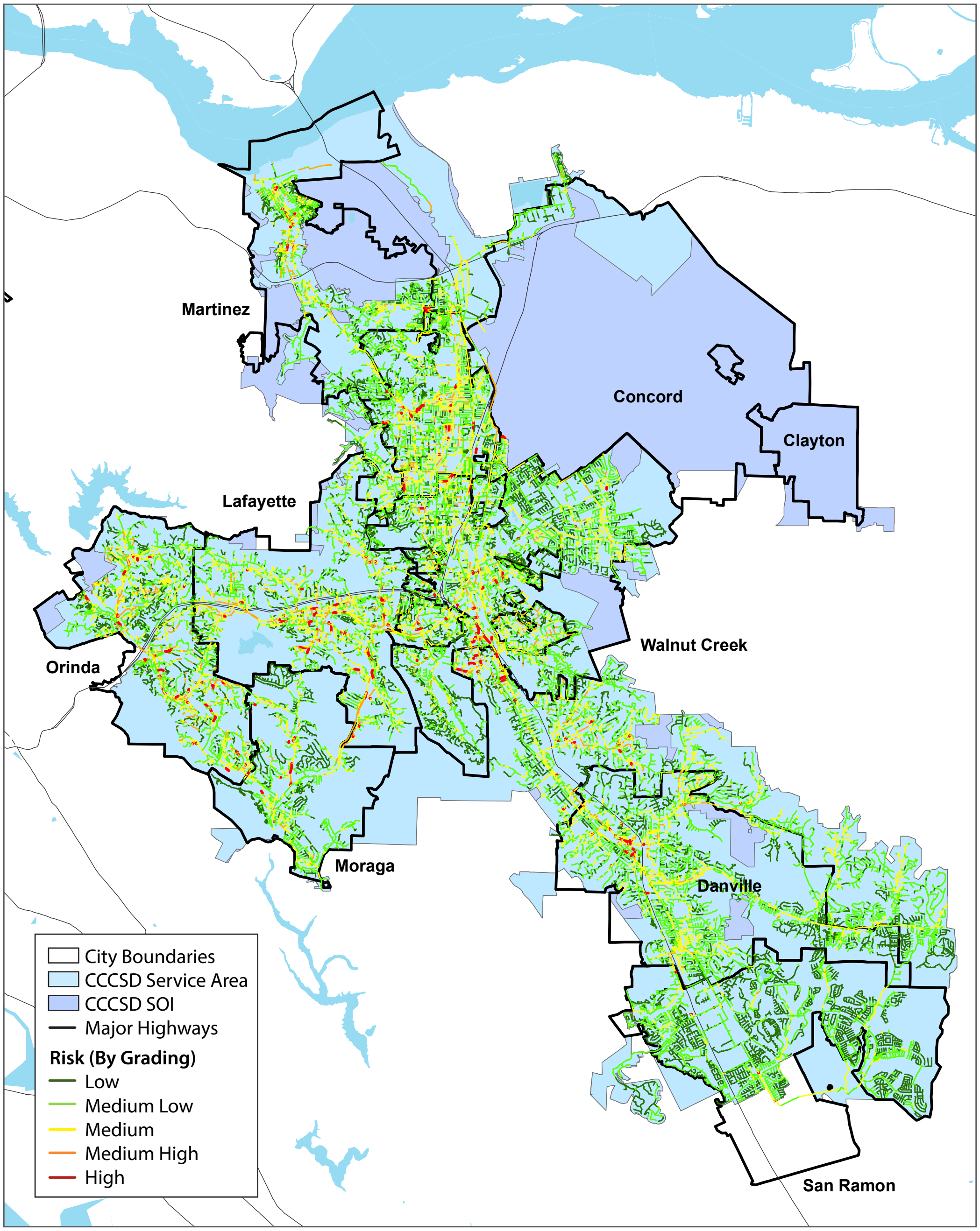
Historical Dry Weather Flows and Projection

4. EVALUATING INFRASTRUCTURE NEEDS

Collection System

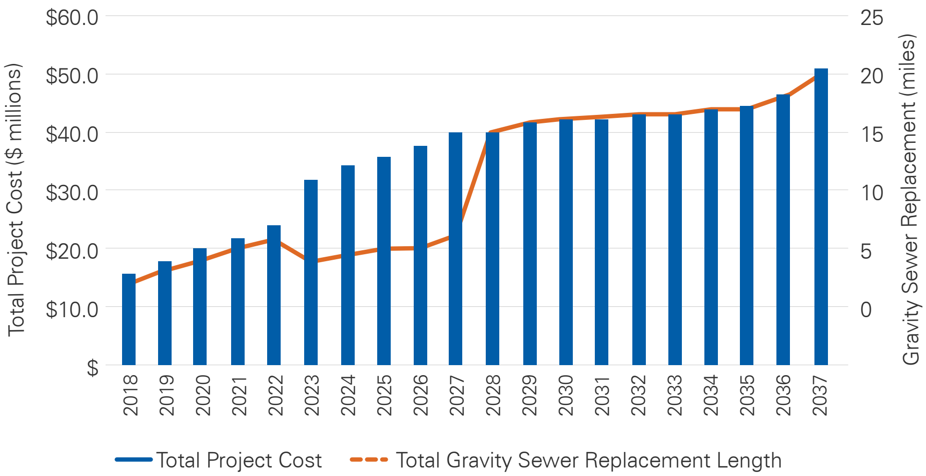
Condition and Risk Assessment

Planning investments in the collection system requires knowing the condition of the collection system assets and leveraging data and asset information to predict when an asset will fail. The methods used to assess the condition and risk of the collection system varied by asset type:



Risk Map from the InfoMaster® Risk Assessment Model

- Gravity sewers — Most of the Central San collection system consists of gravity sewers. Gravity sewers were analyzed with a newly implemented state-of-the art InfoMaster® pipeline degradation modeling software, which helps predict when pipes will fail. The InfoMaster® risk assessment model was used to calculate risk scores based on an asset's consequence of failure (e.g., the amount of flow in the pipe and its proximity to schools, hospitals, and major roadways) and its likelihood of failure. The likelihood of failure is calculated from field condition information, such as cleaning frequency or CCTV inspection score, and pipe age and material.
- Pump stations — Pump stations were evaluated with visual inspections and data collected by the CWMP team and Central San staff during field visits to the 16 pump stations owned by Central San, and through maintenance history and needs discussed with staff.
- Force mains — Force mains were evaluated using available force main material and age data as well as risk analyses performed by Central San for a previously completed Force Main Asset Management Plan.



20-Year Gravity Sewer Replacement Schedule

Gravity Sewers

Central San's gravity sewer system pipelines range from 4 to 102 inches in diameter. The newest sewers are made of polyvinyl chloride (PVC) pipe, high density polyethylene (HDPE) pipe, or reinforced concrete pipe (RCP). Older pipes are made of vitrified clay pipe (VCP), reinforced concrete pipe (RCP), asbestos cement pipe (ACP) or, in a few areas, steel pipe.

Based on available CCTV scoring data, around 70 percent of the collection system pipes are in excellent condition and approximately 30 percent have some defects, with an overall condition of "okay" to "very bad," in which case immediate replacement is recommended. Based on available pipeline cleaning frequency data, around 30 percent of the system experiences routine root intrusion, grease buildup, and stoppages or blockages and is on a less than 12-month cleaning cycle, with 3 percent requiring cleaning every few months. Another 15 percent is cleaned every 12 to 18 months, and the remaining 55 percent is on a cleaning cycle between 18 and 60+ months.

Using the InfoMaster® risk assessment tool, around 265 miles of gravity sewers will need to be replaced over the next 20 years.

Pump Stations

Pump stations convey wastewater flows from where the topography does not allow flows to be conveyed by gravity alone. Central San operates the 16 pump stations it owns as well as 3 privately owned stations in Orinda. Because pump stations collect large amounts of wastewater and are typically located in low lying areas near creeks and other waterways, the equipment at these facilities must reliably convey wastewater flows to avoid overflows. Many facilities are in tight spaces, without the ability to store wastewater for extended periods when equipment is down unexpectedly.

The condition assessment identified $33 million in pump station renovation projects to be completed in the near-term (0 to 5 years) to maintain operational reliability. The most critical improvements are needed at the Fairview, Maltby, Moraga, and Orinda Crossroads pump stations. These improvements include rehabilitating or replacing corroded buried steel pump station dry pits at Maltby and Fairview, adding grinders at Moraga to reduce routine manual cleaning of bar screens, replacing backup generators and original diesel engines from 1959 at Moraga and Orinda Crossroads, expanding diesel engine day tank capacity at Orinda Crossroads, fuel system improvements, miscellaneous pump/valve/piping improvements, and other mechanical, safety, electrical, and instrumentation improvements.

Force Mains

Force mains are pressurized pipelines that convey wastewater from the pump stations to a high point, where it can then flow by gravity through gravity sewers to the treatment plant. Central San manages 31 force mains with a combined length of 22.8 miles. When the collection system condition assessment was performed, the force mains were not accessible for inspection. To obtain a better understanding of the condition of the force mains, a phased force main inspection program is recommended. The inspection program would establish risk scores for each asset, prioritize replacement needs, and ultimately establish a renovation program. Until then, force main renovation priorities are based on a previous Central San risk assessment based more on qualitative force main information such as material and age.

Fairview Pump Station

Capacity Assessment for Gravity Sewers

To identify hydraulic capacity deficiencies, the trunk sewer system was analyzed for a peak wet weather flow (PWWF) based on a 10-year sewer system event, meaning that theoretically the event would have a 1 in 10 year, or 10 percent, chance of occurring each year.

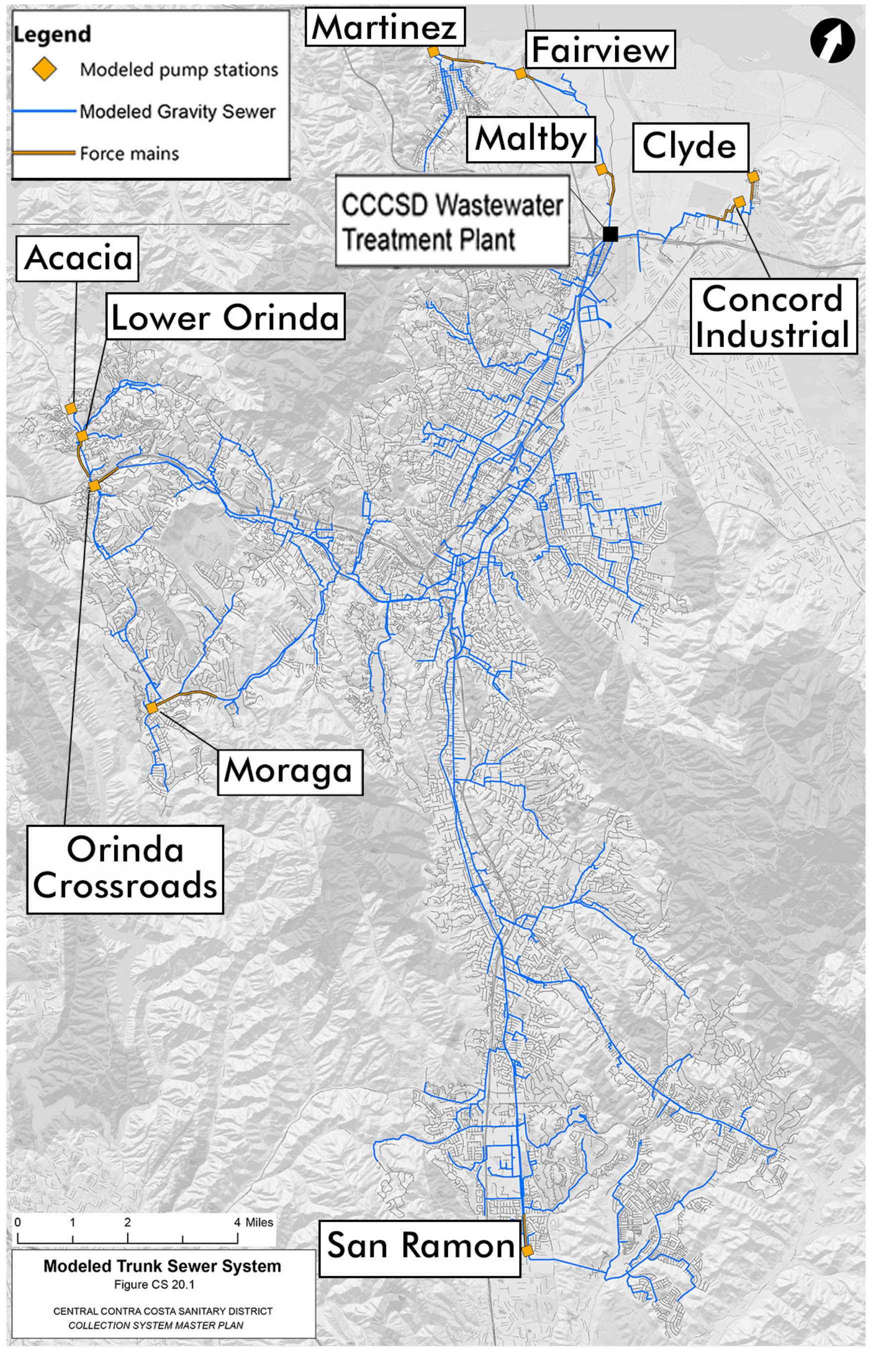
The system capacity was assessed using a newly implemented hydraulically dynamic model of the system developed with the InfoWorks™ ICM software. The modeled network has over 290 miles of trunks and interceptors and was calibrated with flow measurements taken in the 2015-2016 wet weather season with 70 temporary flow meters and gauge adjusted radar rainfall. Using established design criteria, the gravity sewers in the model were allowed to surcharge during the 10-year event, meaning the water level was allowed to rise above the top of the pipe and into the manholes, but not allowed to overflow.

Sewers within the modeled network where the levels in the manholes rose to within 5 feet of the ground surface during the event were deemed capacity deficient. According to the dynamic model, approximately 7 miles of sewer pipes are capacity deficient for the design wet weather condition, over 50 percent less than what Central San's previous, less capable hydraulically static model predicted, which also did not allow for modeling water levels throughout the pipes and manholes. This new model helped eliminate four capacity-related capital projects.

Aside from the North Concord system, which will see additional flows when the Concord Community Reuse Area (formerly the Concord Naval Weapons Station) starts to develop, Central San's modeled network has sufficient capacity for existing and future dry weather flows, including daily peak flows. Therefore, major capacity improvements are required only to correct flow bottlenecks in the system under wet weather conditions. No capacity projects are included in the CIP to accommodate population growth.

Minor improvements may be required in localized areas of development for the smaller diameter sewers (<10 inch), but those are evaluated case by case since they are not within the dynamic modeled network.

In most cases, the approach modeled for relieving the flow restrictions was to replace the deficient pipe with a larger one. However, in some locations, adding new relief sewers was more cost effective. These relief sewers divert excess flows from the deficient sewer to nearby sewers with sufficient capacity to convey them.



Modeled Trunk Sewer System

The model also confirmed that the modeled pump stations have adequate firm capacity with the largest pumping unit out of service to convey flows for a 10-year event.

Treatment Plant

Condition Assessment

The treatment plant's condition was assessed with a team of Central San's Operations and Maintenance staff and consultant discipline specialists for structural, mechanical, electrical, and instrumentation evaluations.

Key findings include:

- Some concrete renovation work is needed, but all concrete tanks and structures are in good condition and do not need major structural upgrades or replacement in the next 20 years.
- Each of the two Multiple Hearth Furnaces (MHF) has an estimated 20 years of remaining serviceable life. Despite being 35 years old, the MHFs have significant remaining life because Central San alternates operation from one MHF to the other each year, which allows performing annual preventive maintenance on the offline furnace. Several improvements will be needed over time to keep the MHFs operational and to replace MHF support equipment; however, those improvements are not considered significant enough to abandon the furnaces.
- Air piping to the activated sludge tanks has significant leaks. Additionally, the ceramic aeration diffusers and plenum are less efficient than modern diffuser technology, and they are nearing the end of their useful life.
- The steam-driven aeration blowers are inefficient and cannot be turned down to match low air demands during low flow conditions. For optimal efficiency, the air piping and diffuser system should be replaced when aeration blowers are replaced so they can be properly designed as a system.
- The secondary clarifier concrete tanks are in good condition, but the sludge collector mechanisms and RAS pumps are over 40 years old and should be replaced within the next 15 years.
- The DAFT tanks and skimmer arms were recently renovated; however, the sludge collector mechanisms were not upgraded and will need rehabilitation within the next 15 years.
- The ultraviolet disinfection system requires significant ongoing maintenance and cleaning, and many elements of the electrical and control systems need to be replaced. The UV disinfection system should be replaced within the next 5 years or so.
- The SCADA and PLC control systems function adequately. Routine upgrades are being completed to ensure reliable operation. However, a major SCADA controls replacement will be required within the next 15 years.
- The sludge dewatering centrifuges and cake pumps are obsolete. Spare parts are becoming difficult or impossible to acquire. To maintain reliable dewatering options, these systems need to be replaced within the next few years.
- Ongoing replacement of old or non-functioning mechanical equipment (piping, valves, and gates), electrical support equipment, and instrumentation devices is required to maintain stable, reliable operation.

Concrete Repairs are Necessary

Leaks in Air Piping Need Renovation

CAPACITIES OF LIQUID STREAM PROCESSES – AVERAGE DRY WEATHER FLOW (ADWF)

Unit Process	Average Flow and Loading Conditions		Peak Flow and Loading Conditions		2035 Projected ADWF mgd
	Total ADWF Capacity(1) mgd	Firm ADWF Capacity(1) mgd	Total ADWF Capacity(2) mgd	Firm ADWF Capacity(2) mgd	
Primary and Secondary Treatment (PST, Aeration tanks, Secondary Clarifiers)	54	48	44	43	41

Notes:

Abbreviation: PST = Primary sedimentation tanks

(1) Total Capacity is calculated with all units in service, using the average peaking factor from the last five years. Firm Capacity is calculated with either 1 PST, 1 Aeration tank, or 1 Secondary Clarifier offline at a time, using the average peaking factor from the last five years.

(2) Total Capacity is calculated with all units in service, using the maximum peaking factor from the last five years. Firm Capacity is calculated with either 1 PST, 1 Aeration tank, or 1 Secondary Clarifier offline at a time, using the highest peaking factor from the last five years.

Capacity Assessment

For each treatment plant process, treatment performance and capacity were assessed for wet weather and dry weather loading conditions. A customized BioWin process model, calibrated to Central San's process data, was used for the capacity assessment.

Liquid Stream Capacities

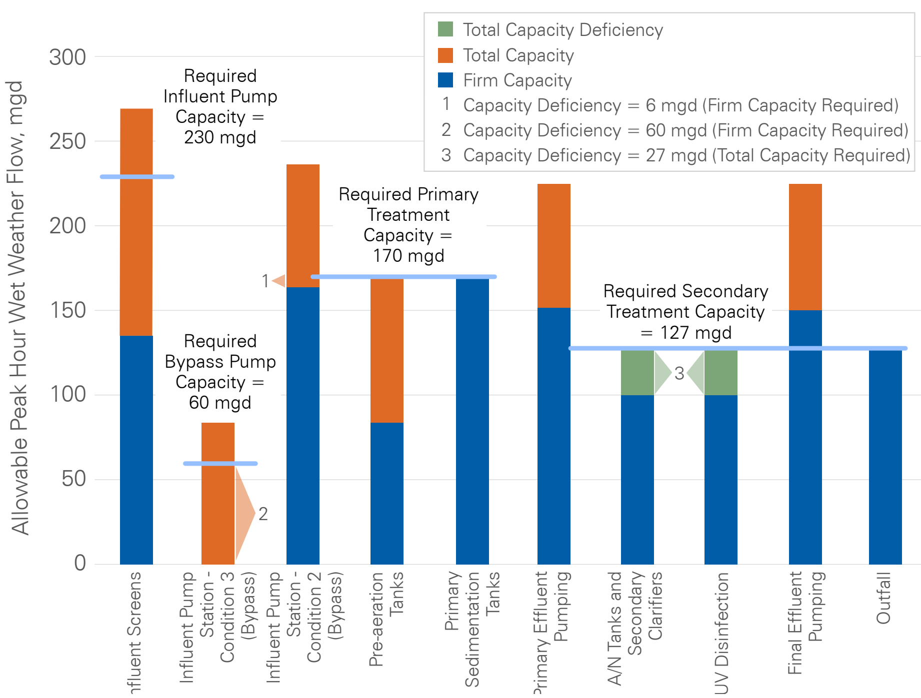
Dry Weather Capacity

Because the primary and secondary treatment processes are linked, the overall plant capacity was evaluated with these processes combined. Using this approach, the dry weather capacity was estimated for two conditions: "average conditions" and "peak conditions." The capacity for average conditions was calculated from the average loading and flow peaking factors over the past five years. For peak conditions, the capacity was estimated by applying the highest peaking factor that occurred in the last five years.

The analysis showed that the primary and secondary treatment processes have sufficient capacity for average and peak conditions, assuming the flow to the secondary clarifiers is distributed evenly.
To reliably maintain an even flow distribution, a flow splitter structured is recommended.

Wet Weather Capacity

Peak process performance, hydraulic capacity, and rated pumping capacity were used to identify capacity needs to accommodate flows generated by a 20-year storm flow event.



Capacities of Liquid Stream Processes - Peak Hour Wet Weather Flow

PEAK HYDRAULIC CAPACITIES FOR LIQUID STREAM PROCESSES

WWTP Unit Process	Total Capacity, mgd	Firm Capacity, mgd	Projected Flow, mgd (2035)	Capacity Deficiency(5), mgd
Mechanical Screens	270	135	230	None
Influent Pump Station: Condition 1	To Preair: 236	To Preair: 118	N/A(3)	N/A(3)
Influent Pump Station: Condition 2	To Preair: 236	To Preair: 164	To Preair: 170	6
Influent Pump Station: Condition 3	Bypass: 85	Bypass: 0	Bypass: 60	60
Pre-aeration Tanks	170	85	170	None
Primary Sedimentation Tanks	170(1)	170(1)	170	None
Primary Effluent Pumps	225	150	127(2)	None
Aeration Tanks / Secondary Clarifiers	100(1)	100(1)	127(2)	27
UV Disinfection System	100(1)	100(1)	127(2)	27
Final Effluent Pumping	127(4)	127(4)	127(2)	None

Notes:

Abbreviation: mgd = million gallons per day

(1) Based on hydraulic capacity.

(2) Required secondary treatment capacity dictated by PICS-MOST storage event model results.

(3) This condition is not applicable for this weather scenario.

(4) Capacity of the final effluent pumping is limited hydraulically by the outfall. The rated capacity of the final effluent pumps and standby effluent pumps is higher.

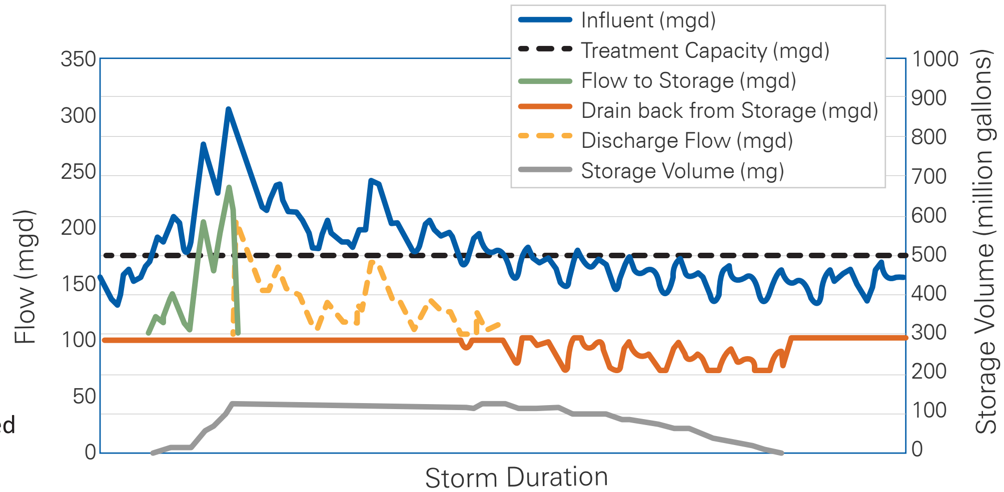
(5) Capacity deficiencies are based on redundancy criteria and requirements.

Wet Weather Holding Basin Site Plan

Wet Weather Holding Basin (WWHB) Storage Volume

The WWTP can receive peak flows that exceed the capacities of the primary and secondary treatment processes in very large storm events. To prevent overloading, excess wet weather flows are typically diverted to up to three Wet Weather Holding Basins (WWHBs) for temporary storage. The stored flow is returned to the treatment plant after the storm recedes. The available volume in the WWHBs, along with the rated capacities of the treatment processes, determines the total volume of wastewater that Central San can accommodate during a storm event without having to discharge untreated flows.

There is not enough land to expand the basins' footprint. In addition, the levees cannot be raised because the soils do not appear to be suitable for supporting additional weight. However, the total available storage volume can be increased by 28 percent by constructing a new overflow structure on Basin B that could allow for Basin B to be reliably filled to within two feet of the top of its levee. The current wooden stop logs are not as reliable as a permanent structure, and should not be considered reliable for operating at a water level in Basin B higher than the top of the adjacent Basin C levees. With this structure in place, the total storage volume in the WWHBs (while maintaining a typical safety factor of 2 feet of freeboard) will increase from 95.8 million gallons (MG) to 122.7 MG.



PICS MOST 20-year storage event simulation

Required Peak Wet Weather Secondary Treatment Capacity

The PICS-MOST model (Program for Infiltration/Inflow Continuous Simulation/Model for Optimization of Storage and Treatment) was used to simulate combined flow-storage volume events at the WWTP. The model uses historical rainfall data and influent flow data to relate wet weather flows at the treatment plant to different storm events, and compares the volume of total wastewater generated from the storm that needs to be managed with available treatment and storage capacity. The results from the model can determine the required treatment capacity to properly handle the flows from any given storm event.

For a 20-year storage event (i.e., 1 in 20 year, or 5 percent, chance of that volume of wastewater requiring treatment or storage each year), and using an available WWHB storage volume of 122.7 MG (after installing a new overflow weir), the secondary treatment and disinfection process must be able to handle a peak hour wet weather flow of 127 mgd. This represents a capacity deficiency of 27 mgd when compared to the 100 mgd capacity of the existing secondary treatment and disinfection processes.

Solids Stream Capacity

Capacities for solids treatment processes were estimated from the maximum monthly solids loadings criteria and maximum day solids criteria for solids pumping facilities and were compared to the projected solids loadings.

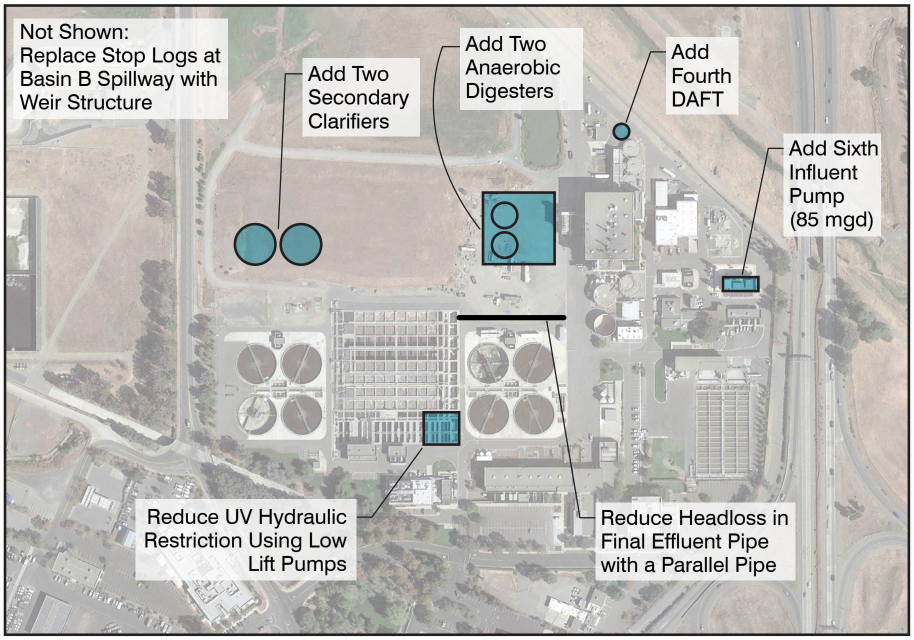
CAPACITIES FOR SOLIDS STREAM PROCESSES

Solids Unit Process	Total Capacity	Firm Capacity	Projected Flow/ Load (2035)	Flow/Load Basis for Capacity	Capacity Deficiency(11)
Primary Solids/ Recirculation Pumps	520 gpm	390 gpm	280 gpm(1)	Peak Day Flow	None
WAS Pumps	5,800 gpm	3,800 gpm	2,770 gpm(2)	Peak Day Flow	None
DAFT without polymer	122,400 lb/d	81,600 lb/d	83,500 lb/d	Max Month Load	1,900 lb/d(8)
DAFT with polymer	193,000 lb/d	128,700 lb/d	83,500 lb/d	Max Month Load	None
TWAS Pumps	450 gpm	450 gpm	310 gpm(3)	Peak Day Flow	None
Sludge Storage	1.17 MG	N/A	1.18 MG(4)	Max Month Load	Negligible
Centrifuge Feed Pumps	920 gpm	645 gpm	600(3)	Peak Day Flow	None
Dewatering Centrifuges	600 gpm	450 gpm	460 gpm(3)	Max Month Flow	None
Cake Pumps	180 gpm	135 gpm	82 gpm(5)	Peak Day Flow	None
Multiple Hearth Furnaces	54.8 dtpd(7)		54-61 dtpd	Average Day Load	0 to 6.2 dtpd
	60 dtpd(9)	88-99 dtpd(6)	Peak Day Load	None(10)	None(10)
Steam Supply	96,000 lb/hr	38,500 lb/hr	43,500 lb/hr	Peak Day	5,000 lb/hr

Notes:
Abbreviations: TS = total solids; lb/d or lb/hr = pounds per day or hour; gpm = gallons per minute; dtpd = dry tons per day
(1) Primary Solids flow at 4% TS.
(2) Waste Activated Sludge (WAS) flow at 0.3% TS.
(3) Thickened WAS (TWAS) and combined solids flow at 3% TS.
(4) Equalization of peak shaving volume that was calculated based on the full incineration capacity permitted solids loading that could be reached prior to 2035. The volume to store is the difference between the maximum month solids loading and the amount that is permitted to be processed by incineration.
(5) Cake flow at 23% TS.
(6) Range in values show plant reported loading as lower range and model predicted loading as higher range.
(7) Based on the Title V permit limit of 20,000 dry tons per rolling 365 days.
(8) There is no capacity deficiency if decreased performance of Dissolved Air Flotation Thickeners (DAFT) below 95 percent capture is tolerable.
(9) Based on the Title V permit limit.
(10) Peak solids loads are effectively managed by storing blended sludge in the Sludge Blend Tank (SBT) and/or Emergency Sludge Storage Tank (ESST).
(11) Capacity deficiencies are based on redundancy criteria and requirements.

Capacity Assessment Findings and Conclusions Summary

- **Overall Dry Weather Capacity —** All the liquid stream processes have adequate capacity through 2035 under dry weather conditions.
- **Wet Weather Holding Basins —** A new weir structure on the Basin B spillway is recommended to gain an additional two feet of reliable storage in Basin B. This will result in a maximum available storage volume of 122.7 MG for all three holding basins combined (with two feed of freeboard).
- **Influent Pump Station —** A sixth influent pump is recommended to provide firm, reliable pumping capacity (i.e., adequate capacity with one pump out of service) to the pre-aeration tanks and to the wet weather holding basins.
- **Secondary Clarifiers —** Two additional clarifiers are recommended to provide the required 127 mgd peak secondary treatment capacity needed to accommodate a 20-year storage event.
- **UV Disinfection and Final Effluent Pipe —** Low lift pumps are recommended to relieve a hydraulic restriction near the UV disinfection effluent channel during wet weather events, and a parallel 72-inch final effluent pipe is recommended to reduce headlosses to accommodate a 127 mgd peak secondary treatment capacity.



Major Capacity Expansion Projects

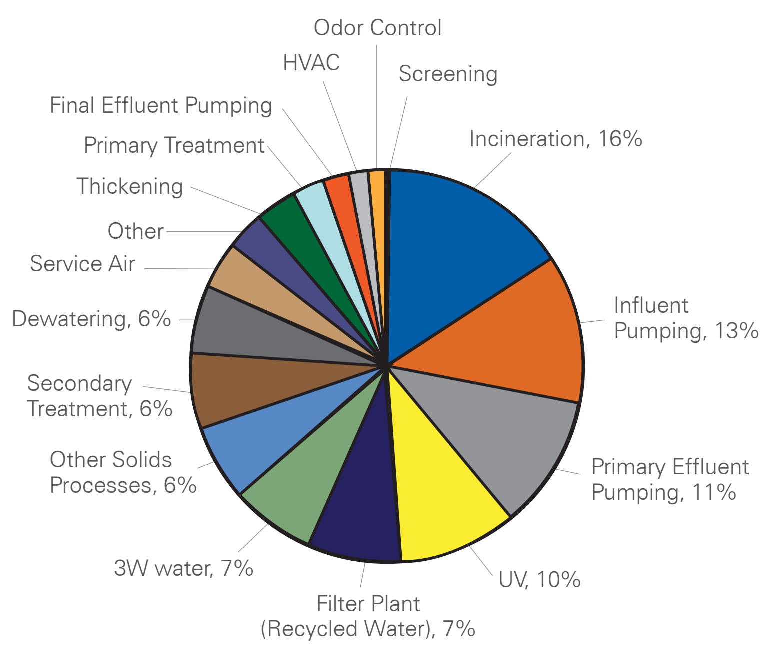
- DAFT — the dissolved air flotation thickeners may not have adequate capacity. After the new centrifuges and cake pump are installed, a polymer optimization test is recommended to evaluate whether polymer should be added as loadings increase to maintain the targeted DAFT performance. If polymer optimization is not successful or the declined DAFT performance is not acceptable, a fourth DAFT will be required in the future.
- MHFs — The current practice is to operate only one multiple hearth furnace (MHF) at a time. With one unit in service, projected annual average solids loading will exceed the MHF permitted throughput limit before 2035. In addition, the MHFs do not have enough capacity for the peak day loadings. The existing Sludge Blend Tank and Emergency Sludge Storage Tank will continue to be needed for both emergency storage and for temporarily storing solids during high peak day loading conditions.

Energy Balance

A plant-wide energy evaluation was completed using 2014 and 2015 treatment plant operating data.

The treatment plant imports energy from three sources: electricity, natural gas, and landfill gas. Energy from wastewater solids is also recovered through combustion in the MHF and waste heat recovery boiler system. Landfill gas is used primarily as supplemental fuel for incineration, and natural gas is used primarily in the cogeneration unit to generate electricity.

From 2014 to 2015, the treatment plant consumed electricity at an average rate of 2,620 kW. The natural gas cogeneration system generated approximately 95 percent of the electricity needs (approximately 2,500 kW), and PG&E supplied the remaining needs (120 kW). Solids handling, process pumping, and UV disinfection use most of the electrical power supplied.



Treatment Plant Energy Consumption by Process Area

Energy Balance Findings and Recommendations

1. Greenhouse gas emissions can be maintained below the California Air Resources Board anthropogenic cap-and-trade threshold of 25,000 MT CO2 per year by maximizing landfill gas usage as long as possible and continuing to recover energy from the wastewater solids. The cogeneration turbine provides a cost-effective way to generate electricity on site, particularly with the current low price of natural gas. It also significantly reduces imported grid electricity from PG&E.

2. Landfill gas production is expected to decline over time as the landfill ramps down its operation. In the future, more efficient solids handling and energy recovery facilities will provide a sustainable way to minimize costs and continue to operate below the cap-and-trade threshold—even if landfill gas is no longer available.

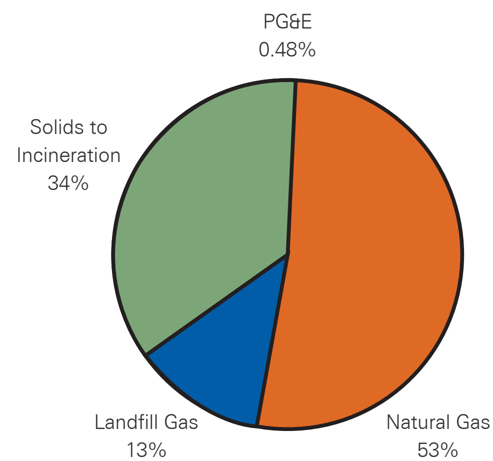
3. Central San's objective for the treatment plant is to achieve Net Zero Energy. Net Zero Energy is defined as "using enough renewable energy to satisfy annual energy consumption requirements." Central San will strive to achieve Net Zero Energy by improving energy efficiency in the following areas:

   – Decoupling the solids and liquid processes by replacing the current energy recovery system and steam-driven aeration blowers with an Organic Rankine Cycle (ORC) turbine and high efficiency electric blowers and new efficient diffusers.

   – Adding anaerobic digestion upstream of the MHFs to produce biogas and generate electricity.

   – Replacing the existing cogeneration turbine with a larger, more efficient turbine.

   – Adding renewable energy sources, such as solar, wind, and co-digestion of imported high-strength waste (HSW) such as fats, oils, and grease (FOG).



Energy Source Profile at Treatment Plant

5. NAVIGATING THE FUTURE REGULATORY ENVIRONMENT

CWMP recommendations for the treatment plant were developed to meet existing regulatory requirements, and to provide the flexibility to meet potential future regulatory requirements. Key findings and recommendations are listed below:

- **Nutrient Limits:** Assumptions for nutrient limits and compliance schedules were based on the Bay Area Clean Water Agency (BACWA) Scoping and Evaluation Plan for potential nutrient reduction.
- **Microconstituents and CECs:** The current trend of increasing monitoring requirements and regulation of microconstituents and other constituents of emerging concern (CECs) could lead to new limits for Central San in the future. However, since the scope and timing for potential limits is still uncertain, new facilities to target CEC reduction were not included in the CIP. To ensure adequate space for these facilities, a future CEC treatment system was included in Central San's site plan.

EXPECTED BACWA NUTRIENT DISCHARGE LIMITS AND COMPLIANCE SCHEDULE

	Concentrations, mg/L			Assumed Compliance Schedule	
	Ammonia	Total Nitrogen	Phosphorus	Initiate Design	Compliance Deadline
Level 1	Optimize nutrients (no exact limits)			2019	2024
Level 2	2	15	1	2027	2037
Level 3	2	6	0.3	2037	2047

- **Future Solids Management:** The current practice of incinerating wastewater solids and ash reuse as a fertilizer amendment is a sustainable option in the current regulatory environment and is expected to remain so over the planning period. Solids loading projections are expected to be higher than the MHF permitted average annual capacity within the next 20 years; therefore, to increase capacity, diversifying solids treatment and reuse options will be required. Central San's emergency sludge storage and loadout facility, where dewatered, unstabilized solids can be temporarily hauled offsite to another treatment facility, is the current contingency plan. However, a more robust expansion of solids handling will be required. In addition, over the next 5+ years, Central San will explore other innovative and emerging solids handling and resource recovery technologies that may prove to be viable long-term solids handling solutions.
- **Future Recycled Water Use:** Central San's current recycled water production is five percent of the wastewater flow processed at the treatment plant. To expand recycled water production and use, Central San will need to develop agreements with the agencies responsible for purveying water within Central San's service area and possibly partner with water purveyors outside Central San's service area that may have a more immediate need for water.

- Biosolids Reuse: The ability to use biosolids as landfill alternative daily cover will decline significantly over the next few years. Recent California legislation requires a 75 percent reduction of organic wastes sent to landfills by 2020 (AB 341). The State will also eliminate diversion credits for green waste used as alternative daily cover by 2020 (AB 1594) and will require 100 percent diversion of organic waste from landfills by 2025. Regional biosolids reuse practices may need to change as these landfill diversion goals are in place, and wastewater utilities may need to compete for other biosolids reuse options, which will likely increase the cost to reuse biosolids. By using MHFs to process the solids and reusing the ash as a fertilizer amendment, Central San can avoid this competition.
- Air Emissions: Several air emissions regulations and anticipated regulatory changes are motivating Central San to invest in new air pollution control equipment. These regulations include:
  - Additional investment in the MHFs will eventually designate them as modified sewage sludge incinerators (SSI) which would trigger air emissions upgrades to provide the best available control technology (BACT).
  - Draft Regulation 11, Rule 18 would require reducing toxic air emissions that pose a health risk to the public. Updated risk assessment methodology will require a Health Risk Assessment (HRA) at the treatment plant to ensure cancer risk from toxic air compounds does not exceed 10 in a million.
  - Future PM2.5 limits (i.e., fine particulates) may be imposed because of the Bay Area's non-attainment status for 24-hour PM2.5. This would require additional air pollution control equipment, such as a wet ESP.
  - Although Central San operates under the new EPA SSI rule, replacing the existing outdated air pollution control equipment with new equipment will enable more reliable air emissions compliance.

Maintaining Equipment Ensures Regulatory Compliance

6. PLANNING FOR MORE RESILIENT FACILITIES

Wet Weather Holding Basin B During a Recent Storm Event

Flooding Resiliency

In 2005, a 40-year storm caused Pacheco Creek to overtop its levees just upstream of the WWTP. Flooding at the treatment plant was narrowly avoided as the levels in Grayson and Walnut Creek rose to the brink of the levee crest.

To avoid catastrophic failure, flood protection is critical. If the levees overtop or breach, the plant will flood, causing over $150 million in damage and long-term interruption of wastewater treatment service. The treatment plant's most susceptible areas are the below-ground utility tunnels. The tunnels contain critical equipment, such as influent pumps and motors, primary effluent pumps, effluent pumps, solids handling support equipment, and the MHF center shaft drive.

The nearby flooding event in 2005 prompted the Contra Costa County Flood Control and Water Conservation District (FCD) and Central San to initiate a joint interim project in 2007. The project included de-silting the Walnut Creek channel and raising the levees along Walnut and Grayson Creeks, protecting against a 100-year storm with a range of freeboard ranging from one to three feet.

- The California Department of Water Resources (DWR) standard is to protect against a 200-year water level with three feet of freeboard, with allowances for sea level rise due to climate change. Central San is collaborating with the FCD to raise the levees along Grayson and Walnut Creeks to protect the site from a 500-year storm with three feet of freeboard.
- Climate change is another potential threat to the treatment plant. Long-term regional precipitation models predict little change in average annual rainfall totals over the next 20 years. However, the frequency of extreme peak wet weather events is expected to double by the year 2050 and triple by the year 2100. By designing for a 500-year event, the higher levee will allow for some additional protection against potentially larger storm surges.
- The influent pump station is most vulnerable to flooding. The dry pit for the influent pumps and motors are below ground, which would flood if the levees breach. The pump motors are close-coupled to the pumps and are at a low elevation that could flood. Although raising the levees will reduce the risk of flooding from the creeks, flood water from the surrounding area can still accumulate in the dry pit that houses the electric motors. A leak in the influent pump piping can also cause catastrophic flooding of the dry pit and pump failure. The influent pumps are critical because they

PROJECTS TO MITIGATE FLOOD RISKS

Project	Description	Cost Estimate
Walnut & Grayson Creeks Levee Rehabilitation	Raise the levee along Walnut & Grayson Creeks to provide protection for a 500-year flood event. To be complete by 2018.	$1,100,000[1]
Replace Influent Pump Motors with Immersible Motors	Provide motors that can operate temporarily in case of dry pit flooding due to wet well leak or piping failure. To be complete by 2021.	$1,186,000[2]

Notes:

(1) Existing District project DP7341. Cost is based on the District's Capital Improvement Budget and 10-Year Plan adopted June 2, 2016.

(2) Recommendation by the CWMP. Cost is based on a 3/30/2016 quote from Gent Components and TM No. G-3 - Basis of Cost Estimates.

are required to pump incoming wastewater to the treatment plant for processing and to send wastewater to the holding basins during peak wet weather events. To guard against this threat, the pumps will be equipped with motors that can be immersed for short durations.

Seismic Resiliency

According to Central San's 2009 plant-wide seismic study, most of the major buildings will likely experience damage if a 6.7 magnitude earthquake occurs on the Concord-Green Valley fault. Per California Building Code, a 6.7 magnitude earthquake corresponds to a 475-year recurrence interval. Damages to structures would weaken the frames that support the building roofs and intermediate floors, and many buildings would be unsafe for plant staff access afterward. For several days or months, buildings would require repairs and treatment operations could be significantly limited, limiting the ability to manage and treat wastewater. The 2009 study recommended seismic upgrades for several buildings at the treatment plant.

Since the 2009 report, Central San completed retrofits of the following buildings:

- The Headquarters Office Building— Installing additional interior moment frames and perimeter posts.
- Household Hazardous Waste Collection Facility — Modifying braces at the frames, installing knee braces at the frames, and adding a short collector member at the location of the re-entrant corner.
- Standby Power Facility — Strengthening frame connections and installation of knee braces at the existing moment frames.

Central San is constructing seismic improvements to the Pump and Blower Building and is further evaluating seismic improvement needs at the Solids Conditioning Building. The remaining seismic improvements are scheduled for completion over the next 10 years.

Process equipment and piping throughout the WWTP are also at risk of damage and long-term service interruption due to seismic events. Since this equipment has not been thoroughly evaluated, seismic evaluation of the mechanical and electrical equipment in each building and of major piping in the utility tunnels is recommended.

The 2009 seismic study did not assess water-retaining structures, such as the primary sedimentation tanks, A/N tanks, and secondary clarifiers. The 2009 evaluation was also based on building codes that have changed significantly. Additional seismic evaluation is recommended for water-retaining structures.

Operational Vulnerabilities

The following recommendations are aimed at maintaining and improving operational resiliency at the WWTP:

- Continue annual updates of Central San's Contingency and Spill Prevention Plan.
- Complete a plant-wide vulnerability assessment with key District operations and maintenance staff for each process area to identify any new emergency response plans, recommended emergency contracts, changes to policies and programs, and any new capital improvement projects. Incorporate recommendations into the Contingency and Spill Prevention Plan and Capital Improvement Plan.
- Decouple the secondary treatment aeration blowers from the solids handling and the steam system. Although the steam-driven aeration turbines and waste heat recovery system are sustainable energy solutions, they create a complicated and vulnerable interconnection between the various processes

Inspection of the Multiple Hearth Furnaces

Capital Improvements are Needed for Security

and equipment. As previously mentioned, converting the waste heat from solids incineration into power using an organic rankine cycle turbine and using electric blowers instead of steam-driven turbine blowers would help overcome this vulnerability.

- Consider constructing a second primary effluent gate. Currently, all flow from the primary sedimentation tanks must go through a single gate to go downstream for secondary treatment. If this gate fails when closed or at an undesirable position, it can restrict flow and reduce level control in the primaries.
- Install a dedicated raw bypass pump station and drainback pipeline for reliable, simultaneous diversion of both raw screened influent and primary effluent during wet weather events. Currently, the ability to bypass these streams simultaneously is limited by the hydraulics of a shared bypass pipeline.

Physical and Cyber Security

An initial review of security measures was completed for the CWMP. The following are recommended capital improvements and studies to improve the physical security:

- Implement the security-related capital improvements identified for the WWTP and pump stations as outlined in a confidential report provided to the District.
- Complete a more comprehensive security study (currently under progress) for all major facilities that utilizes the principles of AWWA J100 Risk Analysis and Management for Critical Asset Protection methodology (RAMCAP® J100). The RAMCAP method is a 7-step process: 1) Asset Characterization; 2) Threat Characterization; 3) Consequence Analysis; 4) Vulnerability Analysis; 5) Threat Analysis; 6) Risk/Resilience Analysis; and 7) Risk/Resilience Management. This study will include recommendations for improving the District’s overall security program.
- Continue to actively track the latest trends in cyber security threats and prevention.
- Initiate an ongoing, annual capital improvement project to assess cyber security threats and implement cyber security improvements as needed.

7. RECYCLED WATER NEEDS AND OPPORTUNITIES

Recycled water demands are expected to increase over the next 20 years. Additional utility water, which is produced by the recycled water facilities, will be needed to accommodate potential future treatment plant processes. In addition, more recycled water will be required to satisfy landscape irrigation demands for the Concord Community Reuse Project development. The projected average Title 22 recycled water demand at 2035 is 5.5 mgd, compared to the current average demand of 1.6 mgd, and the projected peak day demand at 2035 is 11.3 mgd versus the current peak day recycled water demand of 3.8 mgd.

Rehabilitation of Aging Infrastructure

The following improvements are recommended based on the condition assessment:

- Replace the filter media, underdrains, filtered effluent flow meters, instrumentation, controls, and coagulant flash mixing.
- Replace the Clearwell liner and replace the east cover.
- Upgrade or replace the electrical support equipment for the recycled water, filter plant, and applied water process areas.
- Replace chemical support system components (coagulant and sodium hypochlorite).

Reliability Improvements

- Replace one of the unused oversized 300-HP Applied Water Pumps with a new pump sized to match the existing 50-HP Applied Water Pumps; this will provide pumping redundancy for current peak day recycled water demands.
- Perform coagulant testing to evaluate using alternative coagulants instead of alum. Coagulant testing and optimization may lower operating costs and improve filter capacity.
- Add a cover to the west Clearwell
  - currently not covered or used
  - to provide redundant storage and allow for routine draining, cleaning, and maintenance.

PROJECTED RECYCLED WATER DEMANDS

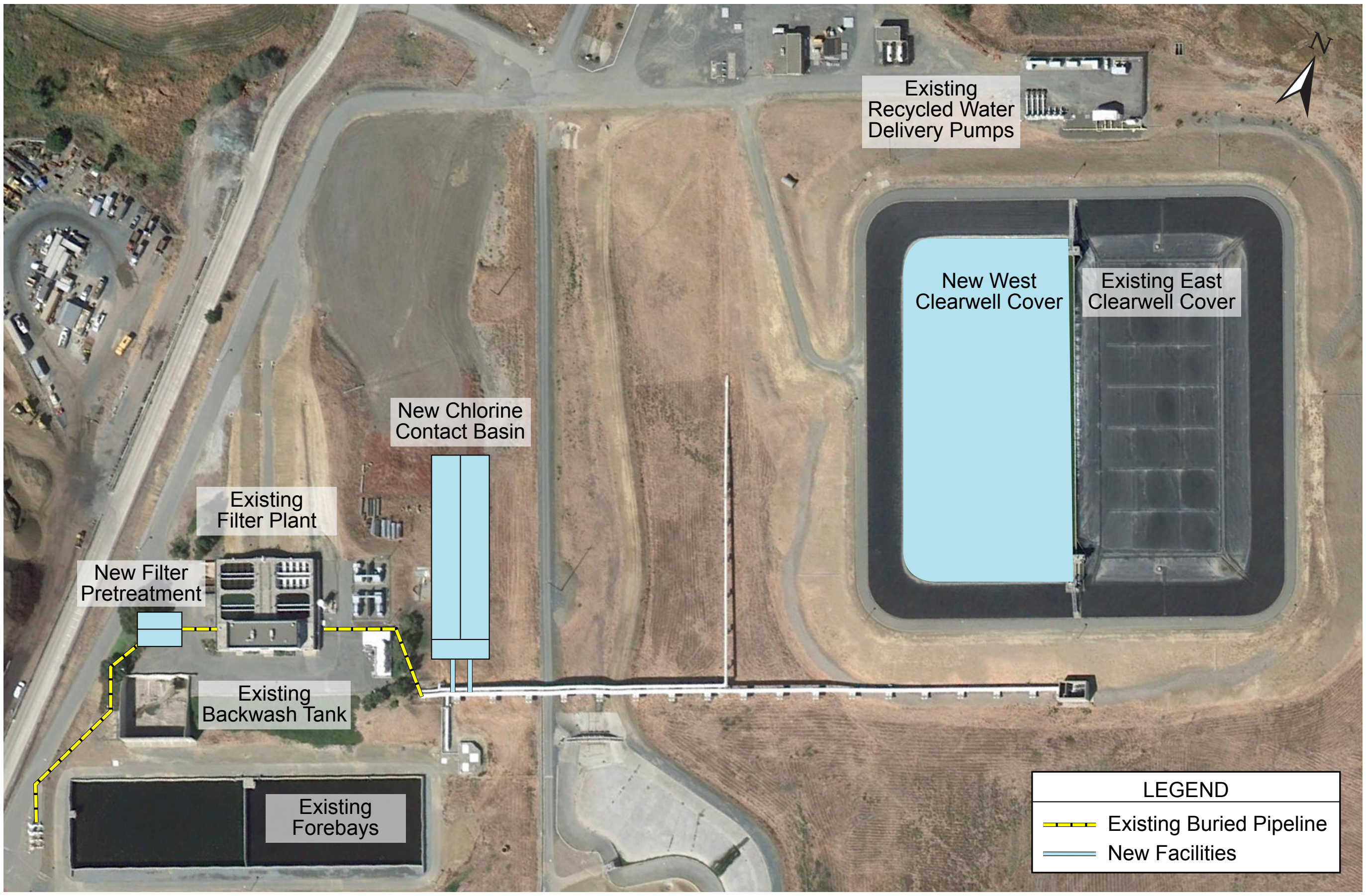
	Current Recycled Water and Utility Water(1)	Future Utility Water(2)	CNWS Redevelopment	Future Zone 1(3)	Total Future Demands(3)
Seasonal Average (mgd)	1.6	1.4	2.5	0.8	5.5
Peak Day (mgd)	3.8	1.7	5.8	1.9	11.3

Notes:

(1) Based on data from 2013 to 2015.

(2) Future utility water demands assume the recommended alternatives for nutrient discharge, recycled water production, and solids handling.

(3) Future Zone 1 demands represent the remaining potential flow to Zone 1 customers based on the District's agreement with Contra Costa Water District. These demands are included for informational purposes only and are not included in the Total Future Demands values shown. The District has not identified any other major users in Zone 1 that are not already connected and that would meet the District's Board Policy (BP 019) project requirement for a 15-year payback.



Recycled Water Facilities

Capacity Improvements

All major recycled water treatment facility components were evaluated, including applied water pumping, tertiary filters, backwash pumping, Clearwell storage, disinfection facilities, and recycled water delivery facilities. The following improvements were identified to meet future recycled water demands:

- Repeat filter capacity testing after rehabilitating the filters and optimizing the coagulant to confirm the reliable capacity of the existing filter plant.
- Replace the applied water pumps with pumps sized to accommodate projected peak day demands. Investigate potential Forebay and Outfall hydraulic limitations on applied water pumping.
- Add a Chlorine Contact Basin to expand disinfection capacity.
- Expand chemical support systems (coagulant and sodium hypochlorite).
- Add filter pretreatment upstream of the filters to improve water filterability when expanding the capacity to meet Concord Community Reuse Project recycled water demands.

Expanding Recycled Water Use

Current recycled water production is limited by the Title 22 recycled water demands. Central San's projected average dry weather flow is 41 mgd and projected average Title 22 recycled water demand is 5.5 mgd, meaning an average of 35.5 mgd is available for additional recycled water production. Driven by California's drought, water conservation efforts, and Central San's long-term goal of zero discharge, Central San is exploring opportunities to expand recycled water production and help augment regional water supplies.

In 2016, Central San commissioned a study to identify wholesale recycled water opportunities. There are opportunities to offset raw water used at neighboring refineries by supplying high-quality recycled water, export recycled water to agricultural users via the Delta Mendota Canal, or produce high-quality water for Indirect or Direct Potable Reuse (IPR/DPR) for water purveyors in the region.

The refinery opportunity appears to be the most feasible recycled water expansion option. The refineries currently use a combined total of 20 mgd of raw canal water supplied by Contra Costa Water District (CCWD). Supplying recycled water to the refineries would require treatment upgrades to remove ammonia and possibly nitrogen and dissolved salts. Because Central San understands that recycled water can play a key role in augmenting limited regional water supplies, recycled water treatment upgrades were considered in evaluating future facilities and developing future site plans.

RECYCLED WATER CAPACITIES

Component	Approximate Capacity, mgd
Applied Water Pumping	3.8(1)
Tertiary Filters	6 to 11(2,3)
Backwash Pumping	25.8 gpm/ft^2(4)
Disinfection: Clearwell Storage and Contact Time Facilities	6
Recycled Water Delivery Facilities	5

Notes:

(1) Current operational capacity is 3.8 mgd. The applied water pumps have the physical capacity to achieve 18 mgd; however, to efficiently meet demands above 3.8 mgd, modifications would be required, including adding VFDs on the 300 HP pumps and replacing the 50-HP pumps with larger pumps. The applied water pumping capacity corresponds to a recycled water production of 3.4 mgd assuming 10% of filter feed is ultimately used for backwashing (3.8 mgd x 90% = 3.4 mgd).

(2) Filter capacity based on performance during April and May 2016 filter testing. 6 mgd capacity with a 24 hour minimum filter run time 95% of the time; 11 mgd capacity requires decreasing minimum filter run time to approximately 14 hours. Capacity based on three filters in operation at a time.

(3) Modifications, such as adding a new static mixer and instrumentation/metering improvements, would be needed to achieve the filter capacity shown.

(4) Backwash pumps have adequate capacity to backwash one filter cell at a time. The maximum backwash rate is close to the original plant design criteria of 25 gpm/ft^2 and exceeds the current backwashing rate of about 20 gpm/ft^2.

8. MEETING FUTURE NUTRIENT REGULATIONS AND EXPANDING RECYCLED WATER USE

Evaluation of Alternatives

Treatment alternatives for liquids and solids streams were identified for their ability to meet potential future nutrient limits, strive toward net zero energy, diversify solids handling and biosolids reuse options to meet the projected solids load, to supply recycled water to nearby refineries, and strive towards zero discharge. To evaluate the alternatives, the "universe" of technology alternatives was first screened. Treatment alternatives were then evaluated from the list of viable technologies.

Screening of Alternatives

In December 2015, Central San held a workshop to evaluate the universe of alternatives, which is the broad field of possible liquid, solids stream, and energy process technologies currently available. The following pass/fail criteria were used for the initial screening:

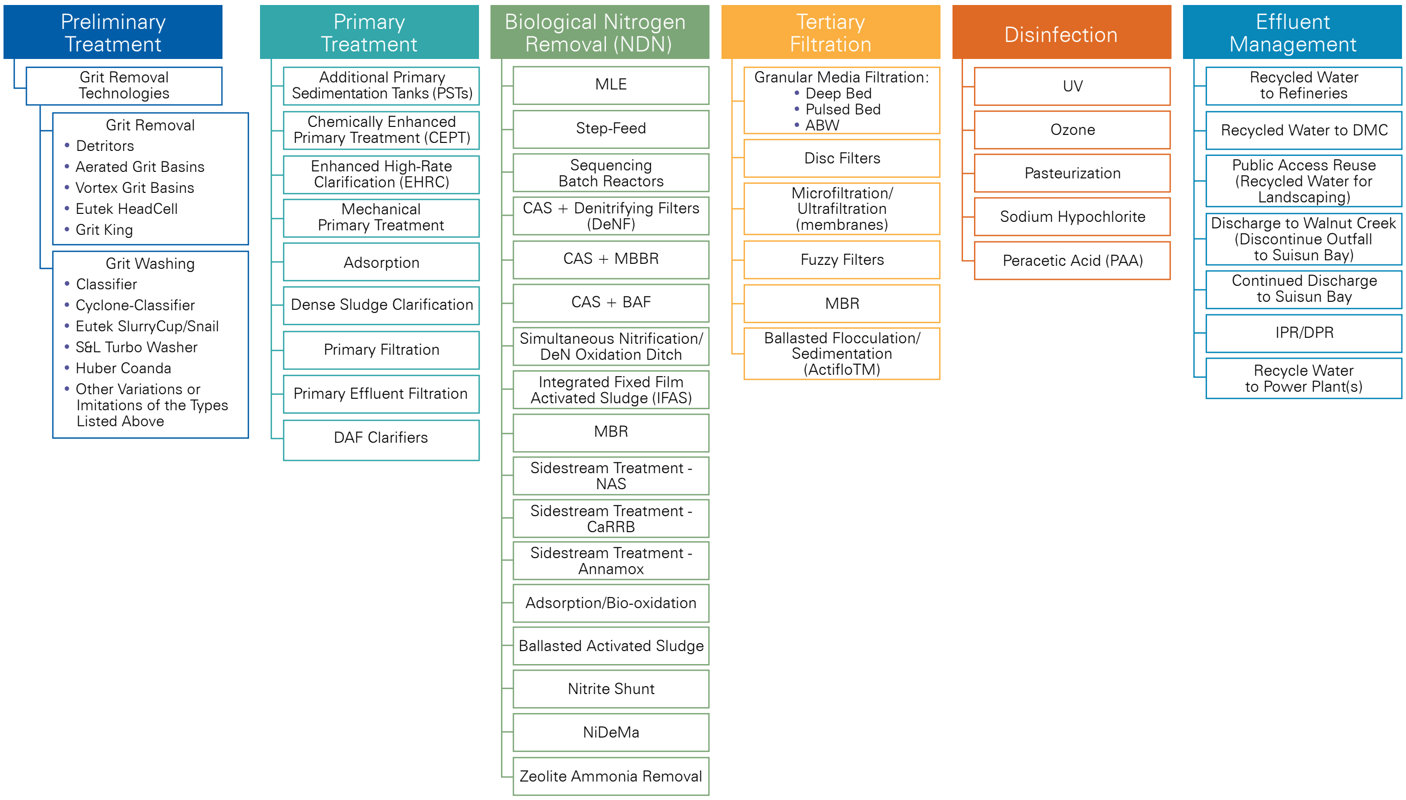
1. Is the technology proven/scalable to meet liquid, solids, and air regulations?
2. Does the technology fit within site constraints?
3. Does the technology maximize use of existing facilities? In other words, does it avoid abandoning facilities in good condition?

Triple Bottom Line Plus (TBL +) Evaluation

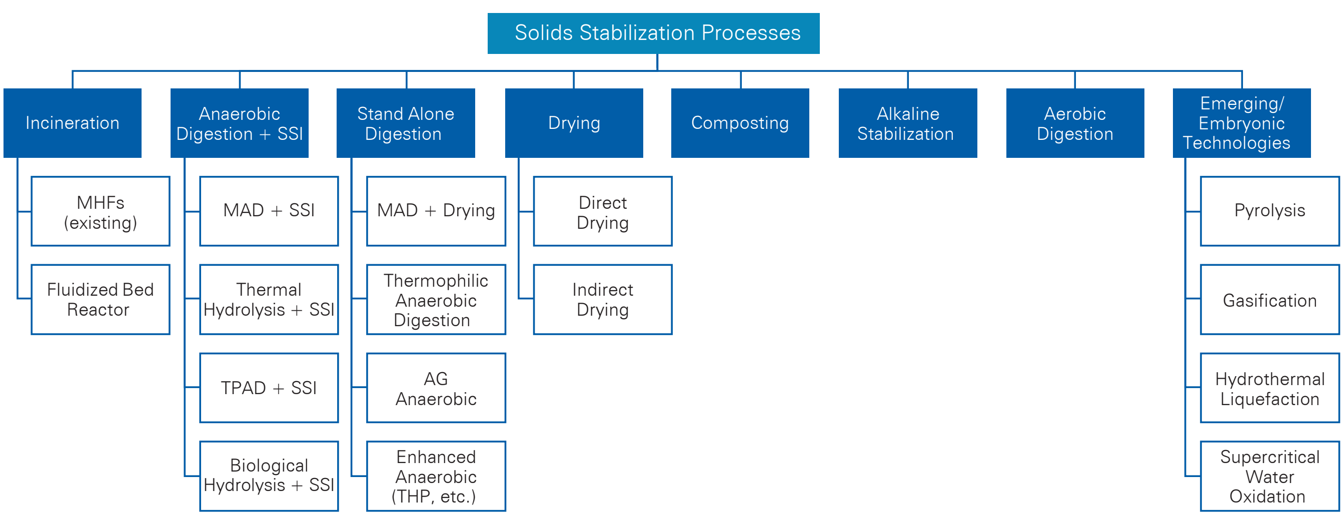
The "triple bottom line +" evaluation process was used to compare the alternatives. The TBL+ process evaluates how well alternatives meet the project's needs based on the three traditional categories (financial, social, and environmental) and the fourth category (denoted by the "+") is added to include technical advantages and disadvantages.

Evaluation criteria for each category were identified according to the CWMP planning objectives. The evaluation criteria were then further developed to identify performance parameters and units of measure.

The three liquids and three solids alternatives listed below were evaluated during a workshop with Central San staff from Operations, Maintenance, Planning, Regulatory, and Capital Projects Divisions.



Universe of Liquids Treatment Technologies



Universe of Solids Handling Technologies

LIQUIDS ALTERNATIVES

Alternative L1 - MLE + MF + RO: Expand activated sludge process for biological nutrient removal (MLE or Modified Ludzack Ettinger) and add microfiltration (MF) and reverse osmosis (RO) for refinery recycled water.

Alternative L2 - MLE + MBR + RO: Expand activated sludge process for biological nutrient removal and add membrane bioreactors (MBR) and RO for refinery recycled water.

Alternative L3 - IFAS + MF + RO: Convert activated sludge to integrated fixed film activated sludge (IFAS) and add MF/RO for refinery recycled water.

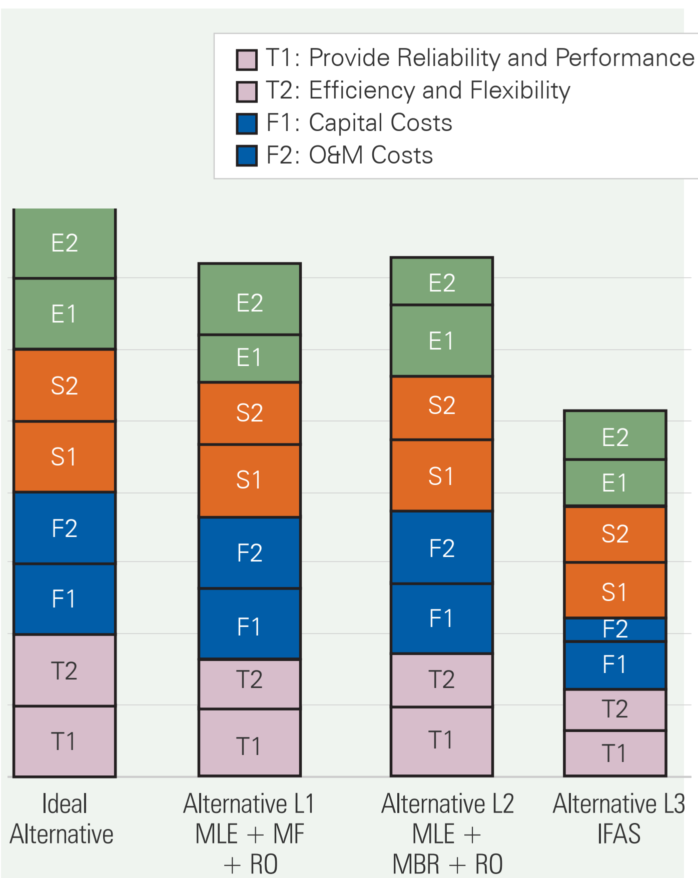
SOLIDS ALTERNATIVES

Alternative S1 - FBIs: Replace MHFs with two Fluidized Bed Incinerators (FBI).

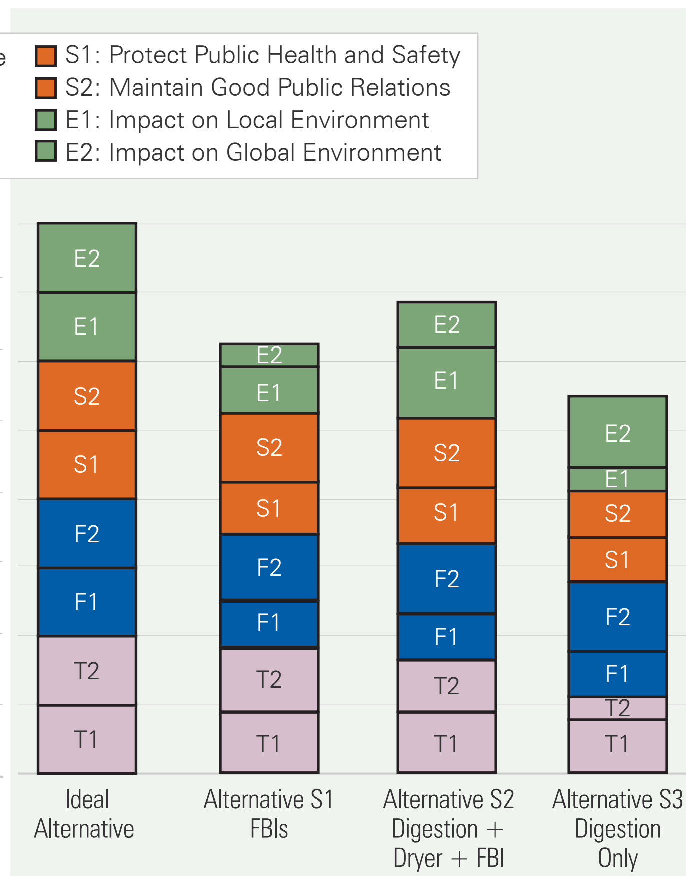
Alternative S2 - Digestion + Dryer + FBI: Add anaerobic digestion and drying followed by one FBI.

Alternative S3 - Digestion Only: Add standalone anaerobic digestion with thermal hydrolysis to produce Class A biosolids that will eliminate the use of incineration.

At the workshop, the team scored the liquid and solids alternatives for each category and objective. In the end, the team selected liquid stream Alternative L2 — MLE process for nutrient removal and the MBR process for recycled water production for the refineries and solids alternative S2 — anaerobic digestion followed by incineration, where the existing MHFs would be replaced with one FBI when the MHFs reach the end of their useful life.



Liquids Alternatives TBL+ Scoring Summary



Solids Alternatives TBL + Scoring Summary

9. RECOMMENDATIONS

Collection System

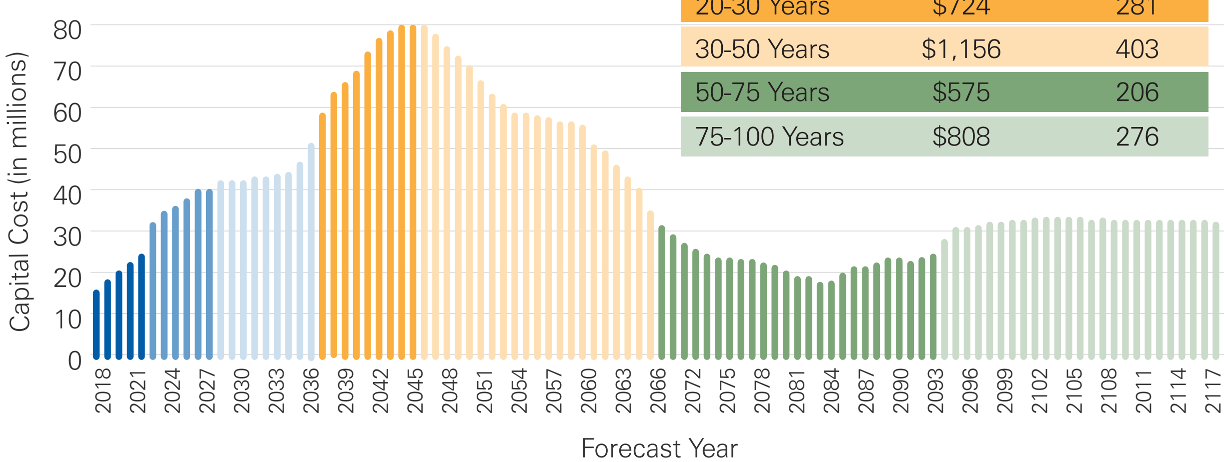
Long-term reliable collection and conveyance of wastewater to the treatment plant in Martinez is critical for protecting public health and the environment. To maintain a high level of service and continue to reduce SSOs, the following projects and programs are recommended.

Aging Infrastructure

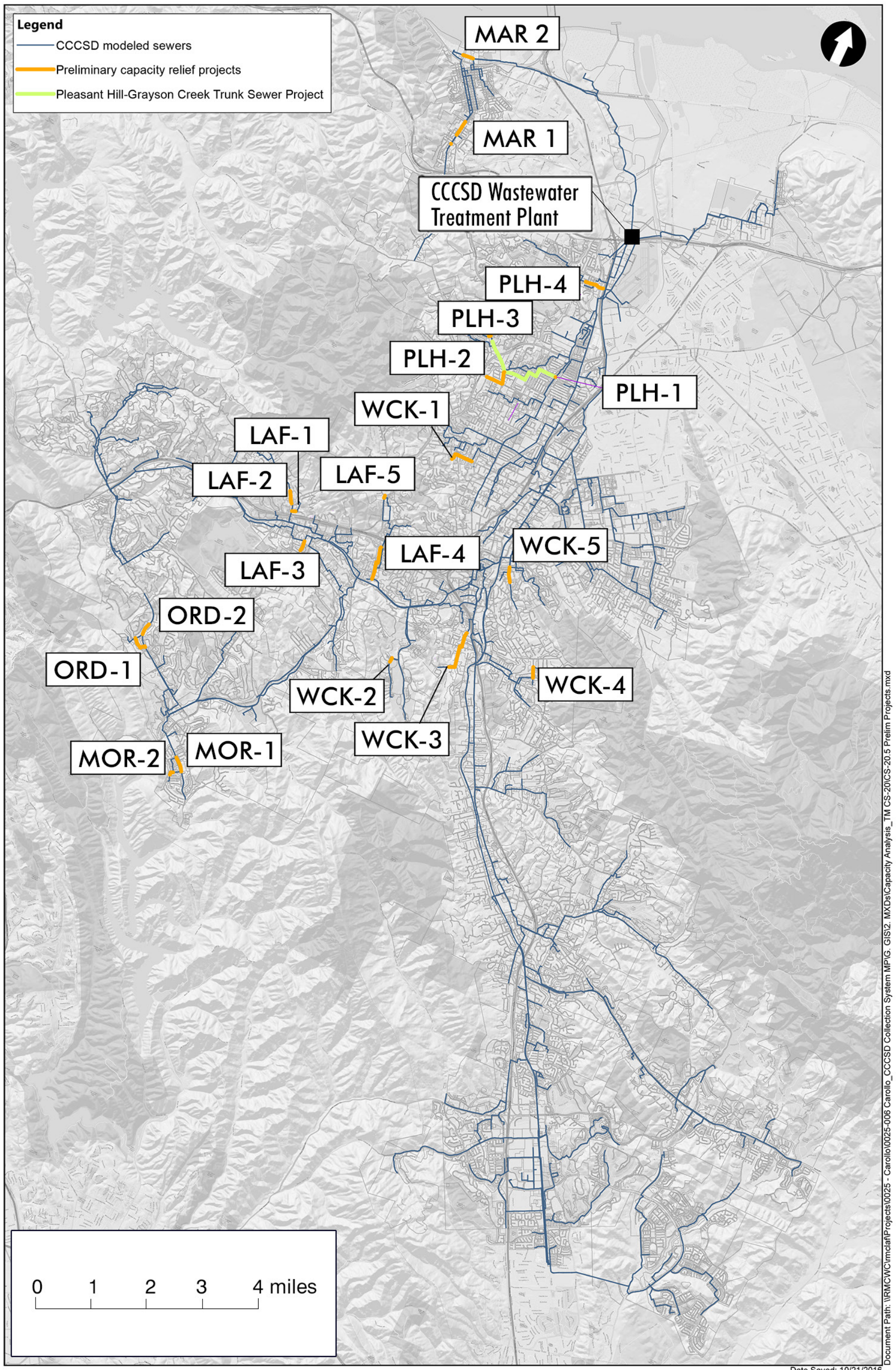
Aging infrastructure projects include improvements to gravity sewers and pump stations to either replace or rehabilitate and extend the useful lives of assets.

- **Gravity Sewers** — Central San replaces gravity sewers at a rate of less than 0.5 percent per year. The recommended annual replacement rate of gravity sewers starts at 0.5 percent and ramps up to 1.2 percent within 10 years. At this rate, 81 miles of sewer will be replaced in the next 10 years at a cost of approximately $280M, and an additional 184 miles will be replaced in 10 to 20 years at a cost of approximately $440M. Over the 20-year period, that 265 miles represents nearly 18 percent of the collection system.
- **Pump Stations** — An estimated $33 million in pump station improvements is recommended between 2019 and 2023. The largest projects will rehabilitate the Fairview, Maltby, Moraga, and Orinda Crossroads pump stations. Similar improvements will be required at other pump stations within the next 10 years.

PERIOD	COST ($M)	MILEAGE
0-5 Years	$99	38
5-10 Years	$180	42
10-20 Years	$441	184
20-30 Years	$724	281
30-50 Years	$1,156	403
50-75 Years	$575	206
75-100 Years	$808	276



100-Year Recommended Pipeline Replacement Plan



Preliminary Capacity Relief Projects

Capacity

According to the hydraulic model, a 10-year wet weather event will cause surcharging in 21 locations in the service area. This means flow will exceed the 5-foot freeboard criteria in the manholes. Twelve of these locations are predicted to overflow the manholes and cause an SSO.

One project/location (Pleasant Hill-Grayson Creek Trunk Sewer) is already under construction. For the remaining 20 locations, capacity relief projects were developed, prioritized, and included in the CIP. Before implementing some of them, additional localized level and flow monitoring specific to the project locations will help confirm the priority and scope of the relief project. Validating the collection system model is an important ongoing effort to ensure the highest priority projects are addressed first and to further confirm the need for capacity relief projects.

No capacity relief projects are required to handle increasing dry weather flows. However, implementing some improvements and expanding the collection system in North Concord will be required to receive flows from the Concord Community Reuse Project development. Current ratepayers would not need to fund those improvements, and they are not included in the CIP.

COLLECTION SYSTEM WET WEATHER CAPACITY RELIEF PROJECTS

Project ID	Project Name	Project Length (ft)
ORD-1	El Camino Moraga Easement (Orinda)	1,612
ORD-2	Moraga Way (Orinda)	1,156
MOR-1	Camino Pablo Diversion (Moraga)	1,442
MOR-2	Hodges Drive/Rimer Drive (Moraga)	475
LAF-1	Deer Hill Road (Lafayette)	363
LAF-2	Happy Valley Road (Lafayette)	1,185
LAF-3	Moraga Road (Lafayette)	982
LAF-4	Pleasant Hill Road/ Buchan Drive (Lafayette)	3,316
LAF-5	Pleasant Hill Road/ Springhill Road (Lafayette)	232
WCK-1	Camino Verde/Geary Road (Walnut Creek)	2,276
WCK-2	Tice Creek Drive (Walnut Creek)	403
WCK-3	Tice Valley Blvd./ Meadow Road/ Lancaster Road (Walnut Creek)	4,154
WCK-4	Palmer Road (Walnut Creek)	1,026
WCK-5	Walnut Blvd. (Walnut Creek)	1,428
PLH-1	Ardith/Kathleen Drive Diversion (Pleasant Hill)	~20
	Pleasant Hill-Grayson Creek Trunk Sewer	See project plans
PLH-2	Grayson Road/Pleasant Hill Road (Pleasant Hill)	2,882
PLH-3	Virginia Hills Drive (Martinez)	200
PLH-4	2nd Avenue (Pacheco/ Pleasant Hill)	1,837
MAR-1	Alhambra Avenue (Martinez)	1,528
MAR-2	Embarcadero Street Easement (Martinez)	987

Collection System Crew Cleaning a Sewer

Regulatory

The main regulatory driver for collection system is the State Water Resources Control Board (SWRCB) issued general Water Discharge Requirements (WDRs) for sanitary sewer systems. Central San's Sewer System Management Plan (SSMP) summarizes Central San's management and operations of its collection system. The main goal of the SSMP is reduce the occurrence of SSOs through preventative maintenance and monitoring. Central San is in the process of updating its SSMP.

Most of the SSOs in Central San's service area are caused by root intrusion in 6-inch and 8-inch vitrified clay pipe. Using cleaning data, the InfoMaster® capital planning software identified high cleaning frequency locations in the service area. To show continuous improvement and to reduce SSOs in the collection system, these pipes will be a priority for future sewer renovation projects.

Changes to Air Emissions requirements over the last five years from CARB, and the EPA will affect the Central San's air quality permits that are enforced through the Bay Area Air Quality Management District (BAAQMD) Permit-to-Operate (PTO) (annual permit) and the Title V permit (five-year permit). Central San should plan for increasingly stringent emissions requirements and for emissions control equipment for stationary and mobile combustion facilities and engines.

Sustainability

To ensure Central San can reliably maintain a high level of service for critical infrastructure, projects were identified to rehabilitate existing facilities based on the findings from field condition assessments.

In addition to the rehabilitation projects, it is recommended that Central San implement inspection programs that utilize use high-tech inspection technologies to assess the condition of force mains and large diameter sewer pipes, which are traditionally difficult to assess. The inspection programs prioritize high risk facilities that have a high consequence of failure. These new inspections will update the prioritization and timing for replacement of force mains and large diameter pipes and establish baseline data for condition that can be used in the InfoMaster® model for tracking and financial planning as each pipeline ages and degrades.

Since the collection system has not experienced wet weather capacity related overflows in many years, there is no immediate regulatory driver to implement a private sewer lateral program. However, Central San may consider an infiltration and inflow (I/I) identification pilot program to assess the potential for reduction of I/I from renovation projects. By monitoring flow before and after pipeline rehabilitation, Central San can quantify the reduction in I/I and can identify the most effective methods of I/I reduction to be used in the future.

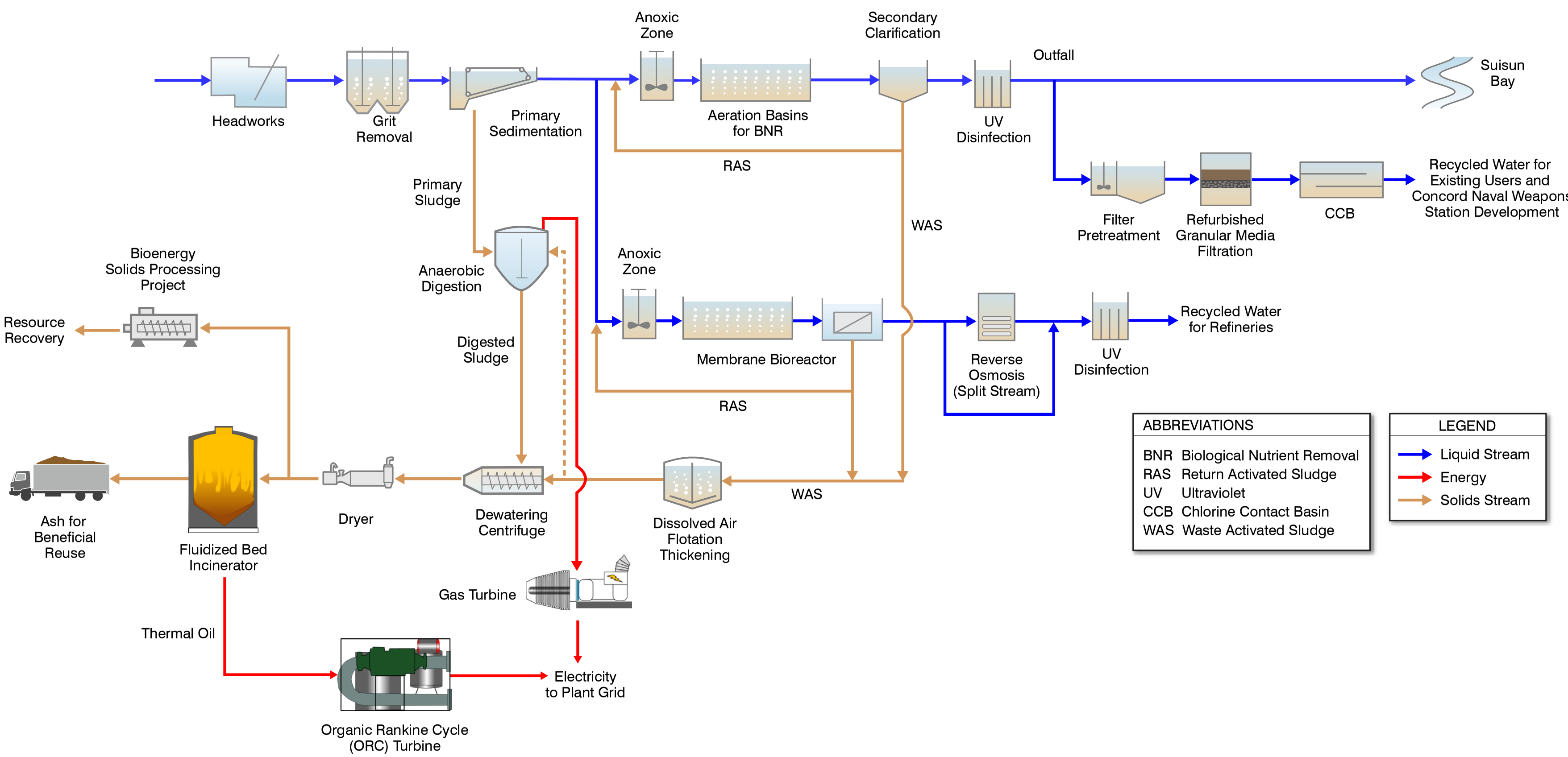
Summary of Major Treatment Plant & Recycled Water Recommendations

The following list summarizes the major recommended treatment plant improvement projects by phase (timing) and by the applicable capital improvement drivers. Phase 1 projects are in the 0 to 5 year time frame, Phase 2 projects are in the 5 to 10 year time frame, and Phase 3 projects are in the 10 to 20 year time frame. Some projects span multiple phases and/or are driven by multiple key issues.

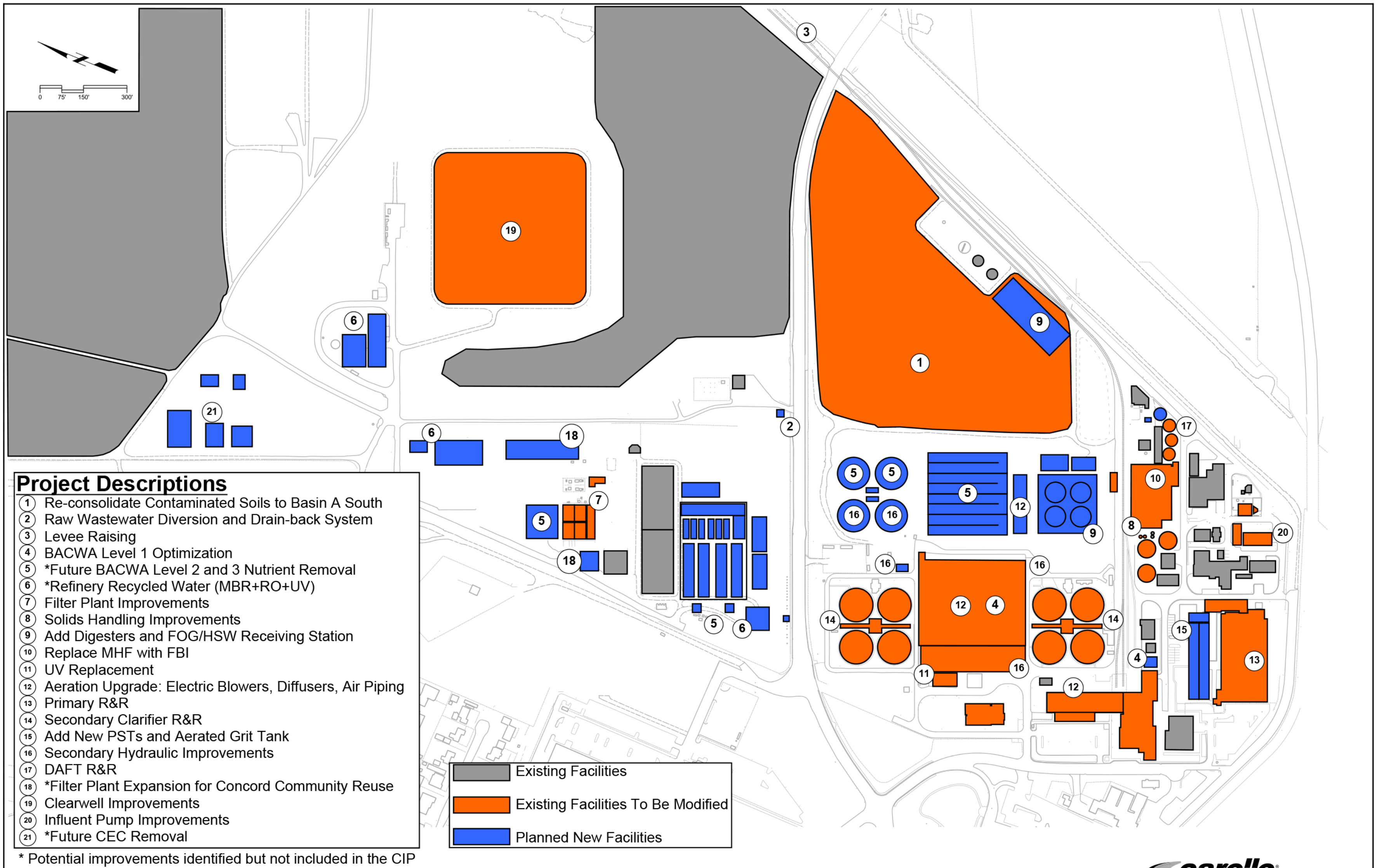
Phase	Aging Infrastructure	Capacity	Regulatory	Sustainability	Project
1	●			●	Headworks Screenings Upgrade
1			●	●	Pump & Blower Building Seismic Upgrade
1	●				Switchgear Refurbishment - Phase 2
1	●	●		●	Influent Pump Station Electrical Improvements
1	●				Mechanical and Concrete Renovations
1	●				Plant Control System I/O Replacement
1	●			●	Equipment Replacement
1	●		●		Fire Protection System - Phases 2 to 6
1	●			●	Piping Renovation - Phase 9
1				●	Walnut Creek/Grayson Creek Levee Rehab
1	●			●	UV Disinfection Upgrades
1				●	Treatment Plant Security Improvements
1				●	Plant-Wide Instrumentation Upgrades
1		●		●	Innovative Bioenergy Demonstration
1	●				Solids Conditioning Building Roof Replacement
1		●	●		UV Hydraulic Improvements
1	●				Condition Assessment of Buried Pipelines
1				●	Plant Operations & Lab Data Improvements
1	●			●	Filter Plant Improvements
1, 2	●		●	●	Aeration and Energy Upgrades
1, 2	●	●	●	●	Solids Handling Facility Improvements
1, 2			●	●	Plant Operations Building Seismic Upgrades
1, 2			●		Surcharge Soil Pile Relocation
1, 2			●		Nutrient Removal (BACWA Level 1)
1, 2	●			●	UV Disinfection Replacement
1, 2	●				Treatment Plant SCADA Improvements
1, 2, 3	●				PLC Systems Upgrades Phases 1 and 2
1, 2, 3	●				Treatment Plant Urgent Repairs
1, 2, 3	●	●	●	●	Applied Research & Innovations
1, 2, 3	●				Outfall Improvements - Phase 7 to 9
1, 2, 3			●		TP Safety Enhancements - Phases 4 to 11
1, 2, 3	●				Annual Infrastructure Replacement Program
1, 2, 3	●				Recycled Water Distribution System Renovations
1, 3	●				Plant Control System Network Upgrade Phases 1 and 2
1, 3	●		●		Odor Control Upgrades - Phase 1 and 2
2			●	●	Wet Weather Flow Management
2	●	●		●	Primary Expansion Project
2			●	●	Warehouse Seismic Upgrades
2			●	●	Laboratory Seismic Upgrades
2			●	●	Miscellaneous Seismic Upgrades
2	●			●	Clearwell Improvements
2, 3		●	●		Secondary Treatment Hydraulic Improvements
2, 3	●				WWTP SCADA Replacement
2, 3	●	●		●	Solids Handling Facility Improvements - Phase 2
3	●			●	Solids Handling Facility Improvements - Phase 3
3	●		●	●	Tunnel Improvements
3	●				Secondary Clarifier Improvements
3	●				DAFT Improvements

Legend: ● Aging Infrastructure; ● Capacity; ● Regulatory; ● Sustainability; (1) Phase 1 (0 to 5 years); (2) Phase 2 (5 to 10 years); (3) Phase 3 (10 to 20 years)

Treatment Plant Projects and Their Drivers



Plant of the Future Process Flow Diagram



Plant of the Future Site Plan

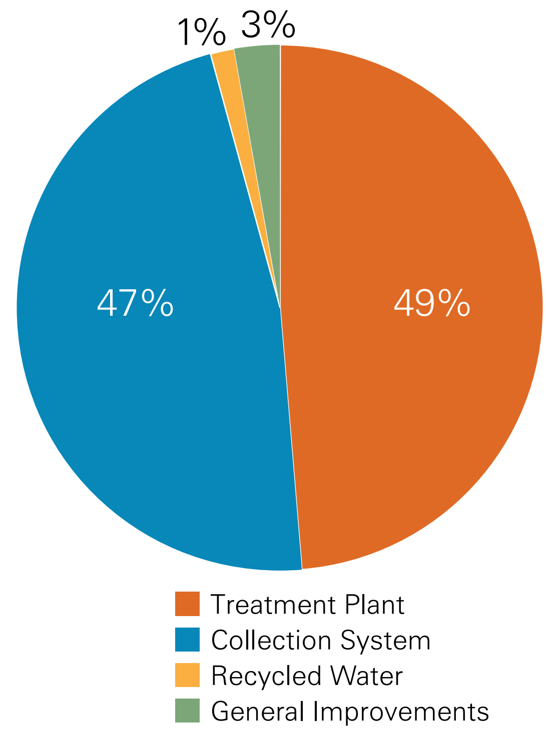
10.RECOMMENDED CAPITAL IMPROVEMENT PLAN

The Capital Improvement Plan (CIP) encompasses a $1.8 Billion (2016 dollars) 20-year improvement program.

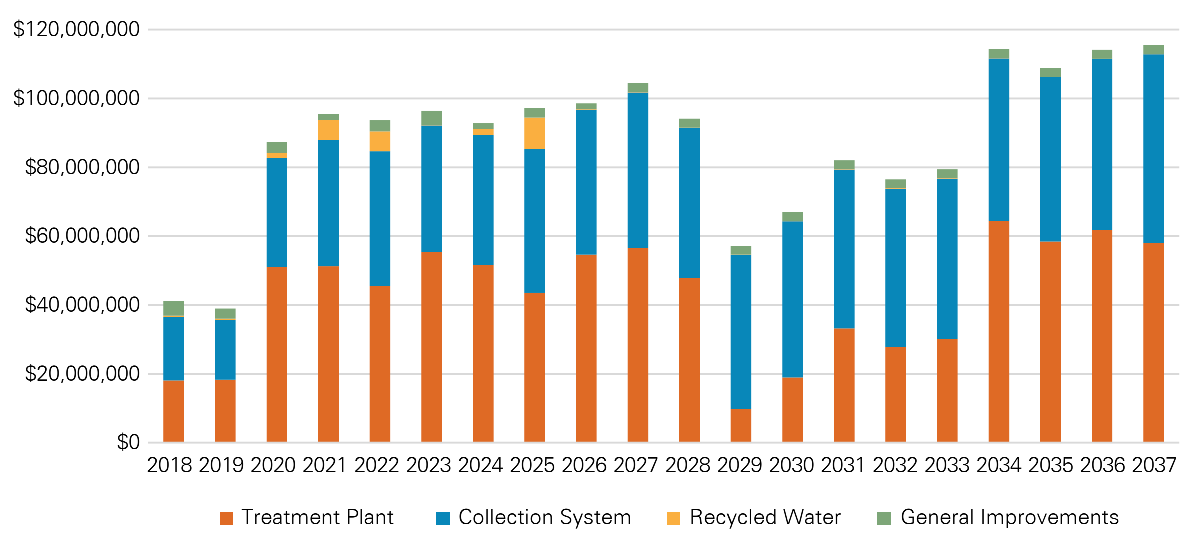
The Management Plan's recommended projects were categorized into four programs:

1. Treatment Plant ($856 Million)
2. Collection System ($819 Million)
3. Recycled Water ($26 Million)
4. General Improvements ($54 Million)

A fifth category "Future Unfunded" includes other identified projects that are not currently included in the CIP. These "future unfunded" projects amount to an additional $920 million beyond the $1.8 Billion CIP, of which approximately $501 million may be within the next 20 years. Some of these projects were identified to meet potential uncertain future regulations and other projects expected to be cost-neutral to Central San, such as the future wholesale of recycled water.



Total 20-Year CIP Breakdown by Program



Total 20-Year CIP Annual Cash Flow (in 2016 Dollars)

11. EMBRACING INNOVATION

The CMWP has identified proven technologies that can be utilized to meet future nutrient limits, wholesale recycled water needs, and technologies for solids handling and resource recovery. These technologies are essential for ensuring Central San has a flexible plan in place if these systems need to be replaced. However, the industry is rapidly changing and emerging and innovative technologies may offer improved life cycle costs, increased energy efficiency, and/or reduced footprint requirements. Central San continues to invest in applied research to continue to find the best available technologies.

Central San encourages innovation by exploring emerging and embryonic technologies that may change the way wastewater is treated globally. Central San is actively seeking out opportunities to partner with other companies, research and academic institutions, and other public agencies to explore promising solutions to liquids treatment, solids handling, and energy and resource recovery. Although many of these innovative technologies are not considered tried and true in the industry, Central San is invested in being at the forefront of innovation. By embracing innovation, Central San may be able to achieve meaningful reduction in energy demands, maximize recovery of valuable resources, and improve lifecycle costs while still maintaining a high degree of reliable service.

Central San Lab Technician

Biocrude Oil

Central San, part of a consortium led by the Water Environment & Reuse Foundation, was selected by the Department of Energy (DOE) to receive a highly sought after federal grant for an applied research project to test a breakthrough, emerging bioenergy technology (to be hosted at Central San). The proposed technology, hydrothermal processing, is aimed at converting wastewater solids into clean, renewable fuels such as biocrude and biomethane gas. The project is scheduled to begin in Summer 2017.

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