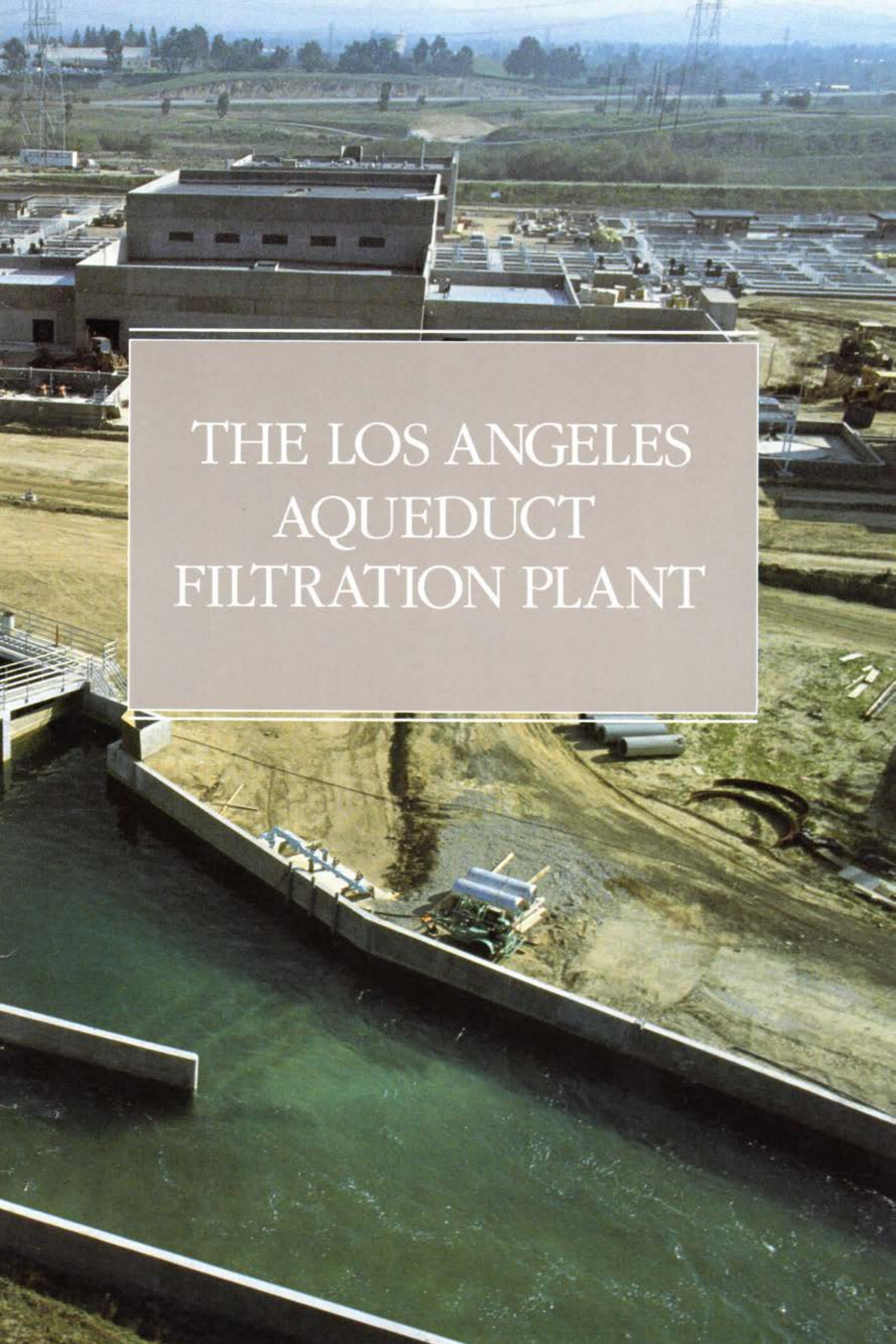
THE LOS ANGELES AQUEDUCT FILTRATION PLANT



The Los Angeles Aqueduct System

The City of Los Angeles encompasses 464 square miles and has a population of 3.1 million. A vast network of facilities is in place to serve customers with a reliable supply of water and electricity. Approximately 80 percent of Los Angeles' water is imported from the eastern Sierra Nevada and is brought to the city via the two Los Angeles Owens River Aqueducts.

LOS ANGELES OWENS RIVER AQUEDUCT

SECOND LOS ANGELES AQUEDUCT

The Story of Water Supply in Los Angeles

Water has played a prominent role in the growth and development of the City of Los Angeles. Since the early 1900's, the Los Angeles Department of Water and Power (DWP) has imported water to supplement the City's limited local water supplies.

Today, 80 percent of the water used in Los Angeles is imported from the Owens Valley and Mono Basin areas of California. Snowmelt from the eastern Sierra Nevada mountains flows south through the Los Angeles Aqueduct System, traveling through some 338 miles of pipes, channels, and tunnels to Los Angeles.

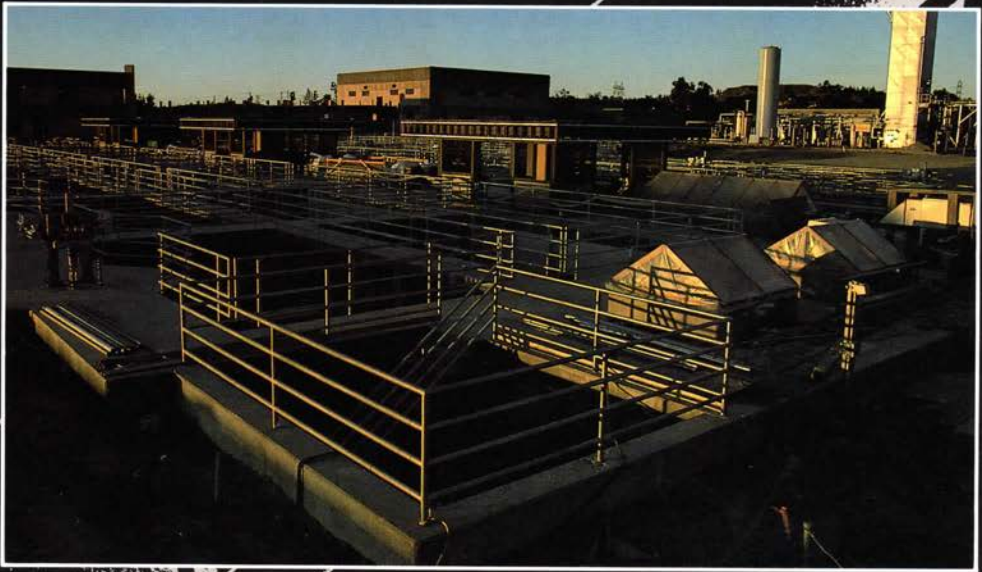
The naturally high quality of the eastern Sierra snowmelt has ensured that water delivered through the Aqueduct System has historically met state and federal standards for water quality. Much of the credit for the excellent water quality Los Angeles enjoys is due to South Haiwee Reservoir, a large storage reservoir along the Los Angeles Aqueduct in the southern Owens Valley.

As Aqueduct water makes its long, slow journey through South Haiwee Reservoir, fine, dust-like particles settle out of the water. These particles, which are called *turbidity*, can often be seen as cloudiness in the water. They are found in varying degrees in almost all surface water supplies. Through the natural settling process at Haiwee, the water loses its turbidity, leaving it clean and clear for use in Los Angeles.

New Turbidity Standards

Turbidity has played an increasingly important role in water quality in recent years. In the past, standards for turbidity reflected a concern for only the aesthetic quality of water supplies. However, recent studies have shown that turbidity can interfere with the ability of disinfecting agents, such as chlorine, to adequately kill bacteria and viruses which may be present in the water.

Water passes through the inlet structure as it begins a six-step treatment process.



The Los Angeles Aqueduct Filtration Plant is scheduled for service in late 1986.

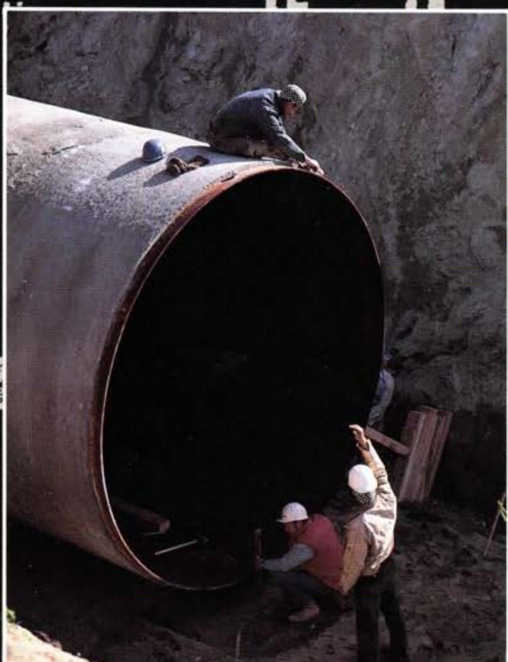
As a result of these studies, the federal government passed the Safe Drinking Water Act in 1974, which placed stricter limits on the amount of turbidity allowed in drinking water supplies. Following this action, the California Department of Health Services established turbidity standards which were even more stringent than those enacted by the federal government.

New Dam Safety Standards

Around this same time, the State of California also established new dam safety standards which permanently reduced the amount of water DWP could store in South Haiwee Reservoir. This reduction in capacity reduced the reservoir's ability to naturally remove turbidity.

With the adoption of the new state turbidity standards and the loss of settling capacity at South Haiwee Reservoir, it became apparent that filtration would be necessary to reduce turbidity in the water and ensure the continued wholesomeness of Los Angeles' largest water source.

Large pipes route the water to the filter beds.



Following filtration a 12-foot diameter pipeline will deliver water to the city distribution system.

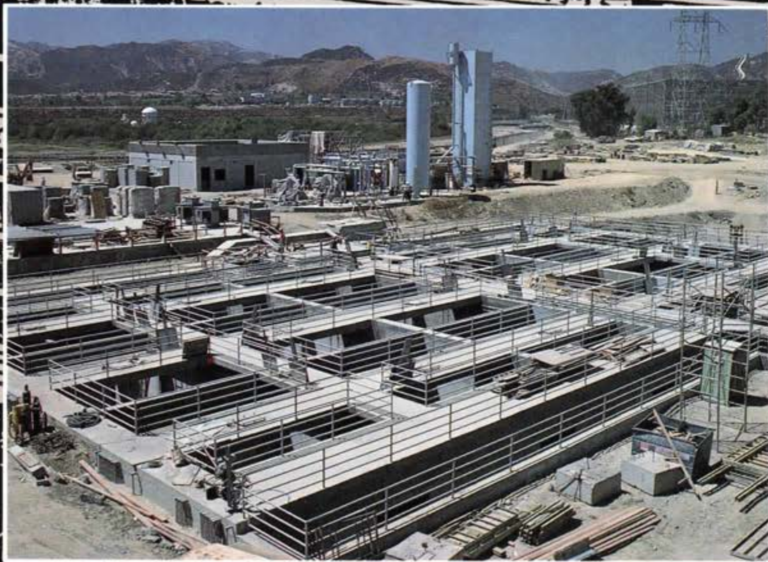
Plant Design

To determine the most efficient and economical treatment method for the Los Angeles water supply, DWP and its consultants conducted extensive testing at a pilot filtration plant constructed along the Aqueduct near Mojave, California. Results from these studies revealed that the use of a special process called *ozonation*, coupled with other treatment processes, would provide the most effective and efficient treatment of the Aqueduct water.

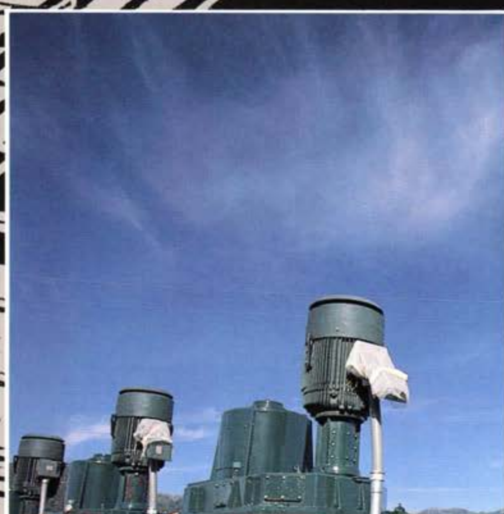
DWP selected the Los Angeles Reservoir complex in the north San Fernando Valley as the site for the water filtration plant. The 1600-acre reservoir complex is the terminal point of the Los Angeles Aqueduct System and the beginning of the City's water distribution network.

Design and construction of the filtration plant and associated water facilities cost $146 million. Funds for the project are provided from current water revenues and through the sale of revenue bonds, which places no tax burden on the citizens of Los Angeles.

The new Los Angeles Aqueduct Filtration Plant is one of the largest and most advanced water treatment facilities in the world, treating up to six million gallons of water per day. The state-of-the-art treatment process technology and sophisticated computer control will ensure the efficient delivery of clean, wholesome water for generations to come.



Up to 600 million gallons of water per day will be treated at the plant.



Rapid mix motors are important in the turbidity removal process.

The Treatment Process

Water entering the plant flows by gravity through several treatment processes which disinfect and remove impurities from the Aqueduct flow. First, the water is screened. Then ozone gas is injected into the water. Next, chemicals are mixed into the water to cluster the particles of turbidity. Finally, the water is filtered and then chlorinated before flowing into the distribution system.

Screening

As the water enters the plant, it passes through heavy bar racks and fine rotating screens which remove any foreign materials such as tree limbs, leaves, and rocks. The racks and screens prevent debris from clogging or damaging mechanical equipment in the plant.

Ozonation

After screening, the water enters one of four large ozone contact basins. Ozone, the plant's primary disinfecting agent, is injected into the water as it flows through the basins. Oxygen and some unused ozone rise off the surface of the water in the contact basins. These excess gases are collected and the ozone is converted into oxygen. The oxygen gas is then released into the atmosphere.

Rapid Mixing

After ozonation, the water enters rapid mixers where chemicals are added to help remove turbidity. The fast-moving blades of the rapid mixers ensure that the chemicals are dispersed uniformly throughout the water. The chemicals react with particles suspended in the water, making it possible for them to cluster together during the next treatment step. The chemicals will be removed from the water along with the turbidity particles during filtration.

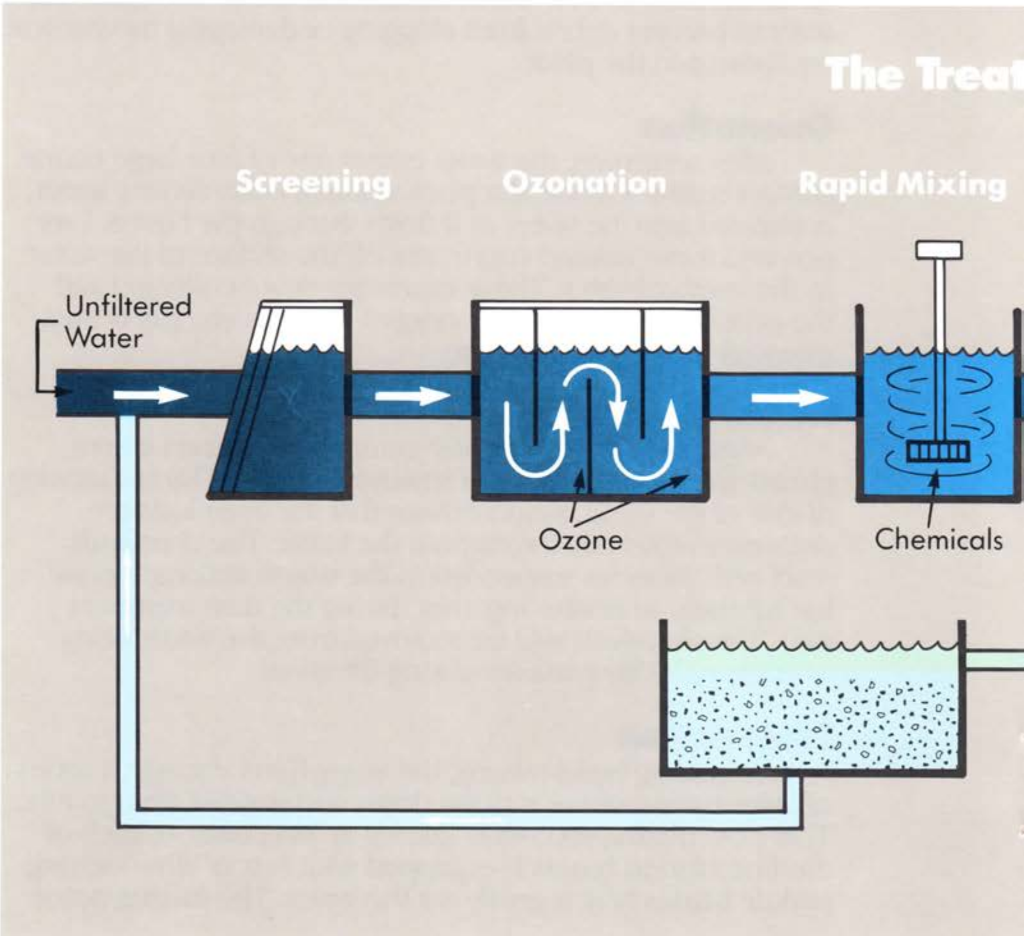
Flocculation

Following rapid mixing, the water flows through a series of large basins where it slows down and is given time to mix. This slow mixing process is known as *flocculation*. Each of the flocculation basins is equipped with sets of slow-moving paddle blades which gently stir the water. The mixing action causes the small particles of turbidity to cluster and form larger particles called *floc*. Once formed, these floc particles are large enough to be easily trapped by the filters.

Filtration

After flocculation, the water flows directly to the filters, where it is distributed over 24 filter beds. Each filter bed is composed of a six-foot layer of crushed anthracite coal over a thin gravel base. The water flows down through the coal, which traps the floc, leaving the water clean and clear.

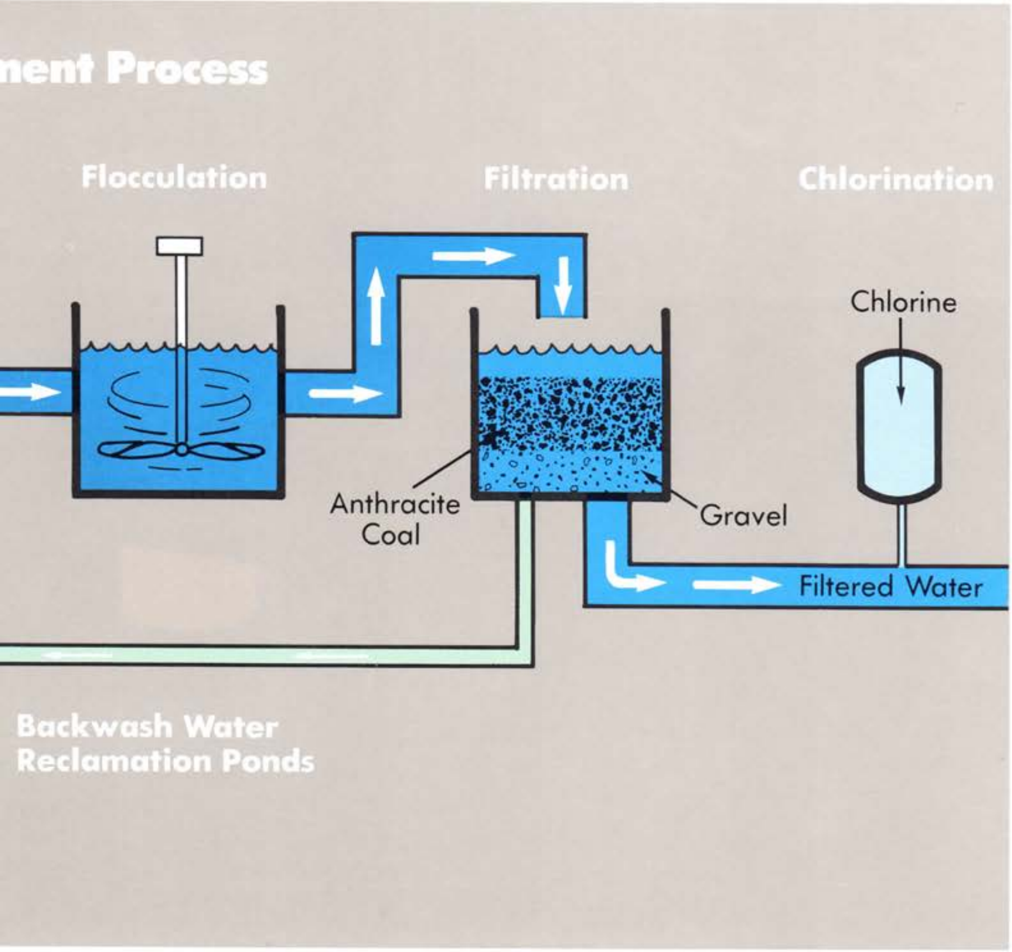
The filters need to be periodically backwashed, or cleaned, by reversing the direction of water flow. A combina-



tion of clean water and air is forced upwards through the filters to loosen the trapped particles. The water and particles are carried away to backwash ponds where the solids are settled out. After settling, the washwater is recycled through the plant to minimize water losses from backwashing.

Chlorination

Before leaving the plant, the filtered water is chlorinated. This final step ensures adequate disinfection and provides a residual level of chlorine for protection of the water as it travels through the City's distribution system.



Facility produces pure oxygen for conversion into ozone.

Generators produce ozone to disinfect water coming into the plant.

A Special Note About Ozonation

Los Angeles' filtration plant utilizes a special treatment process called ozonation. This process uses *ozone*, an extremely powerful disinfecting agent, to destroy bacteria and other living organisms in the water. Ozone also helps control objectionable tastes, odors and color which might otherwise be present in the water.

Use of the ozonation process benefits the health of citizens of Los Angeles. This is because ozone significantly reduces the potential for forming such organic compounds as trihalomethanes (THM's), providing increased protection against long-term adverse health effects.

Microflocculation

Ozonation offers an important and unique advantage over traditional chlorination and other disinfection methods. Through its powerful disinfecting properties, ozone aids in the clustering of small, nearly undetectable turbidity particles. This is called *microflocculation*. As the small particles cluster during the remaining treatment processes, they form larger particles which are readily removed in the treatment plant's filters.

The microflocculation function of ozone reduces the chemical requirements for later processes, and allows the water to be filtered at a rate which is much higher than that possible when other disinfectants are used.

Improved chemical treatment and increased filtration rates have significantly reduced the size of the plant's treatment facilities, resulting in substantial savings in construction costs. The microflocculation benefit of ozone is expected to reduce operational costs as well.

The Ozonation Process

To begin the ozonation process, pure oxygen gas is produced in the on-site oxygen generation facility. A portion of this oxygen is converted to ozone in the ozone generators. The combination ozone/oxygen gas is then injected into the water in the ozone contact basins.

In the contact basins, the ozone reacts with organic impurities in the water and destroys them in a process called *oxidation.* The oxygen and unused ozone are collected in the air space at the top of the basins. These gases are then passed through a special process which converts any remaining ozone back into oxygen. This ensures that no ozone is released to the atmosphere.

Worldwide Ozone Use

Ozone has been used as a disinfectant in Europe since the turn of the century. Countries such as France, Switzerland, and Canada rely heavily on the ozonation process in treating their domestic water supplies. Ozone's success around the world and in several smaller treatment plants in the U.S. has proven its value and effectiveness in water treatment.

The selection of ozonation as the primary disinfecting agent at the filtration plant ensures that the plant will produce safe, clean water at the lowest cost possible to the people and businesses of Los Angeles.

Project Cost

	(Millions)
Filtration Plant:	$106
Treated Water Pump Station:	20
Other Related Facilities:	13
Project Studies & Administration:	7
Total Project Cost:	**$146 Million**

Technical Data and Plant Specifications

Plant Flow	
Maximum:	600 mgd (2271 ML/day)
Normal:	420 mgd (1590 ML/day)
Pretreatment	
Ozone Generation	
Number of Generators	5 (4 online, 1 standby)
Fabricator	Brown Boveri Corp.
Capacity	8340 lb./day (3783 kg/day)
Ozone Contact Basins	
Number	4
Dimensions	100 ft. x 34 ft. x 20 ft.
Minimum Detention Time	4.9 min.
Diffusers	Porous Ceramic
Maximum Applied Dosage, Max. Flow	1.50 mg/L
Coagulation (Rapid Mixing)	
Number of Mixers	8
Dimensions	10 ft. x 10 ft. x 14 ft.
Minimum Detention Time (2 mixers in series)	0.86 sec.
Treatment Chemicals	Cationic Polymer, Ferric Chloride, Alum, Anionic and Nonionic Polymers, Caustic Soda, Chlorine
Flocculation	
Number of Basins	36
Dimensions	25 ft. x 25 ft. x 20 ft.
Minimum Detention Time (3 basins in series)	8.0 min.
Filtration	
Number of Filters	24
Area Per Filter	1,410 sq. ft.
Maximum Filtration Rate, 2 Filters Out For Backwashing	13.4 gpm/sq. ft. (32.8 m/hr.)
Filter Media	Anthracite Coal
Media Depth	6 ft.
Effective Size of Media	1.5 mm.
Uniformity Coefficient of Media	1.5
Backwash	
Type	Air/Water
Maximum Air Rate	4 cfm/sq. ft. (73 m/hr.)
Maximum Water Rate	30 gpm/sq. ft. (73 m/hr.)
Number of Reclamation Ponds	8
Area of Ponds	22.6 acres
Depth of Ponds	9 ft.
Capacity of Ponds	7.4 million gallons (28 megaliters)
Chlorination	
Number of Chlorinators	4
Capacity Each	8,000 lb./day
Maximum Dosage	5.6 mg/L


Your Los Angeles
DWP
Department of Water and Power