Design Criteria

Plant Flow	
Maximum In-Plant Flow	26.4 mgd
Maximum Plant Production	24 mgd
Carbon Dioxide	
Number of Storage Tanks	1
Total Storage Capacity	36 Tons
Design Dose	3 - 40 mg/L
Liquid Oxygen	
Number of Storage Tanks	1
Total Storage Capacity	11,000 gallons
Number of Ambient Vaporizers	3
Ozone Generators	
Number of Ozone Generators	3 (2 duty, 1 standby)
Capacity of Each Ozone Generator	440 lbs/day
Total Firm Ozone Generation Capacity	880 lbs/day
Total Ozone Generation Capacity	1,320 lbs/day
Design Dose	1 - 4 mg/L
Ozone Contactor Structure	
Type	Over/Under Baffle, Fine Bubble Diffusion
Number of Contactor Basins	1
Number of Cells Per Basin	8
Total Volume of Contactor Basin	148,000 gallons
Theoretical Detention Time at Max Flow	8 minutes
Filters	
Number of Filters	6
Filter Media Area Per Filter	680 sf
Total Filter Media Area (All Filters)	4,080 sf
Underdrain Type	Gravel-less
Filter Media	
Anthracite	
Depth	44 inches
Effective Size	1.2 - 1.3 mm
Uniformity Coefficient	<1.4
Silica Sand	
Depth	12 inches
Effective Size	0.6 - 0.7 mm
Uniformity Coefficient	<1.4
Filter Empty Bed Contact Time at Max Flow	
With All Filters Online	5.4 minutes
With One Filter Offline	4.5 minutes
Filter Backwashing	
Maximum Backwash Water Flowrate	25 gpm/sf
Air Scour Rate	4 scfm/sf
Chlorine Contact Basin	
Type	Serpentine Concrete Basin
Volume	342,000 gallons
Design Chlorine Residual	2.9 mg/L
Contact Time at Max Flow	18.6 minutes
Plant Water Pump Station	
Number of Plant Water Pumps	3 (2 duty, 1 standby)
Capacity of Each Plant Water Pump	1,100 gpm
Total Firm Capacity of Plant Water Pumps	2,200 gpm
Number of Jockey Pumps	2 (1 duty, 1 standby)
Capacity of Each Jockey Pump	310 gpm
Treated Water Pump Station	
Number of Treated Water Pumps	5 (4 duty, 1 standby)
Capacity of Each Treated Water Pump	4,167 gpm
Finished Water Storage	
Number of Clearwells	2
Volume of Each Clearwell	2 and 5 million gallons
Total Storage Volume	7 million gallons
Filter-to-Waste Pump Station	
Number of Pumps	2 (1 duty, 1 standby)
Capacity of Each Pump	4,080 gpm
Washwater Recovery Pump Station	
Number of Pumps	3 (2 duty, 1 standby)
Capacity of Each Pump	850 gpm
Detention Basin	
Total Storage Volume	369,000 gallons

Zone 7 Water Agency

About Us

Zone 7 Water Agency supplies treated drinking water to retailers serving over a quarter million people in the Tri-Valley area including the cities of Pleasanton, Livermore, Dublin, and through special agreement with Dublin San Ramon Services District, to the Dougherty Valley area of San Ramon. In a typical year, approximately 80 percent of the agency's water supply originates in the Sierra and is imported through the Delta, with the rest pumped from the groundwater basin or coming from rain runoff in our Lake Del Valle watershed. Zone 7 also supplies irrigation water primarily to agricultural customers, manages the groundwater basin, and provides flood protection to all of eastern Alameda County. The Agency operates two surface water treatment plants, ten municipal supply wells, and a groundwater demineralization plant.

Acknowledgements

Zone 7 Water Agency

Board of Directors

Angela Ramirez Holmes (President)
Sarah Palmer (Vice President)
Sandy Figuers
Dennis Gambs
Laurene Green
Olivia Sanwong
Michelle Smith McDonald

Zone 7 Staff

Designed by: CDM Smith

Prime Contractor: C. Overaa & Co.

Construction Manager: Psomas

ZONE 7 WATER AGENCY

Delivering Quality, Reliability and Safety

Patterson Pass Water Treatment Plant Upgrades and Ozonation Project

Project Purpose and Benefits

The PPWTP Upgrades and Ozonation Project modernizes the plant so that Zone 7 can continue to meet its commitment to providing a reliable supply of high quality water. This project:

- Increases plant and process reliability by replacing aging treatment facilities
- Increases plant production capacity from 12 million gallons of water a day (mgd) to 24 mgd
- Increases in-plant storage capacity of finished water by approximately 5 million gallons
- Adds ozonation facilities to improve treated water quality

In summary, PPWTP is essentially be a brand new 24 mgd plant and will provide much needed redundancy in case of potential outages at the Del Valle Water Treatment Plant. Additional operational flexibility provides for a reliable water supply in the event of emergencies such as earthquakes.

Project Facts

Major Improvements:

- Increase plant capacity from 12 million gallons a day (mgd) to 24 mgd
- New ozonation facilities, including liquid oxygen storage and vaporization, ozone generation, ozone contactor, and ozone offgas destruct
- New carbon dioxide system for pH adjustment prior to ozonation
- New biological filters with water/air backwash
- New Chlorine Contact Basin to provide post-filtration and backup disinfection during ozone system outage
- New plant water pump station to replace existing plant water pumps and supply cooling water to ozone equipment
- New Treated Water Pump Station
- New 5 Million Gallon Clearwell
- New Detention Basin
- New Washwater Recovery Pump Station
- New emergency generator/ backup power generator
- Modifications to plant electrical system to accommodate new loads and provide reliable power supply to the entire plant
- Modifications to existing chemical systems
- Plant overflow modifications

Project Costs:

- Planning and design: $6 million
- Construction and construction management: $104 million
- Funded by a combination of water rates, new connection fees, and $19 million in bonds

Schedule:

- In service May 2022

Plant History

The Patterson Pass Water Treatment Plant (PPWTP) was constructed in 1962 as a conventional treatment plant with upflow solids contact clarification, dual-media filtration, and chlorine disinfection. In 1969, the plant was expanded from its original peak capacity of 7.5 mgd to 13.5 mgd (12 mgd nominal capacity). Construction of the ultrafiltration membrane pilot plant (UF Plant) at the PPWTP site was completed in 2003, which increased the production by 8 mgd for a 21.5 mgd peak total capacity. However, the UF Plant has been out of service for several years due to some of its components reaching the end of their useful life and the unavailability of replacement membranes. Consequently, for the past several years, the sustainable plant capacity has been approximately 12 mgd.

PPWTP is supplied by surface water imported through the Sacramento-San Joaquin River Delta and conveyed via the South Bay Aqueduct (SBA). In recent years, treating this water supply with currently installed treatment processes at PPWTP has become increasingly difficult due to high levels of organic matter and more frequent algae blooms that can cause taste and odor (T&O) problems. Temporary powdered activated carbon treatment provided a short-term solution to remove T&O-causing compounds. Numerous studies completed over the years led to identifying ozone treatment at PPWTP as the most effective method for disinfection, minimizing chlorinated disinfection by-products, and mitigating T&O compounds and contaminants of emerging concern such as cyanotoxins, endocrine disruptors, and pharmaceuticals. In addition to ozone treatment, this project will add 5 million gallons of treated water storage, increase plant capacity from 12 to 24 mgd, and replace and upgrade many aging plant components. Project design and construction began in 2017 and 2019, respectively.

Treatment Process

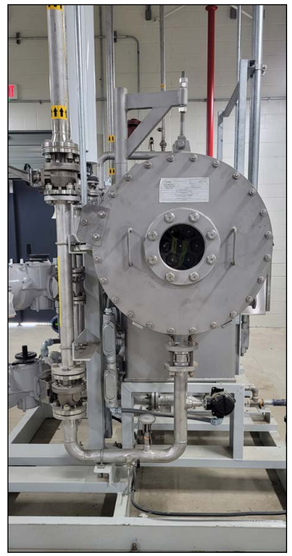
This project adds ozonation, biological filtration, and finished water storage as well as pretreatment, backup disinfection, residuals handling processes to PPWTP. With the exception of the existing clarifiers, the PPWTP will be a new 24 mgd facility.

Pretreatment

Prechloramination and pH Adjustment: Low doses of chlorine and ammonia, as well as carbon dioxide, are added to the raw water. Chlorine and ammonia combine to form chloramines, while carbon dioxide lowers and stabilizes the raw water pH. Prechloramination and pH adjustment/stabilization help to control the formation of bromate, a byproduct of ozonation, and enhance the performance of downstream treatment processes.

Ozonation

Liquid Oxygen Storage and Vaporization: High-purity liquid oxygen (LOX) is stored in an outdoor cryogenic storage tank. Three air vaporizers use ambient heat to vaporize the LOX into oxygen gas, which then passes through a particulate filter and flows to ozone generators.



Ozone Generation: The Ozone Generation Building houses three ozone generators, each with its own power supply unit (PSU), as well as cooling water pumps and heat exchanger, electrical, and other ancillary equipment. Ozone generators are stainless steel vessels containing horizontal dielectric tubes that generate an ozone-in-oxygen gas mixture with 5-10% ozone by weight.

Ozone Contacting: The ozone-in-oxygen gas mixture is bubbled into the pretreated raw water at the ozone contactor basin. The ozone contacting process provides primary disinfection in the PPWTP's treatment train. Disk-style ceramic fine bubble diffusers provide constant and uniform distribution of the emergent diffused ozone-oxygen bubbles. The basins have internal baffle walls that facilitate an efficient hydraulic flow path and ensure that the ozone contacting process meets disinfection contact time requirements.

Ozone Offgas Destruct: Not all of the applied ozone gas reacts with the raw water. Unused ozone gas, called ozone offgas, is collected in the sealed headspace of the ozone contactor basins and treated by an offgas destruct system. The offgas is converted to ozone-free oxygen gas, and is continuously monitored and discharged to the atmosphere above the contactor basins.

Monitoring and Control: The ozone-in-water residual is continuously monitored by PPWTP's automatic analyzers and control system at various sampling points along the ozone contactor basins. The control system continuously calculates the disinfection compliance ratio achieved by the ozonation process and automatically makes adjustments to various parameters, such as the ozone dose, so the ozonation process complies with disinfection requirements.

Biological Filtration

Ozonation of drinking water prior to filtration breaks up larger organic carbon molecules into smaller molecules that are more easily metabolized by bacteria. Waters with higher levels of bioavailable organic carbon have been linked to biofilm growth and instability in the distribution system. This project doubles the PPWTP's filtration capacity with six new biological filters, which allows the biological population in the filters to degrade organics as the water is filtered through the granular media, reducing the amount of bioavailable organic carbon in the treated water.

Prior to this project, the PPWTP achieved primary disinfection via chlorination upstream of the filters. Since raw water ozonation will provide primary disinfection after this project, chlorine will no longer be regularly fed directly upstream of the filters. This allows a biological population to be established in the filters.

Deeper, Coarser Media: Operational experience at other utilities indicates that converting traditional filters to biological filters without changing the media to a deeper, coarser configuration can lead to higher headloss accumulation rates, shorter filter run times, and higher backwash frequency. Therefore, in this project, the new filters will be equipped with coarser sand and anthracite media. In addition, the depth of the anthracite layer is approximately doubled after the project compared to the existing filters.

New Underdrain System and Air Scour: To allow for a deeper media configuration the new filters will have a stainless steel, gravel-less underdrain design with a lower profile. An air scour blower and piping system is also added to effectively remove unattached particles and microorganisms from the filter media during backwashing.

Backup Primary Disinfection and Chlorination for Multi-barrier Treatment

The post-filter Chlorine Contact Basin (CCB) will consist of a covered and baffled concrete basin. Chlorine will normally be fed to the filtered water at the entrance of the CCB, to provide additional virus and HPC bacteria inactivation. The CCB will provide sufficient contact time to meet disinfection requirements. Should the ozone process go down, additional chlorine dosing at the CCB will then also provide primary disinfection. Downstream addition of caustic soda and ammonia to the finished water provides a chloramine residual in the distribution system.

Treated Water Pump Station and 5 MG Clearwell

After disinfection and chloramination of the filtered water, treatment is complete. This treated water flows into the existing 2 MG Clearwell. From here, the treated water can be pumped into a new above ground 5 MG Clearwell for increased operational storage to complement the plant's increase in capacity from 12 mgd to 24 mgd and to increase PPWTP's operational flexibility in delivering treated water to its customers.

Emergency Power

Because the ozone system is critical to providing disinfection of the PPWTP's treated water, a new 1500 kW emergency generator is installed to provide power to the ozone equipment, as well as other plant equipment, during an interruption of utility power. This emergency generator will start automatically when power loss is detected and will supply the emergency circuits via an automatic transfer switch. It will start and provide power within 10 seconds or less of losing the normal power source.

Ozone Life-Safety System

An extensive life-safety system detects any ozone or oxygen leaks and prevents plant personnel from exposure to ozone gas. This system includes ozone and oxygen leak detection monitors, emergency alarm systems, ventilation equipment for ozone areas, and automatic sequences in the plant control system to issue alarms and/or initiate equipment shutdown in the event of a leak. The life-safety equipment and instruments are connected to the emergency power system, allowing them to function even during a utility power interruption.