City of San Diego
PUBLIC UTILITIES
Water & Wastewater

Application For Renewal of NPDES CA0107409 and 301(h) Modified Secondary Treatment Requirements

POINT LOMA OCEAN OUTFALL

Volume IV
Appendices A & B

January 2015

THE CITY OF SAN DIEGO PUBLIC UTILITIES DEPARTMENT

Application for Renewal of NPDES CA0107409

301(h) Modified Secondary Treatment Requirements for Biochemical Oxygen Demand and Total Suspended Solids

POINT LOMA OCEAN OUTFALL & POINT LOMA WASTEWATER TREATMENT PLANT

Submitted pursuant to
Sections 301(h) and 301(j)(5) of the Clean Water Act

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January 2015

APPLICATION FOR RENEWAL OF NPDES CA0107409
301(h) MODIFIED SECONDARY TREATMENT REQUIREMENTS

Point Loma Ocean Outfall
Point Loma Wastewater Treatment Plant

VOLUME IV
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Appendix A
EXISTING METRO SYSTEM FACILITIES AND OPERATIONS

Renewal of NPDES CA0107409

APPENDIX A

EXISTING METRO SYSTEM FACILITIES AND OPERATIONS

San Diego Public Utilities Department

January 2015

APPENDIX A

EXISTING METRO SYSTEM FACILITIES AND OPERATIONS

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BOD	biochemical oxygen demand
cm	centimeters
COMC	City of San Diego Central Operations and Management Center
COMNET	City of San Diego Control Operations and Management Network
ft	feet
gpm	gallons per minute
gpd	gallons per day
HGL	hydraulic grade line
HP	horsepower
ISO	International Organization for Standardization
MBC	Metro Biosolids Center
m^3/sec	cubic meters per second
Metro System	San Diego Metropolitan Sewerage System
MLLW	mean low low water
MSL	mean sea level
MLSS	mixed liquor suspended solids (aeration basin suspended solids)
MLVSS	mixed liquor volatile suspended solids
mgd	million gallons per day
mg/l	milligrams per liter
NEOC	North Effluent Outfall Circuit
North City WRP	North City Water Reclamation Plant
NMI	North Metro Interceptor
NMVI	North Mission Valley Interceptor
NTU	Nephelometric Turbidity Units
O&M	Operations and Maintenance
ORP	oxidation reduction potential
PLOO	Point Loma Ocean Outfall
Point Loma WWTP	Point Loma Wastewater Treatment Plant
PRI-SC	Peroxide Regenerated Iron Sulfide Control
PSRP	Processes to Significantly Reduce Pathogens
PUD	City of San Diego Public Utilities Department
RAS	return activated sludge
SMI	South Metro Interceptor
SEOC	South Effluent Outfall Circuit
SOP	Standard Operating Procedures
South Bay WRP	South Bay Water Reclamation Plant
TSS	total suspended solids
VSS	volatile suspended solids
WAS	waste activated sludge

APPENDIX A

METROPOLITAN SEWERAGE SYSTEM EXISTING FACILITIES AND OPERATIONS

A.1 INTRODUCTION

This appendix describes existing Metro System facilities and operations. Projected future Metro System flows and planned facility upgrades and improvements are addressed in Appendix B.

Overview and Participating Agencies. The San Diego Metropolitan Sewerage System (Metro System) provides for the conveyance, treatment, reuse, and disposal of wastewater within a 450-square-mile service area for the City of San Diego and regional participating agencies. Metro System facilities include wastewater collection interceptors and pump stations, wastewater treatment and water recycling plants, sludge pipelines and solids handling facilities, and two land/ocean outfall systems.

Metro System facilities are owned by the City of San Diego and are managed and operated by the City of San Diego Public Utilities Department (PUD). The mission of the City of San Diego PUD is:

> *To ensure the quality, reliability, and sustainability of water, wastewater, and recycled water services for the benefit of the ratepayers and citizens served.*

The City administers and executes contracts with each participating agency, monitors flows to the Metro System, bills and collects payments from participating agencies, and disburses all monies spent in connection with the Metro System.

Wastewater collection systems that discharge to the Metro System are owned and operated by the respective participating agencies. Currently, wastewater flows from the City of San Diego comprise approximately 66 percent of the total Metro System flows. Remaining Metro System wastewater flows are contributed by Metro System participating agencies. Table A-1 presents the Metro System participating agencies. Participating agency input to Metro System planning and operation is provided through the Metropolitan Wastewater Commission/Joint Powers Authority (Metro Wastewater JPA).

Table A-1
Metro System Participating Agencies[1]

Municipalities	Water/Wastewater Districts
City of Chula Vista City of Coronado City of Del Mar City of El Cajon City of Imperial Beach City of La Mesa City of National City City of Poway	Lemon Grove Sanitation District Otay Water District Padre Dam Municipal Water District San Diego County Sanitation District[2]

1 See Figure 1 for the location of the Participating Agency service areas.
2 Includes the East Otay Mesa, Lakeside, Alpine, Spring Valley, and Wintergardens Service Areas. See Figure 1 on page A-3.

Figure A-1 (page A-3) presents the Metro System service area and the boundaries of the participating agencies. Figure A-1 also presents the location of key Metro System facilities. Figure A-2 (page A-4) presents a schematic of current Metro System facilities.

Facilities Overview. The Metro System is composed of the following five groups of facilities:

- wastewater conveyance facilities,
- the Point Loma Wastewater Treatment Plant and Point Loma Ocean Outfall,
- the North City Water Reclamation Plant,
- the Metro Biosolids Center (MBC) and sludge conveyance facilities, and
- the South Bay Water Reclamation Plant and South Bay Ocean Outfall.

A.2 WASTEWATER CONVEYANCE FACILITIES

Collection System Overview. As shown in Figure A-1, key wastewater collection facilities within the northern portion of the Metro System service area include the Peñasquitos Pump Station, Pump Station 65, Pump Station 64, the Rose Canyon Trunk Sewer, and the North Metro Interceptor (NMI). Wastewater collected from this northern portion is conveyed to Pump Station 2 and the Point Loma Wastewater Treatment Plant (Point Loma WWTP).

Figure A-1
Location of Metro System Facilities

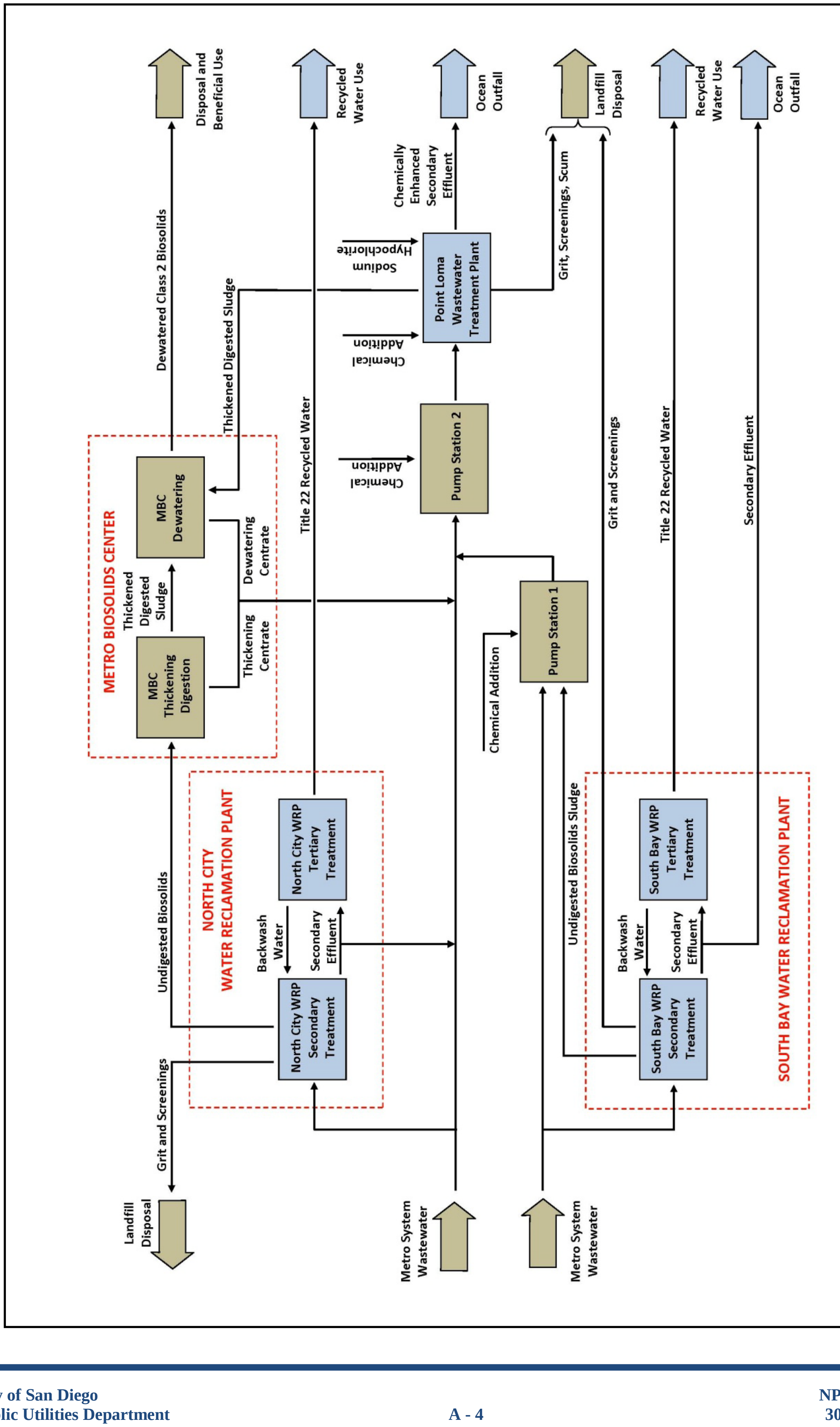


Figure A-2
Schematic of Metro System Treatment Operations

Wastewater from the eastern portion of the Metro System service area is conveyed to Pump Station 2 and the Point Loma WWTP via the East Mission Gorge Pump Station, the Mission Gorge Trunk Sewer, and the North Mission Valley Interceptor. Wastewater from the central portions of the City of San Diego is conveyed to Pump Station 2 and the Point Loma WWTP via the North Mission Valley Interceptor.

Wastewater from the majority of the southern region of the Metro System is directed to the Point Loma WWTP via the South Metro Interceptor (SMI) and Pump Station Nos. 1 and 2. A portion of the wastewater generated within the southern portion of the Metro System is directed to the South Bay Water Reclamation Plant (South Bay WRP) via the Otay River Pump Station and Grove Avenue Pump Station. The NMI and SMI converge at Pump Station 2, which pumps the combined wastewater through two force mains to the Point Loma Tunnel and Interceptor Sewer, which in turn conveys the flow to the Point Loma WWTP for treatment and ocean disposal.

Peñasquitos Pump Station. The Peñasquitos Pump Station (see Figure A-1) was constructed in 1999 and began operations in 2000. The pump station consists of:

- four 400 horsepower variable frequency drive pumps, with an additional slot for a fourth future pump.
- an odor control facility housed in a separate building, and
- a screening facility.

Ferrous chloride, sodium hydroxide and sodium hypochlorite are used for odor and sulfide control. The Peñasquitos Pump Station is designed to handle an average daily flow of 20 mgd and has a maximum capacity of 24 mgd.

Pump Station 65. Pump Station 65 (see Figure A-1) was constructed in 1998 and began operations in 1999. The pump station serves the northeast portion of the Metro System area (Sorrento Valley/Carmel Valley/Del Mar) and currently features two 150 horsepower and two 400 horsepower constant speed pumps with a maximum capacity of 17.2 mgd. The pump station also includes an odor control facility.

Pump Station 65 facilities are being upgraded in 2015 and will feature three 500 horsepower variable frequency drive pumps (two duty and one standby). Pump Station 65 also includes backup generators capable of powering the entire facility at peak flow. Ferrous chloride, sodium hydroxide and sodium hypochlorite are used for odor and sulfide control.

Pump Station 64. Pump Station 64 (see Figure A-1) serves the northernmost 87 square miles of the north region of the Metro Service area, including the cities of Poway and Del Mar. The pumping facility, constructed in 1970 and upgraded in 1988, consists of:

- eight sets of two pumps connected in series and housed in two separate buildings (the East and the West Stations),
- a separate screening structure housing two mechanically-cleaned bar screens and one manually-cleaned bar screen, and
- an odor control facility housed in a separate building and chemical addition (ferrous chloride, sodium hydroxide and sodium hypochlorite) for odor and sulfide control.

Capacities of individual pumps range from 3,400 gallons per minute (gpm) to 8,700 gpm, and motor horsepower ranges from 200 to 500. The total capacity of Pump Station 64 is 73 mgd. Pump Station 64 discharges to the City of San Diego's Rose Canyon Trunk Sewer. The pump station also includes backup generators capable of powering the facility at peak flow in the event of power outage.

Rose Canyon Trunk Sewer. The Rose Canyon Trunk Sewer (see Figure A-1) conveys wastewater approximately five miles from the northern portion of the City of San Diego to the North Metro Interceptor. The City recently completed work to parallel the original 72-inch-diameter Rose Canyon Trunk Sewer with a 24,000-foot-long interceptor that ranges from 48 inches to 60 inches in diameter. Wastewater from the Rose Canyon Trunk Sewer discharges to the Morena Boulevard and East Mission Bay Interceptors, which in turn discharge to the NMI.

In addition to conveying untreated wastewater, excess treated effluent from the North City WRP is discharged to the Rose Canyon Trunk Sewer for transport to the Point Loma WWTP for retreatment and ocean discharge.

North Metro Interceptor (NMI). The NMI (see Figure A-1) conveys wastewater flows from the north region and a portion of the central region of the Metro System service area to Pump Station 2. The NMI consists of two semi-parallel pipelines. The original 96-inch-diameter NMI (West NMI) is 2.4 miles in length and begins at the San Diego River channel on the east side of I-5 and traverses north-to-south along several local streets and across the site of the U.S. Marine Corps Recruit Depot until it reaches Pump Station 2.

The 2.8-mile-long semi-parallel NMI (East NMI) was constructed in 1996. The West NMI relief interceptor begins as a 108-inch sewer on the north side of the San Diego River, where it collects the flow from the new 78-inch North Mission Valley Interceptor. (See Figure A-1) The 108-inch NMI crosses the San Diego River and picks up flow from the 30-inch South Mission Valley

Interceptor. It then crosses under Interstate Highways 8 and 5, and traverses in a southerly direction approximately a half-mile east of the 96-inch West NMI. At Barnett Avenue, it turns to the west and reaches the alignment of the original 96-inch NMI, where it increases in size from 108 to 114 inches. The 114-inch East NMI then parallels the 96-inch West NMI in a southerly direction for approximately 1 mile to Pump Station 2.

East Mission Gorge Pump Station. The East Mission Gorge Pump Station was constructed in 1993 and began operations in 1994. The pump station features:

- four 500 horsepower constant speed pumps,
- an odor control facility housed in a separate building, and
- a screening facility.

Ferrous chloride and sodium hypochlorite are used for odor and sulfide control. The East Mission Gorge Pump Station has a maximum capacity of 34.6 mgd.

North Mission Valley Interceptor (NMVI). The NMVI (see Figure A-1) conveys wastewater flows from the central and eastern portion of the Metro System service area to the NMI for conveyance to Pump System No. 2 and the Point Loma WWTP. The NMVI extends the length of Mission Valley and consists of reinforced concrete pipe ranging from a diameter of 78 inches to 96 inches. The NMVI flows into the East NMI near the San Diego River and Interstate 5.

South Metro Interceptor (SMI). The SMI (see Figure A-1) conveys wastewater flows to Pump Station 2 from the southern region and portions of the central region of the Metro System service area. The upstream reach of the SMI extends from the City of Imperial Beach to Pump Station 1. This 7.6-mile SMI interceptor ranges from 42 to 96 inches in diameter. The downstream reach of the SMI runs between Pump Station 1 and Pump Station 2, and includes 1.6 miles of 72-inch force main, 1.0 mile of 78-inch sewer, 2.1 miles of 84-inch cross-town tunnel sewer, 0.3 miles of 102-inch sewer, and 1.7 miles of 108-inch sewer.

Pump Station 1. Pump Station 1 (see Figure A-1) was initially placed in operation in 1963 with three pumps, and a fourth unit was added in 1974. Two additional pumps were added in 1993. Pump Station 1 conveys flows from the SMI to Pump Station 2. Pump Station 1 is a conventional reinforced concrete structure equipped with:

- six vertical dry pit pumping units, each driven by a 600-horsepower electric motor,
- a screening facility consisting of two traveling screens, and
- an odor removal system consisting of an atomizer vessel.

Ferrous chloride, sodium hydroxide, and sodium hypochlorite are used for odor and sulfide control. With one unit as standby, the Pump Station 1 pumping capacity is approximately 160 million gallons per day (mgd).

Pump Station 2. Pump Station 2 (see Figure A-1) is the terminus of the NMI and SMI. Virtually all inflow to the Point Loma WWTP is conveyed via Pump Station 2. Pump Station 2 is a reinforced concrete structure equipped with:

- eight dry pit pumping units, each rated at 50,000 gpm (six pumps are driven by 2250-horsepower electric motors and the other two by 2,400-horsepower natural gas fueled engines),
- a screening facility consisting of four traveling screens, and
- an odor removal system consisting of an atomizer vessel and five carbon towers.

Hydrogen peroxide, sodium hydroxide and sodium hypochlorite are used for odor and sulfide control and to assist in coagulation/sedimentation at the Point Loma WWTP.

With one main pump serving as a standby unit, Pump Station 2 has a maximum pumping capacity of 432 mgd. Pump Station No. 2 discharges wastewater to the east portal of the Point Loma Tunnel through two 87-inch diameter force mains, respectively 2.9 and 2.7 miles long. One force main, installed in 1963, follows a land route while the second force main, installed in 1975, is routed underneath San Diego Bay. The 108-inch-diameter, 0.8-mile-long Point Loma Tunnel conveys wastewater under the Point Loma peninsula. The 114-inch-diameter, 1.5-mile-long Point Loma Interceptor Sewer begins at the tunnel's west portal and terminates at the Point Loma WWTP headworks.

Grove Avenue Pump Station. The Grove Avenue Pump Station (see Figure A-1) is located three miles north of the South Bay WRP and conveys wastewater from a portion of the southern region of the Metro System to the South Bay WRP. The pump station diverts wastewater from the San Ysidro Trunk Sewer and the Otay Valley Pump Station to the South Bay WRP via a 30-inch diameter force main. This station is capable of providing up to 15 mgd of wastewater to the South Bay WRP (18 mgd peak flow).

The pump station features a below-grade, trench-type, self-cleaning wet well. The pump room is a below-grade structure that houses the pumps, discharge piping and valves, and pump control valves. The motor room houses the pump motors with the pump motors connected to the pumps through extended shafting. The motor room and motor control rooms are situated at-grade and above the 100-year flood level to protect the electrical equipment and motors from damage and failure from flooding. The pump station includes:

- four 300 horsepower pumps (vertical, mixed-flow, non-clog, centrifugal with variable speed drives), and
- a bio-filter unit and two (2) carbon towers for odor control.

Otay River Pump Station. The Otay River Pumping Station (see Figure A-1) conveys wastewater from the Otay River portion of the Metro System service area to the Grove Avenue Pump Station via a conveyance system that includes:

- a 9,300 foot-long 24-inch force main and 3,400-foot-long gravity main to divert flows from the Otay and Chula Vista Trunk Sewers, and
- a 700-foot-long, 36-inch gravity line between Hollister Street and the Grove Avenue Pump Station.

Wet Well No. 1 of the Otay River Pump Station typically handles an average daily flow of 3.5 mgd, but provides a 15.7 mgd capacity. Wet Well No. 1 is served by three 200 horsepower chopper pumps. Wet Well No. 2 of the pump station handles an average daily flow of 2.3 mgd, and has a maximum capacity of 6.8 mgd. Wet Well No. 2 is served by two 40 horsepower chopper pumps. The City is in the process of incorporating ferrous chloride addition into the pump station for sulfide control.

A.3 POINT LOMA WASTEWATER TREATMENT PLANT

Overview. The Point Loma WWTP is a chemically-enhanced primary treatment plant. The plant's rated treatment capacities (with one sedimentation tank out of service) are 240 mgd average annual daily flow and 432 mgd peak wet weather flow. Figure A-3 (page A-10) presents the Point Loma WWTP layout. Figure A-4 (page A-11) presents a general process schematic for Point Loma WWTP treatment processes. Point Loma WWTP processes include:

- mechanical self-cleaning climber screens to remove rags, paper, and other floatable material from the raw wastewater,
- chemical addition to enhance settling and achieve at least 80 percent removal of suspended solids,
- aerated grit removal including grit tanks, separators and washers,
- sedimentation where flocculated solids (sludge) settle to the bottom of the sedimentation tanks and scum floats to the surface,
- sludge and scum removal facilities,
- effluent disinfection,
- final effluent screening, and
- anaerobic digestion of waste solids.

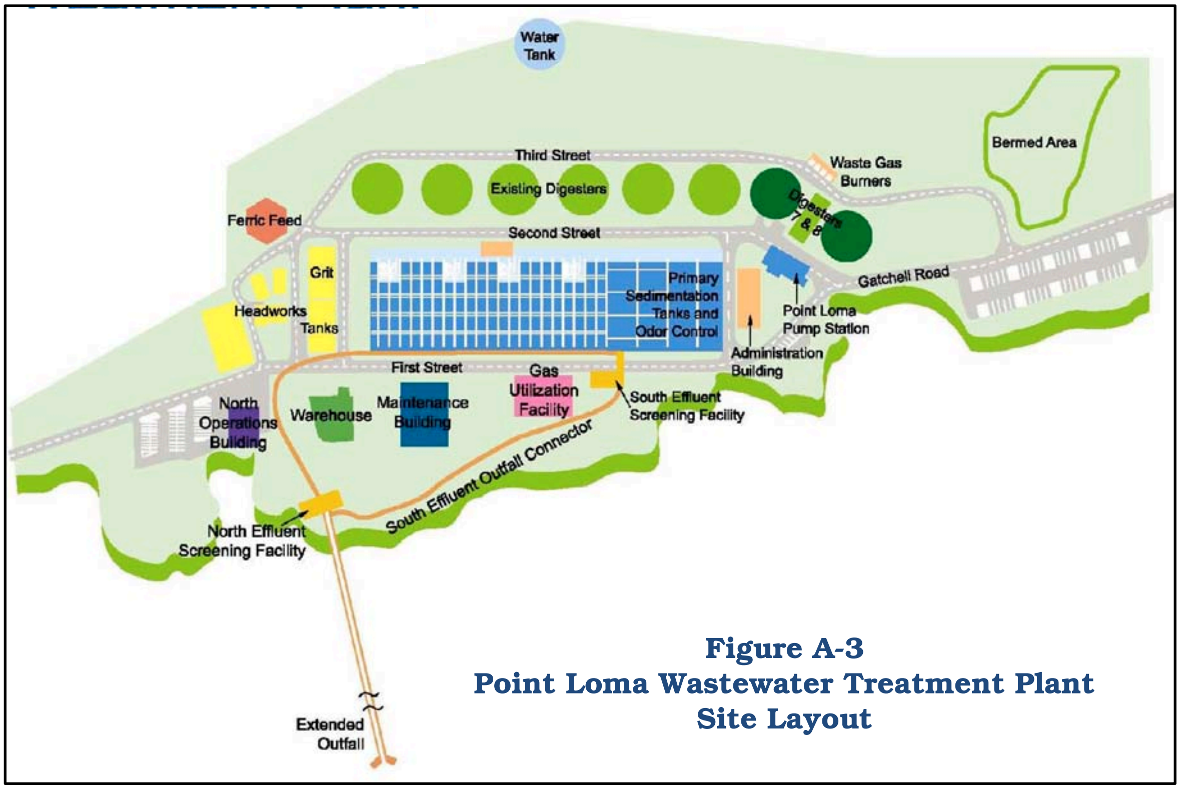


Figure A-3
Point Loma Wastewater Treatment Plant Site Layout

Table A-2 (page A-12) presents design criteria for Point Loma WWTP processes. Onsite solids treatment at the Point Loma WWTP consists of anaerobic sludge digestion. Digested sludge is transported via pipeline to the Metropolitan Biosolids Center (MBC) for dewatering and disposal. Screenings, grit, and scum are trucked to a landfill for disposal.

Plant Inflow. In addition to receiving raw wastewater from both the northern and southern portions of the Metro System service area, the Point Loma WWTP may also receive treated effluent from the North City WRP. Excess North City WRP secondary effluent is discharged to the Point Loma WWTP via the NMI for retreatment and disposal. Additionally, during times when North City WRP recycled water production exceeds demands, excess North City recycled water may also be conveyed to the Point Loma WWTP for treatment and disposal. The Point Loma WWTP also receives centrate from MBC and waste solids from the South Bay WRP.

Preliminary Treatment. Raw wastewater from Pump Station 2 flows into the Point Loma WWTP through five 15 mm mesh mechanically cleaned bar screens. Screened raw wastewater then enters a single basin from which it flows through six parallel Parshall flumes where plant influent flow is measured. Preliminary treatment is also performed at Pump Station 2 where the coarse bar screens are provided, along with chemical addition for sulfide control.

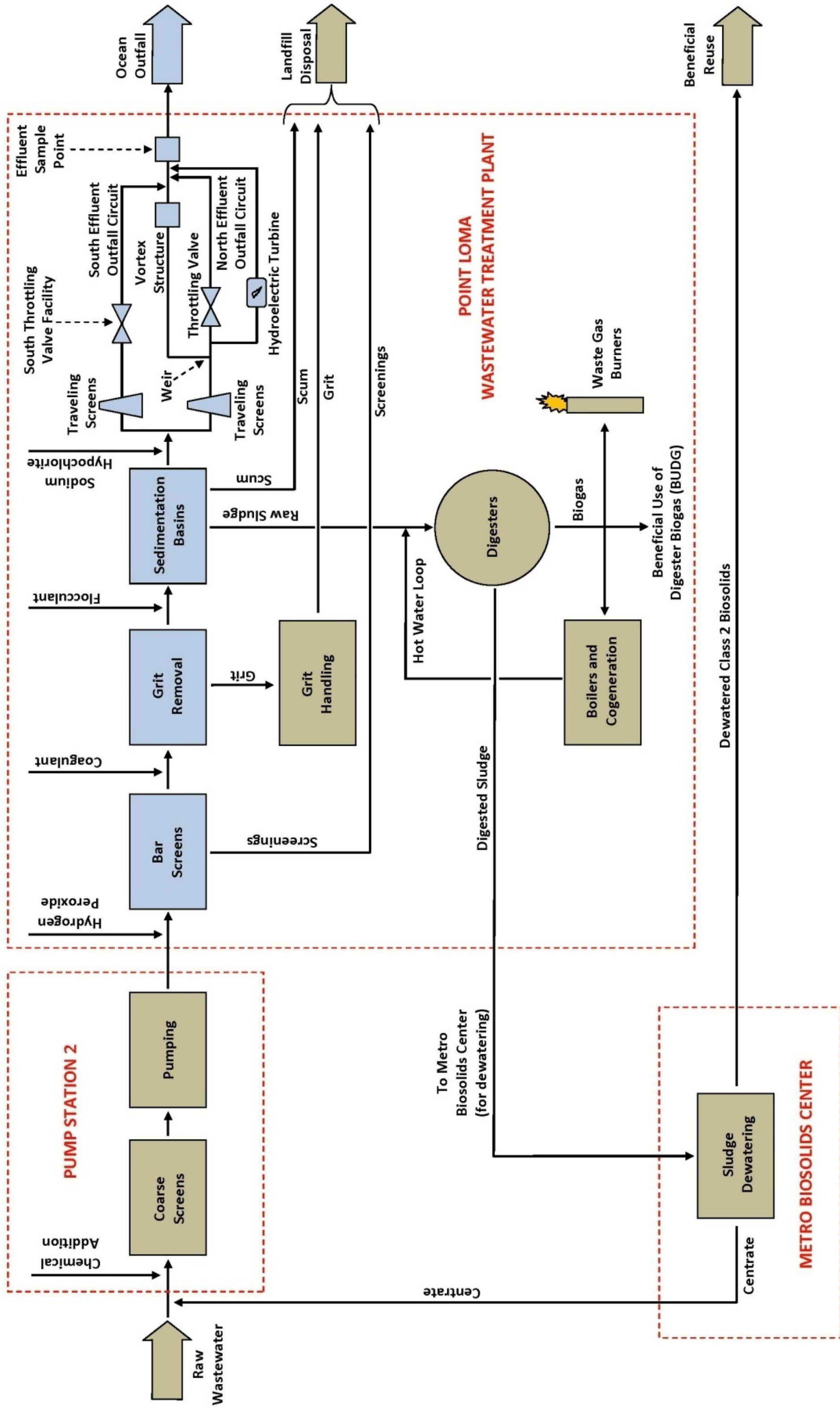


Figure A-4
Point Loma WWTP Treatment Process Schematic

Table A-2
Design Criteria and Loadings
Point Loma Wastewater Treatment Plant[1]

Process		Units	Value
INFLUENT FLOW [2]			
At Annual Average Daily Flow		mgd	240
At Peak Wet Weather Flow		mgd	432
PRELIMINARY TREATMENT			
At Pump Station 2:	Number of screens	--	4
	Channel Width	feet	9.5
	Clear Opening between Bars	millimeters	30
At Treatment Plant:	Number of screens	--	5
	Peak Capacity (each)	mgd	108
	Channel Width	feet	7
	Clear Opening between Bars	millimeters	15
GRIT REMOVAL			
Number of Tanks		-	6
Detention Time @ Peak Wet Weather Flow		minutes	2.8
Tanks C1 and C2[3]	Width	feet	20
	Length	feet	60
	Capacity, each	mgd	62
Tanks N1 and N2	Width	feet	24
	Length	feet	88
	Capacity, each	mgd	91
Tanks S1 and S2	Width	feet	22
	Length	feet	64
	Capacity, each	mgd	73
SEDIMENTATION			
Number of Tanks		-	12
Total Width		feet	60
Length		feet	224
Average Liquid Depth:	Tanks 1 through 6	feet	16.5
	Tanks 7 through 12	feet	16.5
Overflow Rate at AADF		gpd/square foot	1,530
Maximum Hydraulic Capacity, each tank		mgd	21.9
SLUDGE DIGESTION			
Number of Digesters		-	8
Diameter, Digesters 1-6 and 8		feet	125
Diameter, Digester 7		feet	110
Side Water Depth		feet	35
Volume, Digesters 1-6 and 8 (7 used as hold tank)		cubic feet	430,000
Average Detention Time (7 tanks)		days	23
Suspended Solids Loading per Million Gallons		lbs dry solids	2,300
Volatile Solids Loading (7 tanks)		lbs solids/ft/day	0.08
Biogas Production (7 tanks)		million cu. ft/day	3.0 - 3.3

1 From *Point Loma Wastewater Treatment Plant Master Plan* - August 1994. Updated in 2000.
2 The grit removal system is in the process of being upgraded as part of the City's Grit Improvements Project. Improvements are scheduled to be completed in 2015. See Appendix B for a list of improvements being addressed as part of this project.

Grit Removal. The Parshall flumes apportion flow between six aerated grit removal tanks. Settled grit is extracted from the tanks, separated, washed, and conveyed to a hopper for truck loading. The grit removal tanks are covered to contain odors. Foul air is drawn from under the covers and treated in single-stage scrubbers. The City (see Appendix B.1) is in the process of upgrading the Point Loma WWTP grit removal facilities. The Grit Improvement Project is scheduled to be completed in 2015.

Chemical Coagulation. Chemical coagulants are added to the screened raw wastewater to enhance settling of suspended solids. All process chemicals including effluent disinfection are flow-paced. Section A.9 summarizes chemical use, application points, typical dose rates, and purposes of chemical addition at the Point Loma WWTP. Ferric chloride mixing occurs in the Parshall flumes, and anionic polymer (for flocculation) is added in the individual flumes to the sedimentation tanks. Caustic soda, sodium hypochlorite, salt, and ferrous chloride are added (see Section A.9) to assist in odor control, while hydrogen peroxide is used to regenerate iron salts for coagulation

Sedimentation. The partially treated wastewater is discharged into a tunnel/distribution channel for diversion into the twelve sedimentation tanks. Anionic polymer is added at the cutthroat flumes to each bay of the sedimentation basins. Each sedimentation tank consists of three 20-foot wide bays provided with chain and flight sludge and scum collectors. Sludge is scraped along the bottom to a common hopper (at the tank influent end) provided with a cross collector. Scum is skimmed from the tank surface at the opposite end.

To control odors, each primary sedimentation tank is covered. Foul air from the sedimentation basins (as well as air from all other plant processes) is exhausted to an odor control system. The odor control system includes two-stage scrubbers that incorporate both caustic soda and sodium hypochlorite scrubbing. Scrubbed air is treated through activated carbon adsorption.

Effluent Disinfection. Receiving Water Limitation V.A.a of Order No. R9-2009-0001 (NPDES CA0107409) requires the Point Loma Ocean Outfall (PLOO) discharge to comply with recreational body-contact (REC-1) standards within state-regulated waters used for water contact sports. While the PLOO discharges beyond the three nautical mile state-regulated coastal zone, the City in 2008 implemented effluent disinfection of Point Loma WWTP effluent to ensure compliance with receiving water bacteriological standards. Point Loma WWTP effluent disinfection facilities consist of:

- an onsite sodium hypochlorite bulk storage facility,

- sodium hypochlorite feed pumps and controls to regulate sodium hypochlorite dose rates into the Point Loma WWTP effluent, and
- a conveyance and injection system (small diameter double wall pipe) that delivers sodium hypochlorite to the Point Loma WWTP effluent channel and distributes the disinfectant into the channel flow.

Sodium hypochlorite feed rates are regulated by the Distributed Control System to match effluent flows based on target dose. The disinfection operation is designed to reduce regulated pathogen indicator organisms (e.g. total coliform, fecal coliform, and enterococcus), while ensuring that the sodium hypochlorite dose rate is consumed by effluent chlorine demand at the NPDES sample point upstream from the outfall pipe. In this manner, the PLOO discharge maintains zero chlorine residual as the effluent enters the outfall. As documented within Parts 2 and 3 of Volume II, Point Loma WWTP effluent data collected by the City during 2010-2013 demonstrate that sodium hypochlorite dose rates do not lead to the formation of chlorination byproducts that exceed allowable *California Ocean Plan* receiving water concentrations. Additionally, toxicity analyses of the disinfected Point Loma WWTP effluent demonstrate that the PLOO discharge remains in compliance with applicable acute and chronic toxicity standards.

Final Effluent Screening. Treated effluent from the sedimentation tanks discharges to an effluent channel. Plant effluent in the effluent channel can be diverted to the North Effluent Outfall Circuit (NEOC) through four 30-mm Parkson traveling screens and then either through an 84-inch sleeve valve, to a hydroelectric turbine, or over a weir and into a vortex structure. Plant effluent can also be diverted to the South Effluent Outfall Circuit (SEOC) through four 30-mm Parkson traveling screens and then, based on flow and equipment configuration, a combination of three 54-inch sleeve valves and a 54-inch ball valve. (See Figure A-6 on page A-20.)

Onsite Solids Handling. Figure A-5 (page A-15) presents a schematic of Point Loma WWTP solids handling processes. Influent screenings are removed by bar screens and dumped onto a shaftless screw conveyor for transport to a screenings compactor. After the compaction process, the screenings are deposited into a storage bin via a discharge chute. After it is determined that the screenings bin is full, the material is analyzed for solids concentrations to meet the 20 percent solids disposal requirement. Once the disposal requirement is met, the screenings are picked up by truck and transported directly to a sanitary landfill for disposal.

Grit removed in the aerated grit tanks is currently pumped to cyclones where it separates from the wastewater. From the cyclones, grit is discharged to screw type classifiers for washing. The existing cyclone screw system is scheduled to be replaced in early 2015 by a new slurry-cup/snail type separation washing system.

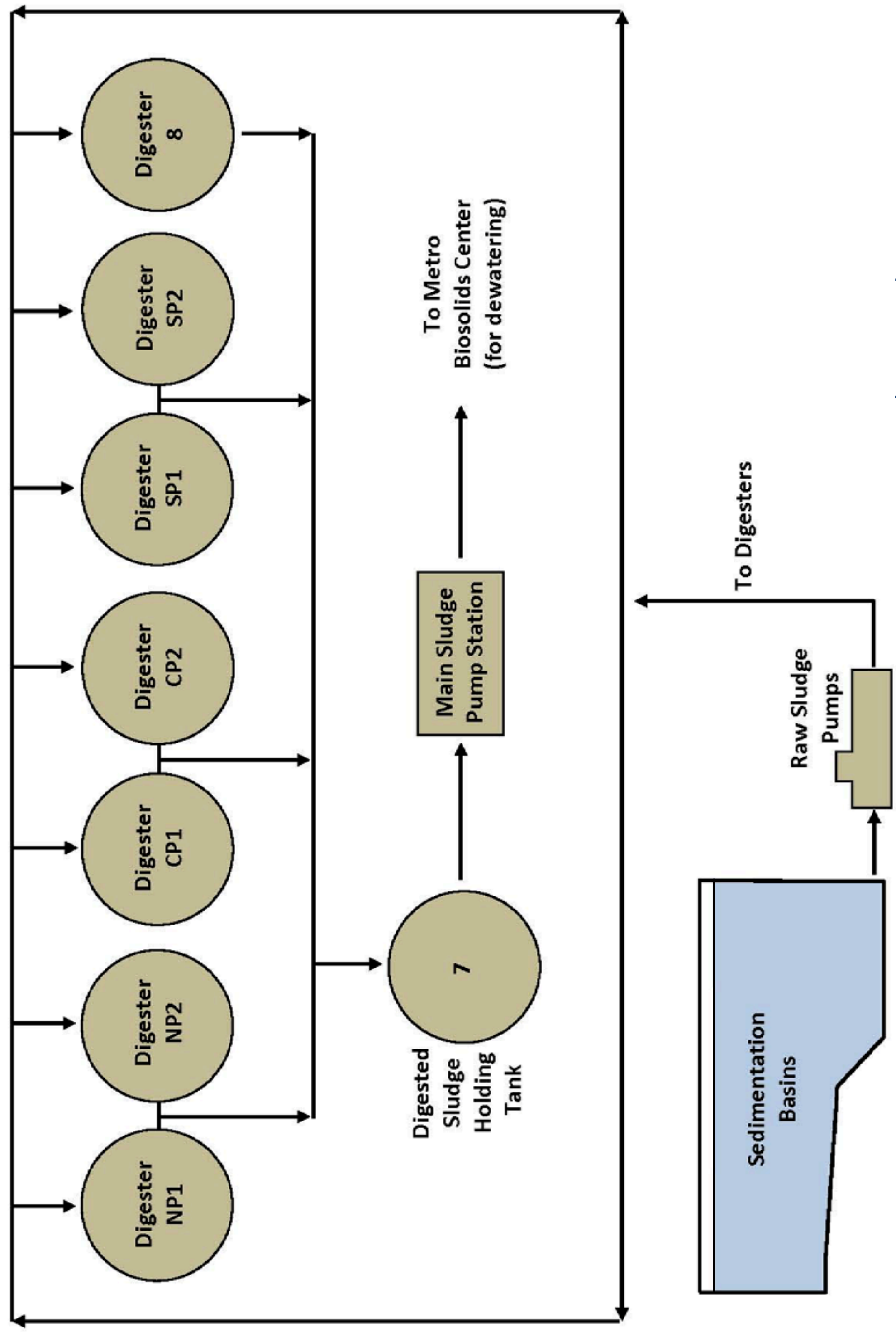


Figure A-5
Point Loma WWTP Sludge Digestion Schematic

Washed grit is deposited into a hopper from where it is loaded onto a bin and analyzed for solids concentration to meet a 40 percent solids concentration disposal requirement. Once the targeted 40 percent solids concentration is achieved, the material is picked up by a truck and transported directly to sanitary landfill for disposal.

Sludge Digestion. As shown in Figure A-5 (page A-15), raw sludge is pumped from the sedimentation tanks to up to seven anaerobic digesters: Digesters N1P, N2P, C1P, C2P, S1P, S2P, and 8. Digester 7 is used as a digested sludge holding tank. All the digesters are heated by hot water using external heating units. Mixing is performed by gas circulation, with the exception of Digester 7 which exclusively uses a pump mixing system.

Approximately 2.9 to 3.2 million cubic feet per day of biogas are produced during the digestion process. Of this total, approximately 1.8 million cubic feet is used as fuel for the plant's cogeneration facility, which consists of two engine/generator sets that together produce about 4,570 kilowatts of power, over one half of which is used on site in the operation of the treatment plant. Excess power is sold to Sempra Energy Solutions. The remaining digester gas generated at the plant is either used to fuel boilers for digester heating, flared off, or delivered to a private customer. The private customer further cleans the gas to conform with Sempra Energy standards and exports the gas through the onsite natural gas line.

Sludge Pumping and Screening. Digested sludge is pumped to MBC for processing and dewatering. The sludge pump station at the Point Loma WWTP features multiple levels. The lower level houses four large positive displacement diaphragm pumps, each rated at 750 gpm. The pumps convey the sludge via a 17.5-mile-long pipeline to the MBC for dewatering.

The top level of the sludge pump station contains five in-line sludge screens. The original and ultimate intent is to screen raw sludge, although they have also been used in the past to screen digested sludge prior to pumping. Each screen can process 450 gpm and has screen openings of 5 millimeters and 2 millimeters. Screenings are conveyed to loading hoppers in the building. The sludge screenings are analyzed to ensure a 20 percent solids content and transported to a sanitary landfill for disposal.

Staffing and Operations. Consistent with its size and pivotal role within the Metro System, the Point Loma WWTP is fully staffed 24 hours per day, 7 days a week. Point Loma WWTP staffing is summarized in Table A-3 (page A-17).

Table A-3
Point Loma WWTP Operations and Maintenance Staffing

Point Loma Operations Staff	Number of Staff
Operations	24
Maintenance	33
Engineering/GUF	16
Clerical	3

The Point Loma WWTP operations staff is supported by administration and support staff, including a power plant engineer and supporting personnel. The day shift (Monday through Friday) consists of the Plant Superintendent, the Senior Operations Supervisor, three shift supervisors, a Process Control Supervisor, and six operators. Support engineering staff, which are also assigned to assist with the South Bay WRP and all large pump stations, consists of a Senior Civil Engineer, four Associate Civil Engineers, two Electrical Engineers, one drafter, and clerical and support staff.

The Point Loma Energy Production group (1) operates and maintains the onsite generation facilities at the Point Loma WWTP and the North City WRP and (2) maintains engine driven pumps and generators throughout the Wastewater Treatment and Disposal Division. This group consists of a Senior Power Plant Supervisor, two Power Plant Supervisors, and four Power Plant Operators.

A Process Control Group, consisting of one supervisor and one operator, supports the day-shift staff. The Process Control Group performs non-routine functions such as developing operating procedures, developing and implementing testing programs, purchasing chemicals, monitoring and assessing process trends, and process trouble-shooting. Operating data is also collected by the Process Control Group. The night shift consists of one shift supervisor and two operators. The maintenance staff is divided into the following two crews:

- mechanical maintenance crew, and
- electrical and instrumentation maintenance crew.

Laboratory analysis for process control and regulatory compliance is performed both on-site by City personnel and off-site at certified laboratories run by the City of San Diego PUD's Environmental Monitoring and Technical Services Division.

Operator Training and Certification. Operator training is an ongoing activity at the Point Loma WWTP. All plant personnel receive training in plant safety procedures.

All Point Loma WWTP operators are required to hold a Certificate of Competence issued by the California Water Resources Control Board (Grades I through V). Certified operators must have a Grade II certificate. Entry level Operator In Training positions are utilized for "time in the field" experience to fulfill Grade 2 requirements. Table A-4 summarizes the current breakdown by grade among the plant's staff. Plant staffing requirements may change in the future, as the City is currently coordinating with the State to evaluate staffing and operator certification requirements.

Table A-4
Point Loma WWTP Operator Certification

Operator Grade	Number of Certified Staff[1]
Grade I or Operator in Training	5
Grade II	8
Grade III	7
Grade IV	0
Grade V	4

1 Certifications of current operating staff. The number of certified operators may vary over time with operator certification upgrades, changes in staffing assignments, and changes in personnel.

The Point Loma WWTP Operations and Maintenance (O&M) Manual includes start-up and shutdown instructions for the plant process units. These instructions are complemented by established procedures for operating plant function. Lock-out/tag-out procedures exist for each piece of electrically driven equipment. A number of the existing operating instructions have been converted into detailed Standard Operating Procedures (SOPs). The plant employs a computerized maintenance management system to schedule preventative and corrective maintenance tasks, which is monitored and controlled by Westinghouse Ovation Distribution Control Systems.

A.4 POINT LOMA OCEAN OUTFALL

Overview. Treated effluent from Point Loma WWTP is discharged to the Pacific Ocean though the Point Loma Ocean Outfall (PLOO). The PLOO discharges treated effluent at a depth of approximately 320 feet approximately 4.5 miles offshore. The PLOO consists of an original 11,226-foot-long outfall section that was constructed in 1963 and a 12,246-foot-long extension that was added in 1993. The total length of the outfall system is 23,472 feet.

Shore Facilities. Figure A-6 (page A-20) presents a schematic of how the PLOO is connected to the Point Loma WWTP. As illustrated in Figure A-6, the shore structures consist of the four parallel pathways:

- the 84-inch throttling valve and the NOEC,
- the hydroelectric turbine, and
- the SEOC, and
- the vortex.

The principal function of the shore structure is to safely dissipate excess head. The hydroelectric unit generates electricity, and is intended to operate in parallel with the 84-inch throttling valve. The SEOC provides an additional parallel path to the outfall and is intended to avoid problems of air entrainment that have affected the performance of the vortex structure. Peak flows will be routed through the SEOC circuit and low flow could be routed through the NOEC. For the foreseeable future, the SEOC will provide the main pathway to the ocean outfall, with the vortex working only as a stand pipe.

Original Outfall Section. The main barrel of the original PLOO consists of 11,226 feet of 9-foot-diameter, reinforced concrete pipe with a wall thickness of 10 inches. Figure A-7 (page A-21) presents the profile of the original and extended sections of the PLOO.

The offshore portion of the main barrel (original section of the outfall) starts at Station 2+08 at the connection to the 9-foot-diameter, concrete-encased, steel pipe leading from the Vortex Structure. Station 2+08 is approximately 20 feet downstream from the connection with the 7-foot-diameter conduit from the throttling valve and turbine. At Station 114+34, the main barrel of the original outfall ends at the connection to the diffuser wye structure. (Note: Each outfall station represents 100 feet of length. Station 114+34, for example, represents a distance of 11,434 feet from the beginning of the structure.)

The original outfall was constructed using bell and spigot pipe with double gaskets at each joint. The bell end of the pipe is of the raised type to provide additional strength at the joint. The original section of the outfall is not internally lined.

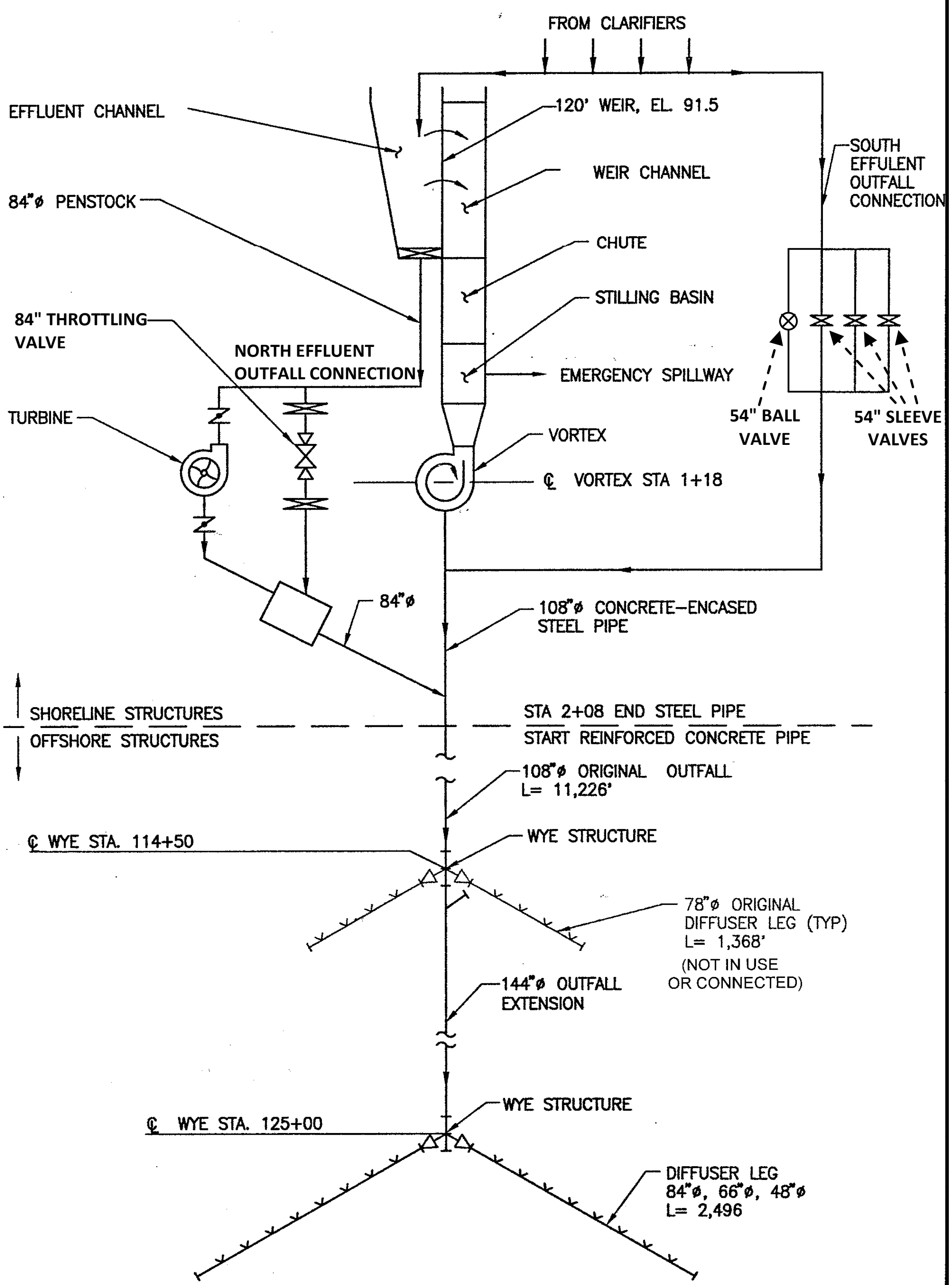


Figure A-6
Point Loma Ocean Outfall Schematic

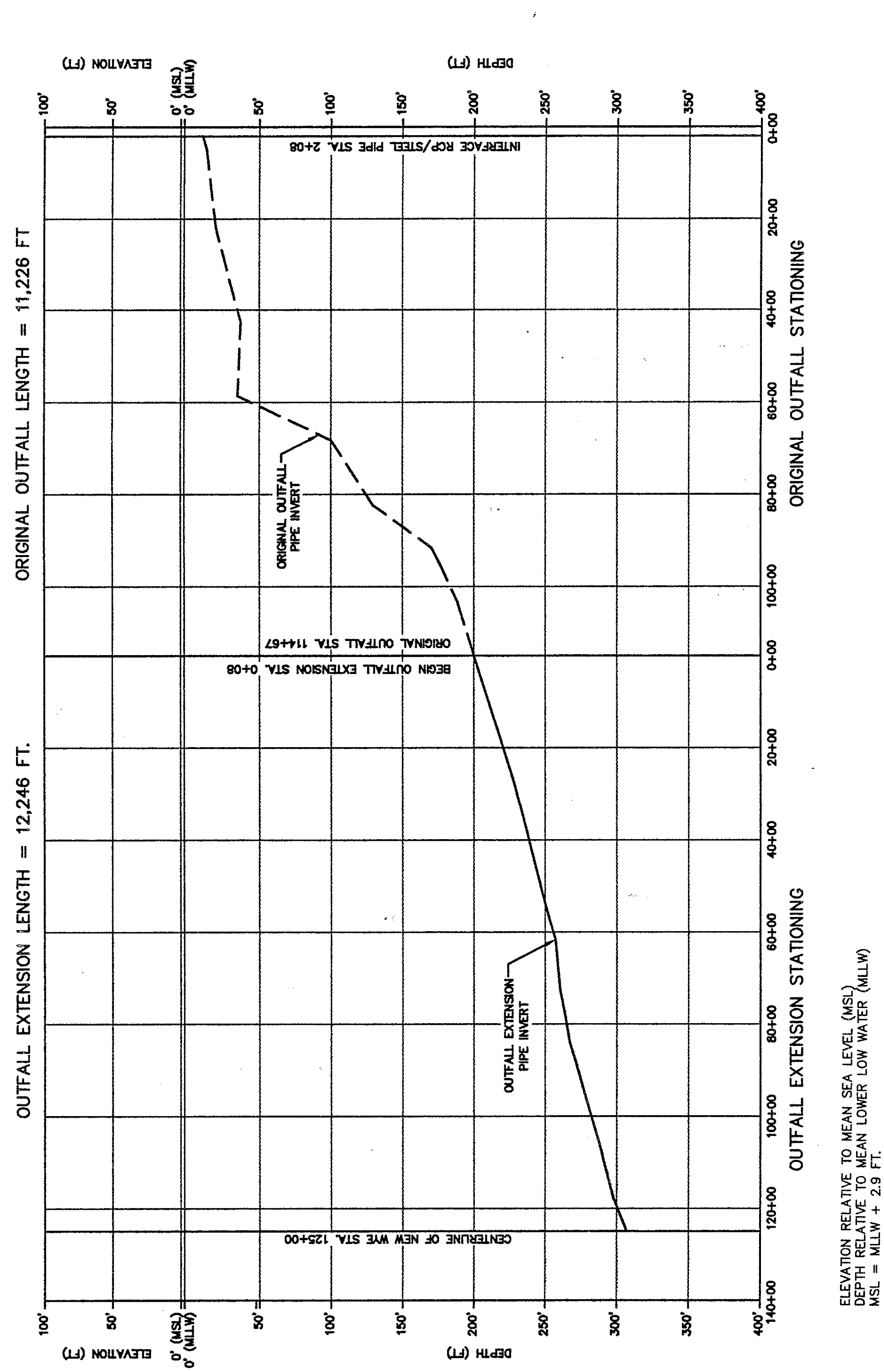


Figure A-7
Point Loma Ocean Outfall Profile

Figure A-8 (page A-23) presents typical details for joints within the outfall. Joints within the original section of the outfall include a Monel tube (see upper diagram of Figure A-8) that connects the outside of the spigot to the space between the two gasket grooves. This arrangement was used at the time of construction to facilitate hydrostatic testing of the joint for leakage. The test tube is connected to a coupling imbedded in the wall of the pipe. After testing, the coupling was sealed with a threaded plug.

Three typical sections were used in the construction of the original main barrel. Between Station 2+08 and Station 26+50, the main barrel was constructed in a trench with the entire pipe below seabed. The pipe was placed in the trench with a minimum bedding thickness up to the spring line of one foot. Above the spring line, the trench was backfilled with concrete and a minimum concrete thickness of two feet was maintained over the top of the pipe.

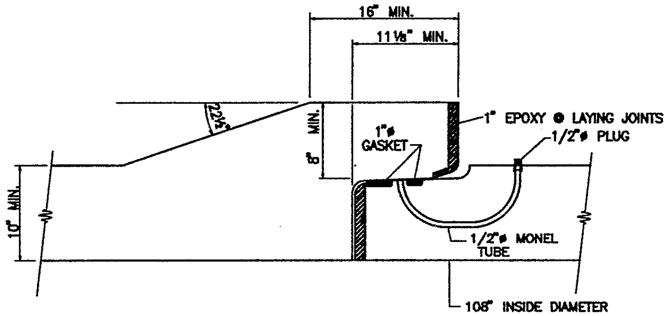
Between Station 26+50 and Station 30+40, a transition zone occurs where the pipe emerges from the rock trench and is laid on the ocean floor. The spring line of the main barrel was constructed roughly at the seabed. Between Station 30+40 and Station 114+34, the main barrel was placed on bedding with a minimum clearance of 1 foot from the seabed to the bottom of the pipe.

The bedding ballast extends up to the spring line. Side slopes for the bedding ballast were set at 1.5:1 (horizontal to vertical). In the months immediately following construction of the original outfall, additional rip rap consisting of one ton boulders was placed on top of the existing ballast rock from Station 26+50 to Station 62+50.

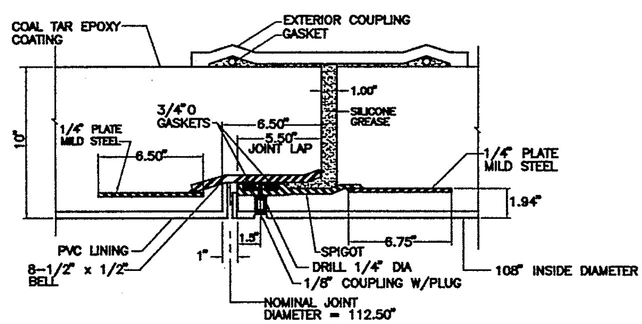
Wye Structure and Original Diffuser. The original diffusers and wye structure incorporate provisions for isolation and flushing. Slots were provided for the insertion of reinforced concrete bulkheads (gates) at the following locations: (1) at the inlet to each diffuser leg at the wye structure, and (2) on the main barrel of the wye structure, immediately downstream of the diffuser leg connections.

At the end-structure of each diffuser leg, a bolted bulkhead was provided. Flow into the original diffusers is presently blocked by bulkheads which were inserted at the time of inauguration of the outfall extension.

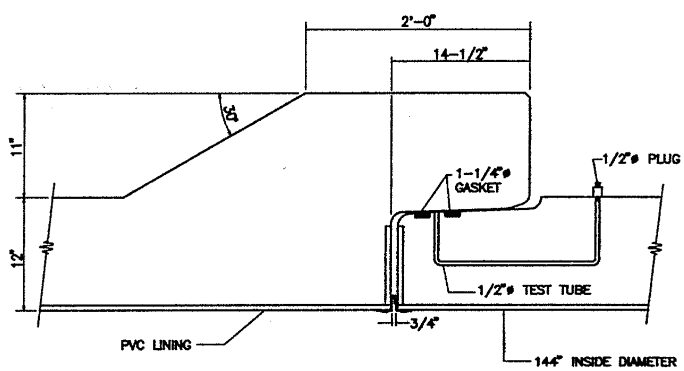
The original PLOO diffuser is no longer in service. The diffuser ports remain open, but outfall flow to the diffuser legs is blocked.



Joint Detail for Original Point Loma Outfall
Not to scale



Joint Detail for Repaired Section
Not to scale



Joint Detail for Outfall Extension
Not to scale

Figure A-8
Point Loma Ocean Outfall Joint Details

Repairs of 1992. On February 2, 1992, a major failure of the original PLOO main barrel occurred between Station 33+28 and Station 37+61. Repair work was designed and completed within 60 days of the failure and involved:

- replacing 433 feet of the main barrel using 9-foot-diameter reinforced concrete pipe with a 360 degree-PVC lining,
- installing bedding, intermediate rock, and armor rock for the 433 foot-long section,
- providing cover that included 1.5 ton (median) armor rock with a minimum thickness of 4.5 feet above the top of the pipe from Station 27+90 to Station 60+00,
- providing armor rock flush with the top of the pipe from Station 60+00 to Station 67+15, and
- installing a manhole and air relief valve assembly at Station 3+52.50.

Details of the typical pipe joint used for the repair work are shown on Figure A-8 (page A-23). The joint is formed by steel rings on the pipe bell and spigot. Pipe is of the double gasket, flush bell type. Each pipe joint has a 1/4 inch-diameter tube between the interior of the pipe at the spigot and the space between the two gasket grooves. This arrangement was used at the time of construction for hydrostatic testing of the joints for leakage.

A 3/4-inch thick, 18-inch wide external steel split sleeve surrounds each joint and incorporates two ring gaskets to provide a tight seal. Silicone grease was injected into the annular space between the sleeve and the outside wall of the pipe through 1-inch-diameter fittings on the coupling.

A special closure piece was fabricated for completion of repair work. The closure piece incorporated a 25-foot-long, internal steel cylinder which provided support for two 13.625-foot-long, reinforced concrete, telescoping pipe sections. Double gaskets on each of the telescoping pipe sections provide a seal between the internal steel cylinder and the pipe. A reinforced, tremie concrete collar joins the telescoping pipe sections. The integrity of joints on each of the two telescoping pipe sections was tested by means of 1/2-inch-diameter, PVC test tubes between the exterior of the closure piece and the middle of the gasket grooves.

PLOO Extension. The PLOO was extended in 1993 to discharge wastewater approximately 4.5 miles offshore (beyond the three nautical mile limit of State-regulated ocean waters). The profile of the outfall extension is presented in Figure A-7 (page A-21). The outfall extension was designed to achieve a 75-year service life.

The main barrel of the PLOO extension is connected to the original wye structure immediately downstream from the original diffuser legs. A slot for a reinforced concrete bulkhead is located in the original wye structure between the diffuser legs and the connection for the outfall extension. The bulkhead has been removed to allow flow to pass through the outfall extension, and a lid has been secured to the top of the slot.

Between the start of the outfall extension at Station 0+08 and Station 1+97, the diameter of the reinforced concrete pipe conduit is 108 inches and the wall thickness is 10 inches. Pipe in this section of the outfall extension is of the extended bell type. A typical joint detail for the outfall extension is presented in the lower diagram of Figure A-8 (page A-23).

The main barrel of the outfall extension has double-gasket bell and spigot joints. As illustrated on Figure A-8, the joint has a tube between the outside of the spigot and the space between the two gasket grooves. This arrangement was used at the time of construction to test each joint for leakage. A special self closing male fitting was provided at the test port on each pipe spigot for use in pressure testing of the pipe joint. The integrity of each joint may be retested in the future with the use of the special male fitting and mating test equipment.

The top 90 degrees of the inside circumference of the main barrel, centered on the crown of the pipe, is provided with a polyvinyl chloride (PVC) liner that is permanently imbedded in the concrete with integral locking extensions. Vertical surfaces at pipe joints are lined with PVC that is bonded to the pipe with a (T Lock) specialized adhesive.

A maintenance access hatch is provided in the outfall extension at Station 0+20 on the 9-foot section of the outfall extension. The cover of the 42-inch opening is made of cast hi-resist alloy that has a low rise (almost flush with the exterior of the pipe). A two-inch threaded opening, presently plugged, will allow piezometric testing of the outfall at future times. The main barrel was laid on a leveled course of bedding material. Following placement of the main barrel, bedding was completed and then ballast rock was placed up to the spring line.

Intermediate Wye. A special transition pipe is provided at Station 1+97 which increases the outfall extension diameter from 108 to 144 inches. The intermediate wye structure starts at the downstream end of the transition pipe (Station 2+21). The purpose of the intermediate wye structure is to allow for the future connection of a 12-foot-diameter outfall that will parallel and replace the original outfall. The wye branch is oriented at 45 degrees to the main barrel and intersects the main barrel at Station 2+50. A reinforced concrete bulkhead is currently set in a special slot on the wye and will be removed upon connection of the parallel outfall conduit. Two Monel lifting hooks are provided for retrieval of the bulkhead.

Constructed of a combination of 3/4-inch steel plate and 2-inch reinforced concrete liner, the intermediate wye is set within a 19-foot high, 48-foot diameter, circular steel plate crib. The space between the wye and the steel ring is backfilled with rock to provide thrust restraint.

Cathodic protection for the steel plate ring at the intermediate wye is provided by a total of 14 active and 14 passive sacrificial anodes arranged in two rows around the periphery of the ring. All anodes are aluminum alloy ingots that contain 3 percent zinc by weight and are joined to the steel plate ring by bonding cables. Each ingot weighs approximately 90 pounds. The passive anodes are completely encapsulated in a wax-tape coating to reduce or eliminate current output.

The anodes on the intermediate wye will be consumed (sacrificed) for the protection of the structure as current is discharged from them into the surrounding soil or seawater. It is estimated the active sacrificial anodes will be consumed in about 50 years. At that time or earlier, it will be necessary to remove the wax-tape coating from the passive anode surfaces using a brush. Upon activation, the life of the passive anodes should exceed the service life of the original outfall. Because it is difficult to estimate the rate of consumption of an anode, the condition of the anodes are monitored to determine when activation of the passive anodes is required.

Between the downstream end of the intermediate wye at Station 2+79 and the upstream end of the diffuser wye structure at Station 127+74, the diameter of the conduit is 144 inches and the wall thickness is 12 inches. Pipe joints, lining, bedding, ballast, and exterior marking are identical to those described for the 9-foot-diameter portion of the outfall extension.

Maintenance access hatches (identical to the one located in the area between the original and intermediate wye) are provided at an interval of roughly 1,000 feet on the 12-foot diameter portion of the main barrel. Twelve access hatches are provided between the intermediate wye and the diffuser wye structures.

Outfall Diffuser Wye. The diffusers branch from the main outfall at the diffuser wye structure (Station 125+00) at a bottom depth of approximately 310 feet below mean low low water (MLLW). The diffuser wye, similar to the intermediate wye, is also constructed of combined fabricated steel plate and reinforced concrete liner, and is set within a 19-foot high, 42-foot- diameter, circular steel plate crib. The space between the wye and the steel ring is backfilled with gravel and provides thrust restraint.

Cathodic protection for the steel plate ring at the intermediate wye is provided by a total of 12 active and 12 passive sacrificial anodes arranged in two rows around the periphery of the ring.

All anodes are aluminum alloy ingots that contain 3 percent zinc by weight and are joined to the steel plate ring by bonding cables. Each ingot weighs approximately 90 pounds. The passive anodes are completely encapsulated in a wax-tape coating to reduce or eliminate current output.

The anodes on the diffuser wye will be consumed (sacrificed) for the protection of the structure as current is discharged from them into the surrounding soil or seawater. As per the intermediate wye, the estimated anode life for the diffuser wye is also estimated to be over 50 years. At the time of depletion of the active anodes, it will be necessary to remove the wax-tape coating from the passive anode surfaces using a brush. Upon activation, the life of the passive anodes for the diffuser wye is estimated to be over 50 years.

Slots for three reinforced concrete bulkheads (gates) are provided at the diffuser wye structure inside the steel plate crib. Two of the bulkheads can be used to shut off flow to the two diffuser legs and can be used during outfall maintenance.

As part of routine maintenance, a bulkhead would be inserted at one diffuser leg to enable flow to be routed to the other leg. Isolation of each leg allows for cleaning, inspection, or repair of the blocked diffuser leg with a minimum interruption of flow. Under normal operation, the diffuser slide gates are not in place and the gate slot is covered by a reinforced concrete lid.

A third slot is provided on the 12-foot diameter main barrel, immediately downstream from the diffuser branches. This slot, which normally has the bulkhead in place, allows full diameter access to the main barrel of the outfall and could be used for mainline cleaning or for a future outfall extension.

The reinforced concrete lids are rectangular in shape and are secured in place by ten 1.25-inch-diameter Monel bolts and rest on collars that are integrally cast into the diffuser wye. A 1.5-inch thick, 3-inch wide gasket is in a rectangular pattern on the collar to ensure a watertight seal. Two lifting hooks are provided on each lid.

A 2-inch-diameter port is located in the crown of the pipe at Station 124+71, immediately upstream of the wye. The purpose of the port is to prevent the accumulation of air, oil, grease, and floatable materials that could otherwise impair the function of the diffusers. A maintenance access hatch is provided in the diffuser wye structure at Station 124+89.50.

Outfall Diffuser Legs. The two diffuser legs for the outfall extension are built on the seabed at a depth between 306 and 313 feet below MLLW. The diffuser legs are oriented N 17° 13' W, and S 11° 16' W, with an internal angle of roughly 151.5 degrees. Each diffuser leg is 2,496 feet long and consists of 7-foot, 5.5-foot, and 4-foot internal diameter pipe. Pipe lengths, port spacings, and numbers of ports on each diffuser leg are summarized in Table A-5. Diffuser ports are set in the middle of each pipe on opposite sides, 6 inches above the springline of the pipe.

Table A-5
Extended Point Loma Outfall Diffuser Configuration[1]

Section Length Per Leg (feet)	Internal Diameter (feet)	Pipe Thickness (inches)	Port Spacing[2] (feet)	Port Diameter (in.)	Number of Ports per Leg	Approx. Range of Depth[3] MLLW (feet)	Port Design Flow Rate (mgd) (maximum)
1008	7.0	9	24	3.75	84	306-309	1.09
840	5.5	9	24	4.25	70	309-311	1.15
648	4.0	9	24	4.75	54	311-313	1.13

1 Data from Engineering Science (1991) and City of San Diego (1995).
2 Port spacing shown is for ports on the same side of diffuser leg. Ports are located on both sides on the diffuser leg.
2 Distance from the centerline of the ports to the ocean surface.

The diffusers, excluding the final 160-foot-long section of the 4-foot-diameter diffuser, are constructed of PVC-lined, reinforced concrete pipe similar to the pipe used for construction of the main barrel. Unlike the main barrel of the outfall extension, all pipe joints on the diffuser have a single gasket.

The final 160-foot section of each diffuser leg is constructed of a single piece of steel pipe which serves as a restraining block. Steel plate used in fabrication of the pipe has a thickness of 5/8 inches and is lined internally with 5 inches of reinforced concrete. Externally, the steel is coated with a 180 mil thick layer of Carboline.

Cathodic protection for the steel diffuser section is provided by two active and two passive sacrificial anode bands arranged on the top of the pipe. All anodes are aluminum alloy ingots that contain 3 percent zinc by weight and are joined to the steel plate ring by welded straps. Each ingot weighs approximately 45 pounds. The passive anodes are completely encapsulated in a 30-mil thick PVC shield to reduce or eliminate current output. The PVC shield on the passive anodes will be removed at a future date to replace depleted active anodes. The estimated life of the active anodes is in excess of 50 years.

The internal lining and bedding of the diffusers are identical to main barrel of the outfall extension. Bedding for the diffusers is similar to that for the main barrel, however, the ballast is depressed at the ports to avoid blockage of the flow. Likewise, the stripe painted along the springline of the diffuser to indicate the height of the ballast rock, is depressed in a "V" shape at the ports. A line is also painted along the circumference of the diffuser from the top of the pipe to each individual diffuser port.

Design Flows. Table A-6 presents design flows for the PLOO. The average dry weather capacity of the outfall of 240 mgd (10.51 m^3/second) matches the rated average annual capacity of the Point Loma WWTP.

Table A-6
Point Loma Ocean Outfall Design Flows[1]

Flow Condition	Flow Rate	
	(m^3/sec)	(mgd)
Minimum flow	3.15	72
Average dry weather flow	10.51	240
Peak wet weather flow	18.92	432

1 Outfall design data from Engineering Science (1991).

The outfall extension was designed based on a maximum allowable hydraulic gradeline (HGL) elevation of 81.5 feet above mean sea level (MSL) at the interconnection between the steel and concrete sections of the original outfall (Station 2+08). Station 2+08 is located roughly 60 feet downstream from the South Effluent Outfall Connection.

Outfall Hydraulics. The hydraulic grade line at the shore structure of the PLOO varies with the tide level and the headlosses through the outfall. Headlosses in the main outfall barrel and diffuser legs are a function of the flow rate through the system. Table A-7 (page A-30) presents projected maximum hydraulic gradelines for the outfall. Table A-8 (page A-30) presents projected minimum hydraulic gradeline elevations. Figure A-9 (page A-31) graphically depicts the range of outfall hydraulic gradeline at the shore facilities.

Table A-7
Point Loma Ocean Outfall Total Head Requirement[1]
Maximum Hydraulic Gradeline

Flow (mgd)	Tide Level (feet MSL)	Headlosses					Maximum Hydraulic Gradeline (feet MSL)
		Original Outfall (feet)	Outfall Extension (feet)	Diffusers (feet)	Density Head (feet)	Minor Losses (feet)	
72	5.3	1.1	0.3	0.2	8.7	0.00	15.6
100	5.3	2.2	0.5	0.4	8.7	0.1	17.1
150	5.3	4.8	1.2	0.9	8.7	0.1	21.1
200	5.3	8.6	2.1	1.6	8.7	0.3	26.6
250	5.3	13.4	3.3	2.5	8.7	0.4	33.6
300	5.3	19.4	4.7	3.7	8.7	0.6	42.3
350	5.3	26.3	6.4	5.0	8.7	0.8	52.5
400	5.3	34.4	8.3	6.5	8.7	1.0	64.3
432	5.3	40.1	9.7	7.6	8.7	1.2	72.7

1 Outfall performance data from *Point Loma Outfall Extension Report* (Engineering Science, 1991).

Table A-8
Point Loma Ocean Outfall Total Head Requirement[1]
Minimum Hydraulic Gradeline

Flow (mgd)	Tide Level (feet MSL)	Headlosses					Maximum Hydraulic Gradeline (feet MSL)
		Original Outfall (feet)	Outfall Extension (feet)	Diffusers (feet)	Density Head (feet)	Minor Losses (feet)	
72	-5.1	1.0	0.2	0.2	7.9	0.00	4.3
100	-5.1	2.0	0.4	0.4	7.9	0.1	5.6
150	-5.1	4.4	0.8	0.9	7.9	0.1	9.1
200	-5.1	7.9	1.4	1.6	7.9	0.3	14.0
250	-5.1	12.4	2.2	2.5	7.9	0.4	20.3
300	-5.1	17.8	3.2	3.7	7.9	0.6	28.0
350	-5.1	24.2	4.3	5.0	7.9	0.8	37.1
400	-5.1	31.6	5.6	6.5	7.9	1.0	47.6
432	-5.1	36.9	6.6	7.6	7.9	1.2	55.1

1 Outfall performance data from *Point Loma Outfall Extension Report* (Engineering Science, 1991).

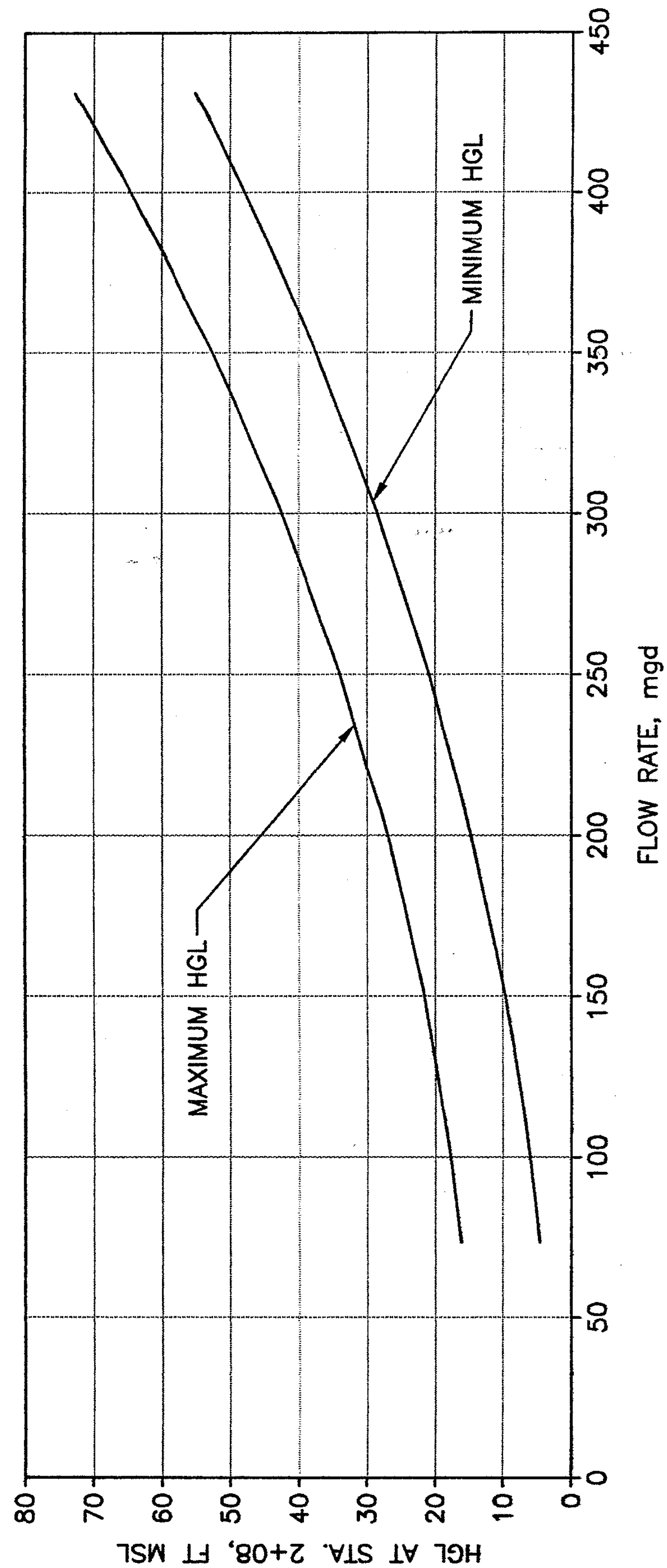


Figure A-9
Estimated Hydraulic Gradeline Elevation
At Shore Facilities

The outfall extension was designed on the basis of a 432 mgd (18.93 m^3/second) peak flow concurrent with a 50-year high tide of 8.2 feet above MLLW (5.3 feet above MSL). The minimum tide level is estimated to be 2.2 feet below MLLW (5.1 feet below MSL). The elevation of the ocean surface varies with the tide stage. For effluent to be discharged through the diffuser ports, the head in the diffuser must overcome the existing tide level. In addition, the head associated with the density difference between seawater and the plant effluent must be overcome.

This latter term, called the "density head", is equivalent to the product of the height of the water column above the diffuser ports and the difference between the specific gravity of seawater (1.026) and the plant effluent (0.9967). The outfall extension diffusers have been designed to avoid seawater intrusion into the diffuser ports at the minimum design flow of 72 mgd (3.15 m^3/second). Seawater intrusion is a problem that occurs in some outfalls during periods of low flow when there are excessive differences in depth over the length of a diffuser. When the head available at the deeper diffuser ports is less than the differential density head between the beginning and end of the diffuser, seawater is able to enter the lower reaches of the diffuser. Sediments carried by the seawater can settle in the diffuser and may not be resuspended when the flow is increased.

Headlosses in the Main Outfall Barrel. Headlosses in the main outfall barrel were estimated using Manning's equation on the basis of the results of hydraulic testing conducted in 1989 and 1990, as reported by Engineering Science in the 1991 *Point Loma Outfall Extension Report*. Table A-9 presents assigned Manning's equation coefficients. Headlosses were computed assuming no air in the system.

Table A-9
Point Loma Ocean Outfall Headlosses in the Main Barrel

Condition	Main Barrel Section	Manning's "n"
Maximum headloss:	Original outfall Outfall extension	0.0146 0.0146
Minimum headloss:	Original outfall Outfall extension	0.0140 0.0120

A.5. NORTH CITY WATER RECLAMATION PLANT

Overview. The North City Water Reclamation Plant (North City WRP) is an advanced wastewater treatment facility capable of producing recycled water that complies with requirements of Title 22, Division 4 of the *California Code of Regulations* for unrestricted body contact. Figure A-10 (page A-34) presents the layout of the North City WRP. The North City WRP provides a capacity to treat 30 mgd (average flow) and can produce up to 27 mgd of recycled water. Figure A-11 (page A-35) presents a schematic of the North City WRP. The main liquid treatment train consists of:

- influent pumping,
- screening,
- aerated grit removal,
- primary sedimentation with sludge and scum removal,
- sideline flow equalization,
- anoxic-aerobic activated sludge consisting of anoxic mixing with mixed liquor recycle and fine bubble aeration,
- secondary clarification with scum removal,
- mixed liquor and excess sludge wasting,
- chemical addition for coagulation,
- flocculation,
- tertiary filtration through anthracite coal media,
- electrodialysis reversal,
- advanced water purification demonstration facilities, and
- effluent chlorination.

Table A-10 (page A-36) presents North City WRP design criteria for each unit treatment process. Tertiary treated recycled water produced at the North City WRP is discharged to a regional conveyance system for transport to qualified recycled water users. Excess secondary treated effluent is discharged to the Rose Canyon Trunk Sewer for conveyance to the NMI and Point Loma WWTP. Sludge from the North City WRP is pumped to the Metro Biosolids Center for processing.

Plant Inflows. Most wastewater processed at the North City WRP is diverted from the 72-inch-diameter Rose Canyon Trunk Sewer. This sewer receives the discharge from Pump Station 64. Diverted wastewater is conveyed through an 84-inch gravity pipeline to the North City WRP Influent Pump Station. Flows discharged from Pump Station 64 in excess of North City WRP influent feed rates continue down the Rose Canyon Trunk Sewer to the NMI and the Point Loma WWTP.

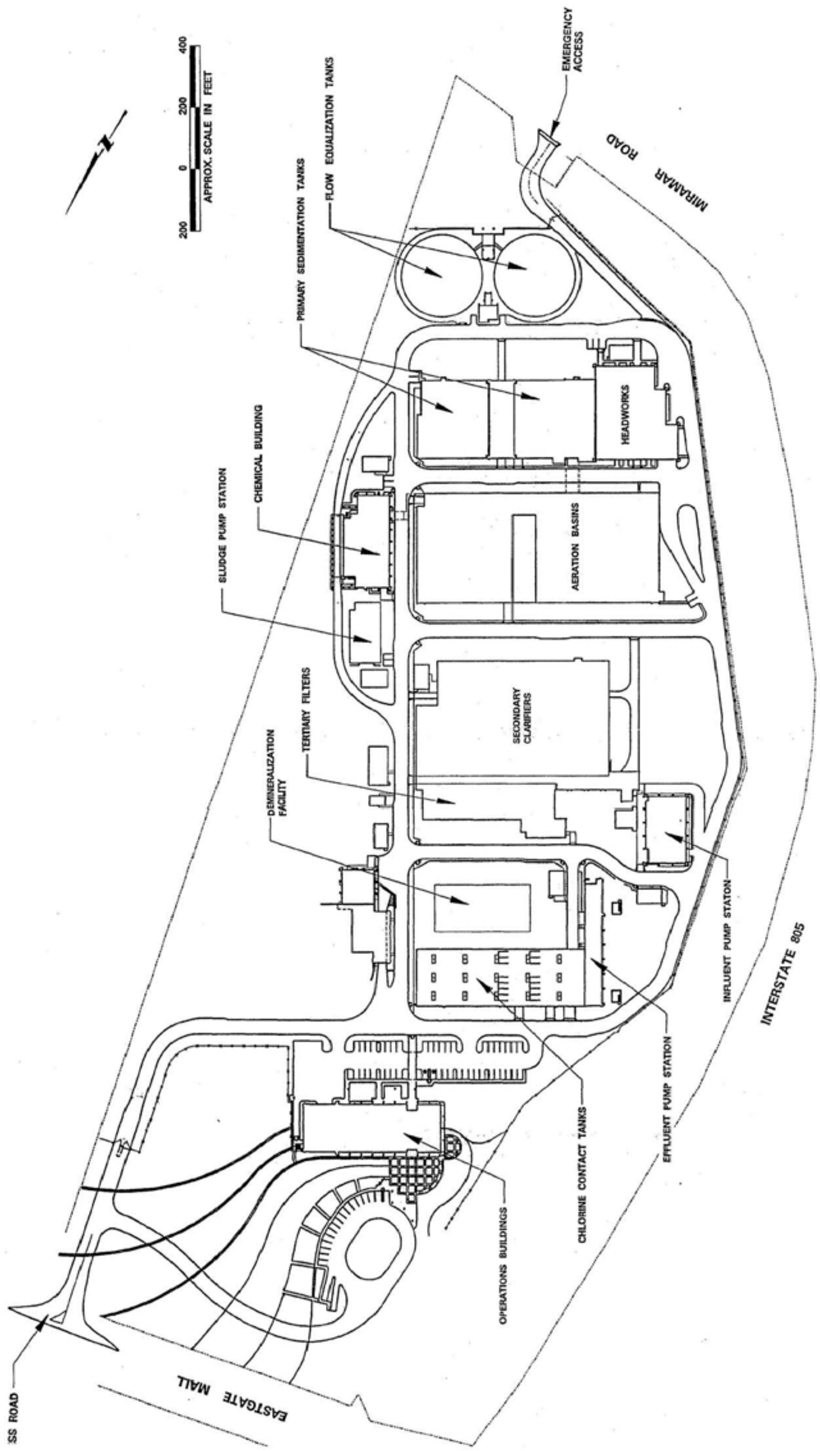


Figure A-10
North City Water Reclamation Plant Site Layout

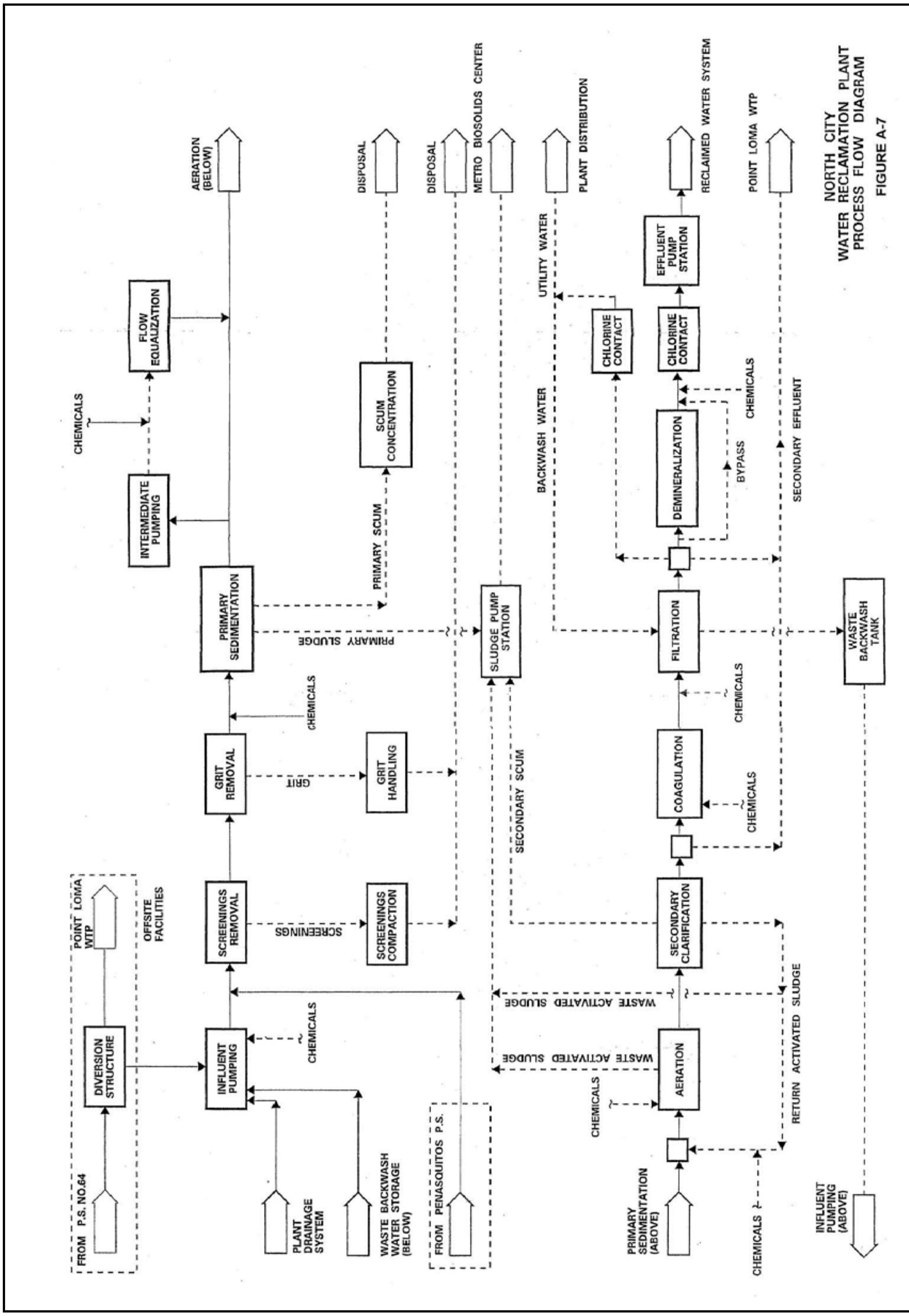


Figure A-11
North City Water Reclamation Plant Process Schematic

Table A-10
Design Criteria and Loadings
North City Water Reclamation Plant

Process	Units	Average	Peak
PLANT INFLUENT			
Influent Flow	mgd	30	60
Total Suspended Solids (TSS) Concentration	mg/l	250	--
TSS Loading	lbs/day	62,600	--
Biochemical Oxygen Demand (BOD) Concentration	mg/l	250	--
BOD Loading	lbs/day	62,600	--
INFLUENT PUMP STATION (with In-Plant Return Flow)			
Influent Flow	mgd	33.82	60
Total Suspended Solids (TSS) Concentration	mg/l	253	--
TSS Loading	lbs/day	71,500	--
Biochemical Oxygen Demand (BOD) Concentration	mg/l	238	--
BOD Loading	lbs/day	67,100	--
SCREENING			
Type: Mechanically Cleaned "Climber Type"	--	--	--
Number of Mechanical Screens	--	1	1
Number of Bypass Mechanical Screens	--	1	1
Total Number of Installed Mechanical Screens	--	2	2
GRIT REMOVAL			
Type: Aerated Grit Removal	--	--	--
Total Number of Units	--	2	2
Unit Width	feet	19	19
Unit Length	feet	60	60
Average Water Depth	feet	14	14
Total Volume	cubic feet	33,600	33,600
Detention Time (all units in service)	minutes	10.2	5.1
Detention Time (one unit out of service)	minutes	5.1	2.9
PRIMARY SEDIMENTATION			
Type: Rectangular - Conventional	--	--	--
Influent Flow	mgd	33.82	60
Influent TSS Load	lbs/day	74,010	--
Influent BOD Load	lbs/day	67,100	--
Total Number of Units	--	6	6
Unit Width	feet	20	20
Unit Length	feet	208	208
Average Depth	feet	11	11
Total Area	square feet	24,960	24,960
Total Volume	cubic feet	274,560	274,560
Surface Overflow Rate (all units in service)	gpd/square foot	1,355	2,404
Surface Overflow Rate (one unit out of service)	gpd/square foot	1,626	2,885
Detention Time (all units in service)	minutes	87	49
Detention Time (one unit out of service)	minutes	73	41
Weir Loading (all units in service)	gpd/foot	22,190	39,370
Weir Loading (one unit out of service)	gpd/foot	26,630	47,240
Percent BOD Removal	%	26	25
Percent TSS Removal	%	60	60

Table A-10
Design Criteria and Loadings
North City Water Reclamation Plant

Process	Units	Average	Peak
FLOW EQUALIZATION BASINS			
Type: Circular Prestressed Tank			
Number of Units	--	2	2
Diameter, each	feet	140	140
Maximum Nominal Depth	feet	29	29
Maximum Storage Volume, All Basins	cubic feet	858,000	858,000
Percent of Average Primary Effluent Flow	%	19	19
PRIMARY EFFLUENT/RAS MIX BASIN			
Volume	cubic feet	11,060	11,060
Detention Time (Based on plant effluent plus RAS)	Minutes	3.6	2.5
Mixing Power Input	HP/1,000 cubic feet	1.2	1.2
AERATION BASINS			
Type: Single Pass-Plug Flow Anoxic/Aerobic Air Activated Sludge	--	--	--
Influent Flow (Equalized Primary Effluent)	mgd	32.8	48
Influent Design BOD_5 load	lbs/day	49,950	97,260
Influent Design TSS load	lbs/day	29,600	55,640
Total Number of Basins	--	7	7
Basin Width	feet	20	20
Basin Depth	feet	20	20
Number of Anoxic Cells per Basin	--	3	3
Anoxic Cells w/Standby Aeration	--	2	2
Anoxic Cell Length	feet	27	27
Number of Aerobic Zones per Basin	--	1	1
Number of Aeration Grids per Basin	--	4	4
Length of Aeration Grid	feet	78	78
Total Aerobic Zone Length Per Basin	feet	312	312
Total Basin Length (Anoxic and Aerobic)	feet	392	392
Total Anoxic Volume	cubic feet	224,000	224,000
Total Aerobic Volume	cubic feet	873,600	873,600
Total Basin Volume	cubic feet	1,098,000	1,098,000
Anoxic Volume as Percent of Total Basin	%	20	20
Maximum Anoxic Detention Time (all units in service)	hours	1.2	0.8
Maximum Anoxic Detention Time (one unit out of service)	hours	1.1	0.7
Minimum Aerobic Detention Time (all units in service)	hours	4.8	3.3
Minimum Aerobic Detention Time (one unit out of service)	hours	4.1	2.8
Anoxic + Aerobic Detention Time (all units in service)	hours	6.0	4.1
Anoxic + Aerobic Detention Time (one unit out of service)	hours	5.2	3.5
Mixed Liquor Suspended Solids (MLSS)	mg/l	2,470	3,000
Mixed Liquor Volatile Suspended Solids (MLVSS)	mg/l	1,930	2,370
Mean Cell Residence Time (all units in service)	days	5.0	3.0
Mean Cell Residence Time (one unit out of service)	days	4.3	2.6
Food:Microorganism (FM) Ratio (all units in service)	--	0.30	0.45
Food:Microorganism (FM) Ratio (one unit out of service)	--	0.35	0.53
Waste Activated Sludge (WAS) Mass Rate	lbs/day	40,270	79,270
WAS TSS Flow	mgd	1.95	1.95
WAS TSS Concentration	mg/l	2,470	3,000
WAS lbs TSS per lbs BOD5 Removed	--	0.85	0.85
Net Actual Oxygen Demand	lbs/day	62,580	103,430

Table A-10
Design Criteria and Loadings
North City Water Reclamation Plant

Process	Units	Average	Peak
SECONDARY CLARIFICATION			
Type: Rectangular - Conventional Influent Flow	--	--	--
Influent Flow (plant effluent only)	mgd	30.8	44.8
Return Activated Sludge (RAS) Flow	mgd	20.5	29.8
RAS TSS Concentration	mg/l	6,180	7,500
Mixed Liquor Flow (less WAS)	mgd	51.3	74.6
Mixed Liquor TSS Concentration	mg/l	2,470	3,000
Total Number of Units	--	14	14
Clarifier Width, per Unit	feet	20	20
Clarifier Unit Length		180	180
Unit Depth	feet	15	15
Total Area	square feet	50,400	50,400
Total Volume	cubic feet	756,000	756,000
Surface Overflow Rate (all units in service)	gpd/square foot	611	890
Surface Overflow Rate (one unit out of service)	gpd/square foot	658	958
Solids Loading Rate w/MLSS waste (all units in service)	lbs/square feet/day	21	37
Solids Loading Rate (one unit out of service)	lbs/square feet/day	23	40
Weir Loading (all units in service)	gpd/foot	15,350	22,340
Weir Loading (one unit out of service)	gpd/foot	16,530	24,060
SECONDARY EFFLUENT BYPASS TO OUTFALL			
Minimum Flow	mgd	0	12.8
Maximum Flow	mgd	30.8	44.8
TERTIARY FILTRATION			
Type: Monomedia	--	--	--
Total Influent Flow	mgd	30.73	32
Number of Units	--	6	6
Unit Width	feet	21	21
Unit Length	feet	53	53
Total Area	square feet	6,678	6,678
Filtration Rate (one unit out of service)	gpm/square foot	3.8	4.0
Filtration Rate (two units out of service)	gpm/square foot	4.8	5.0
DEMINERALIZATION			
Type: Ionics electro dialysis reversal	--	--	--
Number of Trains	--	3	3
Capacity, Each Train	mgd	1.1	1.1
WASTE BACKWASH TANK			
Type: Rectangular w/Influent Pump Station Structure	--	--	--
Maximum Instantaneous Inflow	gpm	22,220	22,220
Number o Units	--	1	1
Volume per Backwash Event	gallons	260,000	260,000
Backwash Water per Day	mgd	2.3	3.6
Outflow Rate	gpm	1,610	2,520
Maximum Depth	feet	30	30
Volume	million gallons	0.66	0.66
	cubic feet	87,690	87,690
Volume as Percent of Daily Backwash Volume	%	28	18

Table A-10
Design Criteria and Loadings
North City Water Reclamation Plant

Process	Units	Average	Peak
CHLORINE CONTACT			
Total Influent Flow	mgd	30.73	32
Total Number of Contact Tanks	--	3	3
Width, Each Tank	feet	14.5	14.5
Length, Each Pass	feet	290	290
Length, Each Tank	feet	580	580
Tank Depth	feet	14.5	14.5
Total Volume, All Tanks	cubic feet	365,800	365,800
Detention Time	minutes	128	123

The North City WRP may also receive inflow from the Peñasquitos Pump Station via a pressure/gravity pipeline (Peñasquitos Trunk Sewer Relief Pipeline) which discharges directly into the plant's headworks. As shown in Figure A-1 (page A-3), the Peñasquitos Trunk Sewer Relief Pipeline diverts wastewater directly to the North City WRP that would otherwise be discharged into the Old Peñasquitos Trunk Sewer and Pump Station 64.

Influent Pumping. The North City WRP Influent Pump Station lifts incoming wastewater (plus recycled flows) to the plant's headworks. The Influent Pump Station is of a conventional wet well/dry well design, and houses four variable speed pumps together with ancillary systems and controls. Space is available to add a fifth pump in the future. The flow range of each pumping unit is 6,000 to 17,300 gpm. A hydraulically-operated influent sluice gate is provided to isolate the pump station in case of power failure or flooding of the dry well.

Chemicals (ferric chloride, hydrogen peroxide and chlorine solution) can be added at the wet well for liquid phase odor control. Two-stage scrubbers are provided to treat odors released within the influent pump station. Chemical use at the Influent Pump Station and other North City WRP facilities is summarized in Section A.9.

Screening. The plant's headworks building houses two mechanically-cleaned bar screens to remove large solids from the influent. A third unit could be installed in the future. Screenings are raked from the bar screens, pressed, and conveyed to a hopper located over a truck loading area.

Grit Removal. Grit is removed in two aerated and baffled grit tanks. Grit removed in each tank is deposited into three hoppers. From the hoppers, the grit is pumped to cyclonic separators followed by grit classifiers/washers. Washed grit is conveyed to storage hoppers. Grit is loaded onto trucks for hauling from the storage hoppers. Agitation air is provided by three positive displacement blowers. The grit tanks are covered to contain odors. Foul air is drawn from under the covers and treated in two-stage scrubbers.

Primary Sedimentation. Six primary sedimentation tanks (three more could be added in the future) are provided to remove settleable (sludge) and floatable (scum) material from the degritted wastewater. Settled wastewater overflows into the effluent launders at each tank from where it is discharged into the primary effluent channel. Primary sludge is scraped by longitudinal chain and flight collectors to sludge hoppers located at the inlet end of the tanks. From the hoppers, the sludge is removed by variable speed pumps, passes through sludge grinders and is discharged into the Sludge Pump Station.

Scum floating on the tanks surface is skimmed by the returning flights to the effluent end of each tank, collected in rotating pipe scum skimmers, and pumped to the scum concentrators. The primary tanks are covered to contain odors. Foul air exhausted from under the covers is passed through two-stage scrubbers. Section A.9 summarizes chemical use, application points, and typical dose rates at the North City WRP.

Flow Equalization. The primary purpose of flow equalization at North City WRP is to attenuate diurnal flow variations through the plant's secondary and tertiary treatment processes. By maintaining reasonably constant flow through the secondary, tertiary, and disinfection processes, the sizing of these processes can be optimized since these facilities do not have to accommodate plant peak flows.

Sideline flow equalization is provided at the North City WRP by diverting peak diurnal flows into two 140-foot diameter, 29-foot deep circular equalization basins. Diverted flow is pumped to the equalization basins and is returned by gravity back to the treatment process when the influent flow drops below average.

Primary effluent is pumped to the equalization basins by variable speed pumps. Primary effluent stored in the basins (up to 6.4 million gallons total for both basins) is returned through a modulating control valve. The basins are covered to minimize odors and chemicals can be added for this purpose. Foul air is transferred to the primary sedimentation tanks where it is used as "sweep" air. A washdown system is provided to clean the equalization basins every time a basin empties.

Activated Sludge Aeration. Secondary treatment at North City WRP is provided by the activated sludge process of aeration, clarification, and the return of the settled activated sludge to the aeration tanks.

Aeration at North City WRP takes place in plug flow reactors that incorporate anoxic selectors to improve sludge settling characteristics. Equalized primary effluent and return activated sludge (RAS) are mixed before flowing by gravity into an aerated distribution channel, which splits the flow equally among seven aeration basins (three more could be added later). Each basin is divided into four zones: the first three zones comprise the anoxic selector and occupy 20 percent of the total basin volume. The remainder of the volume is occupied by the aerobic zone. The primary effluent plus RAS mixture combines in the first anoxic zone with mixed liquor recycle which is pumped from the end of the aerobic zone of each basin. Each anoxic zone is equipped with a submersible mixer and fine bubble aeration is provided in the aerobic zone. Mixed liquor from all basins flows into an effluent collection channel to be conveyed by gravity to the secondary clarifier influent distribution channel. A sump in the effluent collection channel allows wasting excess activated sludge from the mixed liquor stream.

Aeration air for the activated sludge process is supplied by four centrifugal blowers. Three centrifugal pumps are provided to transfer waste mixed liquor to the Sludge Pump Station. Agitation air is supplied by two centrifugal blowers. The aeration basins are covered to contain odors and the foul air is treated in three single-stage scrubbers.

Secondary Clarification. Solid-liquid separation in the activated sludge process takes place in the secondary clarifiers. Clarified liquid is conveyed to additional treatment processes (filtration and disinfection) while the solids are returned to the aeration basins (as RAS). A portion of these solids is wasted (waste activated sludge) to maintain the process in balance.

North City WRP includes 14 rectangular-clarifiers (seven more could be added in a subsequent phase). Each tank is provided with a longitudinal chain and flight collector to move settled sludge towards the effluent end and scum towards the inlet end. Clarified liquid flows over two effluent launders and discharges to the secondary effluent collection channel. Each clarifier is equipped with a centrifugal pump to return sludge to the aeration basins (there is a spare return activated sludge pump for each pair of secondary clarifiers). Two waste activated sludge pumps are provided to transfer waste activated sludge to the Sludge Pump Station. Secondary scum is also pumped to this station.

Coagulation and Filtration. The purpose of the coagulation and filtration processes is to remove additional suspended solids from the plant's secondary effluent in order to meet

California Title 22 requirements for disinfected tertiary recycled water. Coagulation involves the addition of chemicals to promote the agglomeration (i.e. flocculation) of solids to increase their removal during the subsequent granular media filtration.

Chemicals injected in advance of tertiary filtration at the North City WRP include anionic polymer and sodium hypochlorite. (See Table A-14 for North City WRP chemical use). Two static mixers are provided to thoroughly mix the chemicals with secondary effluent before the effluent is distributed onto six (four more could be added in the future) monomedia gravity filters. Each of the six filters is 21 feet by 53 feet in size. Filtered effluent is collected in the underdrain system and flows into a control structure which routes the effluent to the disinfection process. Filter backwash is provided by two vertical turbine pumps. Disinfected plant effluent is used for backwashing. Two centrifugal blowers provide air to scour the filter media during each backwashing cycle.

Demineralization. A demineralization facility was added at the North City WRP in 1998 to reduce the salinity of the recycled water produced at the plant. The facility was needed to meet the City of San Diego PUD's objective for total dissolved solids of 1,000 mg/l for recycled water intended for landscape irrigation. In 1999, the facility was expanded by adding a second stage to the existing two single-stage trains, and by adding a third two-stage train. The combined capacity of the three trains is 3.3 mgd. The demineralization facility uses Ionics electrodialysis reversal technology. Demineralized product water is blended with bypass tertiary effluent water to produce the desired total dissolved solids levels in the recycled water.

Advanced Water Purification Demonstration Project. The City operates advanced water purification facilities at the North City WRP site as part of a Water Purification Demonstration Project that has evaluated the feasibility of using advanced treated purified water as a source of supply to augment local and imported water supplies in a raw water storage reservoir. The project treats 1 mgd of tertiary effluent using membrane filtration, reverse osmosis and ultraviolet/advanced oxidation to purify tertiary treated recycled water. Purified water from the advanced treatment facility is currently blended with North City WRP tertiary effluent and used to augment non-potable recycled water supplies. The project's operational testing and monitoring program, however, has demonstrated that the advanced treatment facility can produce purified water that is comparable to or superior in quality to the City's existing imported raw water supply.

Disinfection. Filtered North City WRP recycled water is disinfected using sodium hypochlorite. The disinfection system is designed to satisfy California Title 22 requirements for recycled water intended for unrestricted body contact (disinfected tertiary recycled water). The required contact time for disinfection is provided in three two-pass plug flow tanks. Sufficient area exists at the North City WSP to allow two more tanks to be added in the future. The plant's disinfection system consists of storage tanks, chemical feed pumps, piping, and controls.

Effluent Pumping. The effluent pumping system provides recycled water for off-site users as well as for internal uses at the North City WRP. The latter includes filter backwash water and utility water for washdown, cooling, pump seal water, and landscape irrigation. Excess recycled water (during the irrigation season) and secondary effluent (during the non-irrigation season) is discharged by gravity to the Rose Canyon Trunk Sewer to be retreated at the Point Loma WWTP. Liquid waste streams from the North City WRP are also returned to this sewer.

Onsite Solids Handling. Screenings and grit are temporarily stored in hoppers and then loaded onto trucks for disposal at a landfill. Scum removed from the surface of the primary sedimentation tanks flows into a sump. Two submersible pumps are provided to pump scum to the concentrators housed in the headworks building. Alternatively, primary scum can be routed to the Sludge Pump Station. Concentrated scum is transferred by positive displacement pumps to a receiving tank for off-site disposal. Secondary scum is pumped to the Sludge Pump Station. The onsite Sludge Pump Station transfers primary sludge, waste activated sludge, and secondary scum to the MBC. Two pumps are provided, but the pump station is sized to provide sufficient space to add a third unit at a later date. Each pump is rated at 2900 gpm against a head of 216 feet and is driven by a 300 horsepower motor.

Cogeneration. Electrical supply for the North City WRP is provided by a cogeneration facility that features five engine/generator units. Four engines and their corresponding generators are operated by a private contractor and one engine and its corresponding generator is operated by City personnel;. The cogeneration plant engines are powered by methane gas extracted from the nearby Miramar Landfill.

Operations and Staffing. The North City WRP is fully staffed 7 days a week from 5:00 a.m. to 3:00 p.m. During off hours the plant is controlled from the City's centralized control center. (Section A.8 presents a description of the City of San Diego's Central Operations and Management Center, or COMC.)

Plant personnel currently include 10 operators and 12 maintenance personnel, supported by an engineering, administrative and support staff of two. The day shift (Monday through Friday) consists of the Plant Superintendent (50 percent of time devoted to North City WRP), a senior supervisor, a shift supervisor, and five operators. The maintenance staff is divided into an electrical and instrumentation crew, and a mechanical preventive maintenance crew. Except for minor tests and analysis, all laboratory work for process control and regulatory compliance is performed off-site at certified laboratories run by the City of San Diego PUD's Environmental Monitoring and Technical Services Division.

Operator Training. The comprehensive North City operator training program consists of three components:

1. Grade II Operator Training
   The site-specific operator training programs provide operators with the necessary knowledge, skills, and abilities to enable them to safely and efficiently operate the North City WRP. The training was developed so that it may be presented either by an instructor or given to the student for self-paced instruction with supervision.

2. Maintenance Certification Training
   The objective of this program is to prepare personnel for the Mechanical Technology certification examination offered by the California Water Environment Association. Maintenance certification training includes self-paced lessons from existing training programs and other self-paced lessons.

3. Maintenance Facility Training
   Materials developed under this program provide maintenance technicians with the skills, knowledge and abilities necessary to safely and efficiently maintain the facilities and equipment provided at the North City WRP.

An Operations Manual (Volume I of the O&M Manual) for the North City WRP covers each major unit process and associated systems and system components. Standard Operating Procedures (SOPs) have been developed for each unit process unit to supplement the information given in the Operations Manual. These SOPs are compiled into Volume II of the O&M Manual. Additionally, standard preventive maintenance procedures and schedules for mechanical and electrical equipment have been developed from the manufacturer's supplied technical literature and are incorporated into Volume III (the Maintenance Manual) of the O&M Manual. These procedures are input into a computerized maintenance management system.

The PUD's Control Operations and Management Network (COMNET) includes a state-of-the-art process control training simulator. Although it requires current operating parameters update, the simulator allows operators to train and develop experience in handling a variety of routine and emergency process scenarios and in interacting with the operations control system.

A.6 METRO BIOSOLIDS CENTER

Overview. The Metro Biosolids Center (MBC) is located at Marine Corps Air Station Miramar. MBC provides dewatering for sludge from the Point Loma WWTP and thickening, anaerobic digestion, and dewatering of sludge form the North City WRP.

Figure A-12 (page A-46) presents the layout of MBC facilities. Figure A-13 (page A-47) presents a schematic of MBC operations. Table A-11 (page A-48) summarizes design criteria for the MBC unit processes.

Screened digested sludge from Point Loma WWTP is pumped to biosolids holding tanks at MBC where it is mixed with sludge from the onsite digesters. The mixed sludge is pumped to the Centrifuge Dewatering Biosolids Storage Building where dewatering is provided by high-solids type centrifuges. The dewatered biosolids cake is then pumped to storage silos which provide approximately three days of capacity.

Raw Sludge Equalization. The Raw Sludge Receiving Tanks receive screened raw sludge from the North City WRP. The tanks are sized to dampen peak flows and allow downstream MBC solids handling facilities to operate at a near-constant flow. Each receiving tank is 45 feet in diameter and has a liquid depth of 45 feet. A pump mixing system is provided. The tanks have a PVC liner cast into the concrete of the roof and walls to reduce the potential for corrosion. The tanks are not insulated, and are connected to the odor control system. Transfer pumps are recessed-impeller centrifugal type and have capacity to transfer the full contents of the tanks in about two days.

Sludge Degritting. Raw sludge degritting is provided as an optional process ahead of the thickening process to protect the centrifuges and other downstream equipment from excessive wear due to abrasion. The degritting process utilizes three Teacup™ degritting units each rated at 1.5 mgd followed by two Snail™ dewatering units. The Teacup™ degritters operate by inducing a vortex flow within the vessel as influent flow enters at the tangent of the vessel. The heavier grit falls to the bottom and the degritted sludge exits the top of the vessel. A constant underflow from the Teacup™ is fed to the Snail™ units which dewater the grit and deposits it into two roll-off grit containers.

Centrifuge Thickening. The mixed primary and waste activated sludge from the North City WRP is thickened using high solids centrifuges. Thickening sludge by means of centrifuges is a continuous (24-hours per day, 7-days per week) process where the wet sludge, at approximately 0.5 percent to 0.8 percent solids concentration, conditioned with a polymer, is thickened by centrifugal force in a high-speed rotating drum.

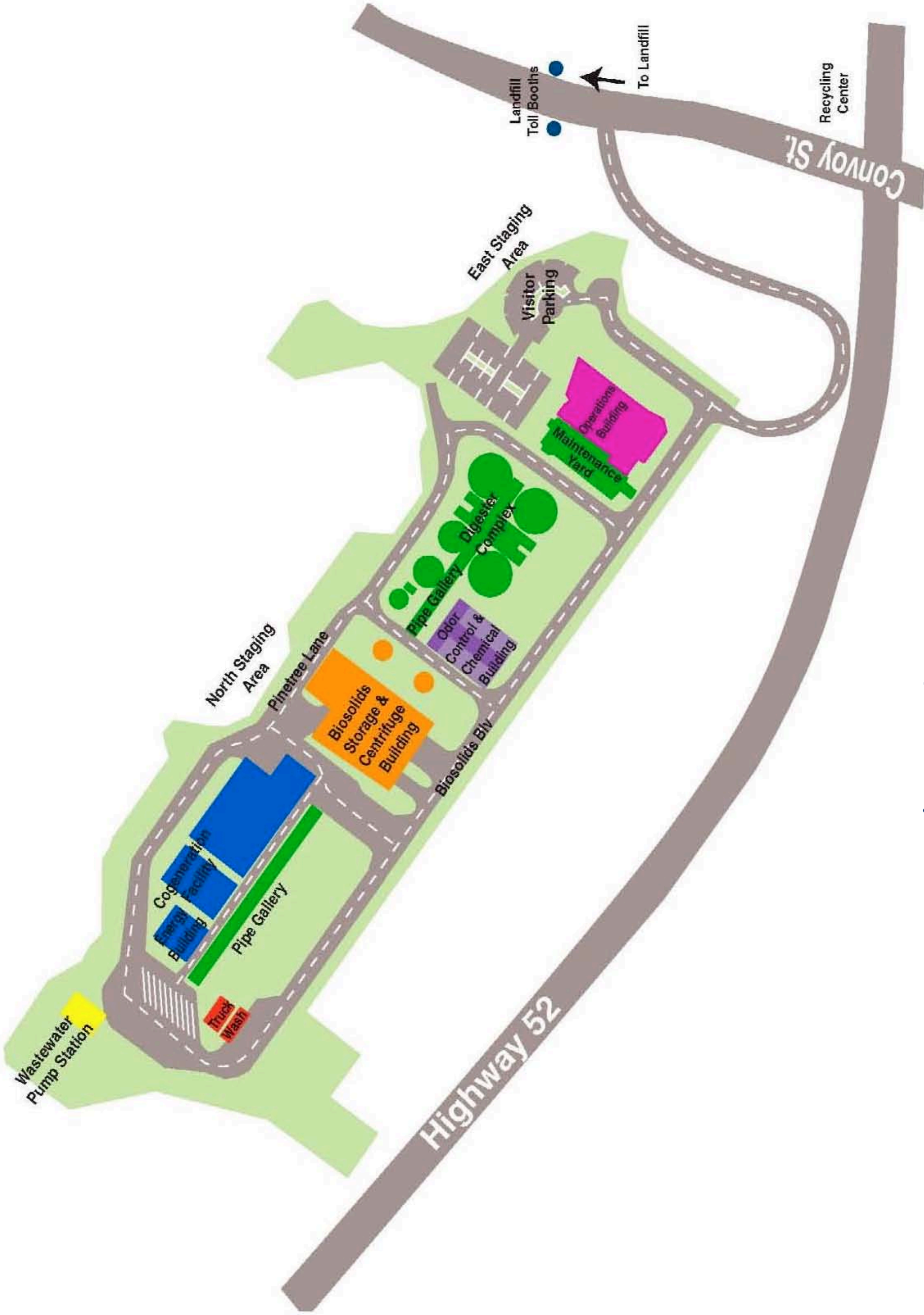


Figure A-12
Metro Biosolids Center Site Layout

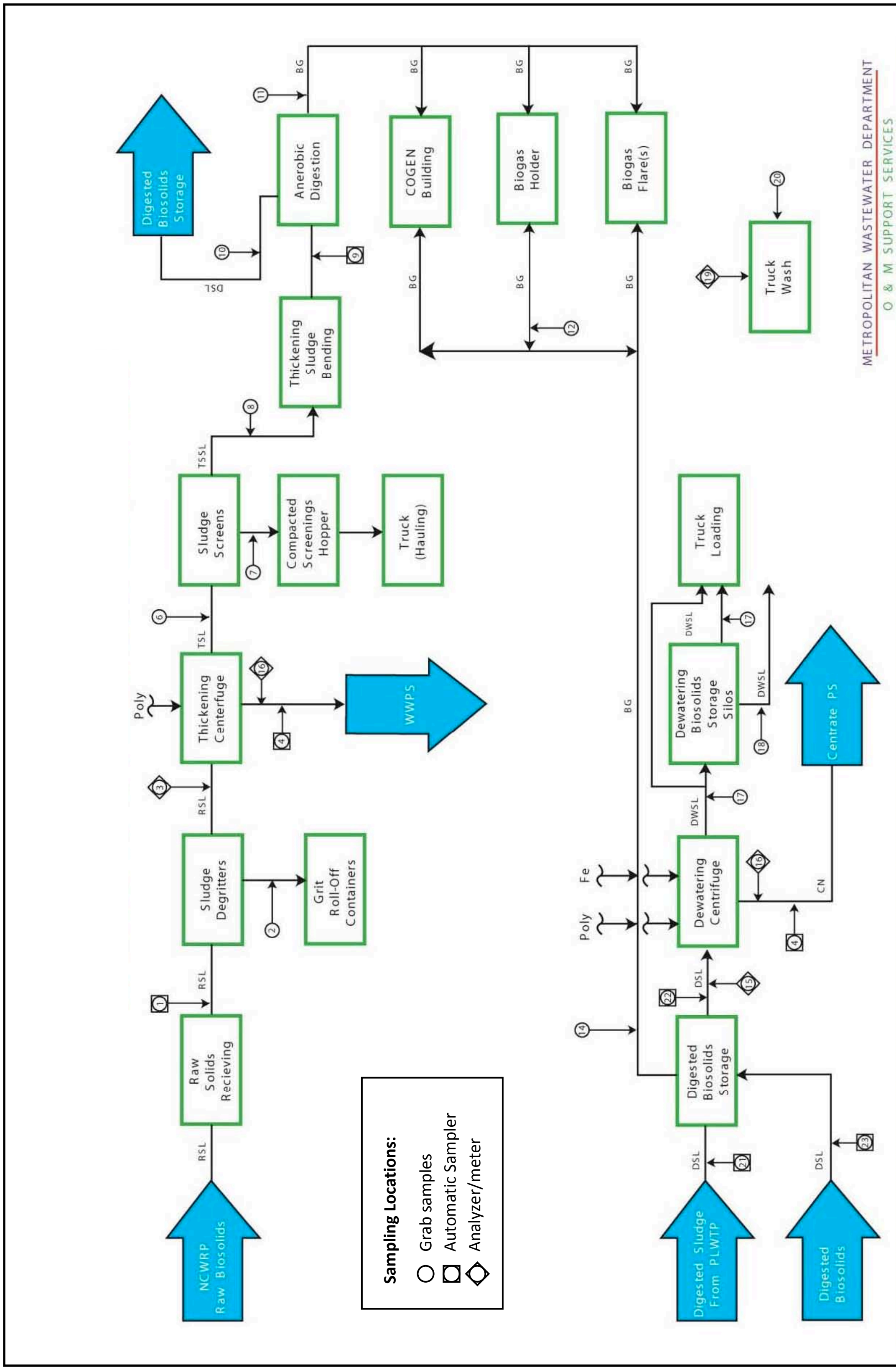


Figure A-13
Metro Biosolids Center Process Schematic

Table A-11
Design Criteria for Metro Biosolids Center

PROCESS	UNITS	VALUE	
		Average	Peak
RAW SOLIDS RECEIVING			
Type: Circular, Covered, Pre-Stressed Concrete Tanks	--	--	--
Flow	mgd gpm	1.76 1,223	2.81 1,957
Solids Loading	lbs/day dry tons/day	79,357 39.7	178,554 89.3
Solids Concentration	%	0.54	0.76
Emergency Duration	hours	--	12
Difference between Peak & Average Flows	gpd	--	1,050,000
Required Tank Storage	gallons	--	525,000
Number of Receiving Tanks Provided		2	2
Receiving Tank Volume (each)	gallons cubic feet	528,303 70,629	528,303 70,629
Total Volume (both tanks)	gallons cubic feet	-- --	1,056,606 141,258
Detention time: w/o Thickening @ Peak Flow w/Thickening @ Peak Flow w/o Thickening	hours days hours	-- -- --	7.20 0.50 4.50
CENTRIFUGE THICKENING			
Influent Flow	mgd gpm	1.76 1,223	2.82 1,957
Influent Sludge Loading	lbs/day dry tons/day	79,357 40	178,554 89
Feed Solids Concentration	%	0.54	0.76
Operating Schedule	hours/day days/week	24 7	24 7
Unit Capacity	gpm	600	750
Number of Centrifuge Units Required	--	2.0	2.6
Number of Centrifuge Units Provided	--	5	5
Number of In-Service Centrifuge Units	--	3	3
Unit Capacity (each unit)	gpm	600	750
Total Capacity (all units)	gpm	1,800	2,250
Percent Capture	%	95	95
Thickened Sludge Solids	lbs/day dry tons/day	73,390 37.7	169,626 84.8
Thickened Sludge Concentration	%	5	5
Thickened Sludge Flow	mgd	0.18	0.41
Centrate Flow	mgd	1.58	2.41
Centrate Solids	lbs/day dry tons/day	3,968 2.0	8,928 4.5
Centrate Solids Concentration	mg/l %	301.1 0.03	444.0 0.04

Table A-11
Design Criteria for Metro Biosolids Center

PROCESS	UNITS	VALUE	
		Average	Peak
ANAEROBIC DIGESTION			
Thickened Sludge Feed Flow (peaking factor = 1.5)	mgd	0.18	0.27
Thickened Sludge Concentration	%	5	5
Total Solids at peaking factor = 2.25	lbs/day dry tons/day	75,390 38	169,626 85
Volatile Suspended Solids	% lbs/day dry tons/day	69 52,215 26	69 78,323 39
Minimum Detention time (design criteria)	days	20	15
Total Volume Required	gallons cubic feet	3,615,805 483,396	4,067,780 543,821
Total Volume Required (0.1 lb VSS/cubic ft.)	gallons cubic feet	3,905,706 522,153	3,905,706 522,153
Unit Volume Required	gallons cubic feet	1,301,902 174,051	1,355,930 181,274
Number of Digesters Provided	--	3	3
Digester Volume (each)	gallons cubic feet	2,913,147 389,458	2,913,147 389,458
Total Digestion Volume (3 tanks)	gallons cubic feet	8,739,440 1,168,374	8,739,440 1,168,374
Hydraulic Resident Time (HRT) All Units in Service One Unit Out-of-Service	 days days	 48 32	 32 21
Volatile Suspended Solids Loading All Units in Service One Unit Out-of-Service	 lbs/cubic feet lbs/cubic feet	 0.04 0.07	 0.07 0.10
Volatile Suspended Solids Reduction	%	50	50
Volatile Suspended Solids Destroyed	lbs/day dry tons/day	26,108 13	39,161 20
Biogas Production @15 cubic feet/lb VSS	cubic feet/day	391,615	587,422
DIGESTED BIOSOLIDS STORAGE			
Digested Biosolids Overflow to Storage	lbs/day dry tons/day mgd	49,282 24.6 0.18	73,923 37.0 0.27
Point Loma WWTP Biosolids to Storage: Flow @ 3% Concentration	mgd gpm	1.14 794.2	1.66 1,150.6
Solids Loading at peaking factor = 1.38	lbs/day dry tons/day	300,401 150	414,553 207
Solids Concentration	mg/l %	31,497 3.15	30,000 3.00
Number of Tanks Provided	--	2	2
Tank Volume (each)	gallons cubic feet	1,296,000 173,262	1,296,000 173,262
Total Volume Provided	gallons	2,590,777	2,590,777
Detention Time (one tank, combined digested flow, no dewatering)	days	0.98	0.67

Table A-11
Design Criteria for Metro Biosolids Center

PROCESS	UNITS	VALUE	
		Average	Peak
CENTRIFUGE DEWATERING (Combined Flows)			
Total Digested Flow (combined)	mgd gpm	1.32 919.7	1.93 1,339.4
Solids Loading	lbs/day dry tons/day	349,683 175	482,562 241
Digested Solids Concentration	%	3.17	3.00
Operating Schedule	hours/day days/wk	24 7	24 7
Centrifuge Capacity (each)	gpm	200	225
Number of Centrifuges Required	-	4.6	6.0
Number of Centrifuges Provided Number of In-Service Centrifuges	- -	8 5	8 6
Flow Rate Per Unit	gpm	184	223
Solids Load per Unit (including polymer)	gpm	70,636	117,727
Percent Capture	%	95	92
Centrate Flow	mgd	1.19	1.74
Centrate Solids	lbs/day dry tons/day	14,162 7.1	34,165 17.1
Centrate Concentration	mg/l %	1,427 0.14	2,359 0.24
DEWATERED SLUDGE PRODUCTION			
Dewatered Sludge Cake Solids Production	lbs/day dry tons/day	335,521 168	448,397 224
Dewatered Sludge Cake Concentration	%	30	28
Dewatered Sludge Cake Flow	mgd	0.13	0.19
Dewatered Sludge Cake Volume	cubic feet/day	17,928	25,671
DEWATERED SLUDGE STORAGE			
Type: Cylindrical Live Bottom Silo	--	--	--
Silo Volume (each)	cubic feet	7,122	7,122
Number of Silos	-	8	8
Storage Available (8 silos)	cubic feet days	56,976 3.18	56,976 2.22
Storage Available (7 silos)	cubic feet days	49,154 2.74	49,154 1.91

The thickened solids are removed from the drum by means of a concentric screw conveyor rotating at a different speed than the drum. Thickened sludge is discharged to a common wet well located below the centrifuges. The wet well is constructed of concrete and lined to reduce the potential for corrosion. Positive displacement pumps transfer thickened sludge from the wet well to the digesters. Centrate is collected in a gravity line and transported to the Wastewater Pump Station.

The centrifuges and the wet well are ventilated and the foul air is treated at the process odor control system to control odors and to limit corrosion to centrifuge equipment.

Anaerobic Digestion. After thickening, the solids are digested in one of three single stage, complete mix 105-foot-diameter anaerobic digesters. Each digester is equipped with a pumped mixing system and an automatic heating system that maintains the temperature of the sludge between 95°F and 105°F (35°C and 41°C (mesophilic). The digesters are operated to maintain minimum mean cell residence times of at least 15 days at these temperatures to comply with 40 CFR 503 Class B pathogen reduction requirements for Processes to Significantly Reduce Pathogens (PSRP).

The digesters reduce influent volatile suspended solids (VSS) by more than 50 percent, which complies with vector attraction reduction requirements of 40 CFR 503 for Class B sludge. Digester gas is captured and conveyed to an on-site, third party cogenerator.

Two day tanks and four feed pumps have been provided in the digester complex to store and feed ferrous chloride into the digesters for hydrogen sulfide and scale control.

Digested Biosolids Storage. The digested biosolids storage tanks provide storage and mixing of digested biosolids from both the Point Loma WWTP and onsite digesters. Each tank is sized to provide approximately one day of storage under average flow conditions.

Centrifuge Dewatering. The digested biosolids are conditioned, with polymer and ferric chloride (optional) before being fed to the dewatering centrifuges by dedicated progressive cavity pumps. These progressive cavity pumps provide the steady flow rate needed for efficient operation of the dewatering centrifuges.

Eight 200 gpm centrifuges are currently installed. A project is underway which will replace 6 of the existing centrifuges with higher capacity (325 gpm) units. The remaining 2 centrifuges will be retained for use in emergencies. Centrate, which flows over adjustable weirs on the rotating drum of the centrifuge, is collected and flows by gravity to the wastewater pump station where it is pumped back to the sewer system for ultimate re-treatment at the Point Loma WWTP.

Dewatered biosolids cake is removed from the centrifuge drum by a concentric screw conveyor rotating at a different speed to the drum. The cake discharged from the centrifuges is collected in biosolids collection bins located under the centrifuges.

To eliminate odors and to limit corrosion of centrifuges, the centrifuge case is vented to the foul air collection system via the centrate discharge piping and the dewatered biosolids collection bin.

Dewatered Biosolids Pumping, Storage, and Loading. Dewatered biosolids are transported from the dewatered biosolids collection bins to storage silos using piston pumps. Eight dewatered biosolids storage silos are currently provided and have sufficient capacity to store three days of dewatered biosolids at average flow. A project currently under construction will add 2 more silos. These new silos will provide adequate storage capacity when the existing silos, which are approaching the end of their useful life, are removed from service and upgraded in the future.

The dewatered biosolids cake from the silos is pumped to weigh and loading bins located above each of the two truck load out lanes. Slide gates on the bottom of the bins open, emptying the dewatered biosolids into a waiting truck or tractor trailer.

Centrate and Wastewater Pumping. A pump station located at the northwest corner of MBC receives separate streams of wastewater and centrate. The wastewater stream originates from on-site showers, restrooms and kitchens. The centrate stream originates from biosolids treatment processes and is therefore sampled and its solids content monitored. Both the wastewater and the centrate streams are returned to the Metro Sewer System downstream of the North City WRP influent and ultimately treated at the Point Loma WTP.

Cogeneration. A privatized cogeneration facility constructed and operated by the Fortistar Methane Group, LLC is located adjacent to the Energy Building. This facility houses four tandem Caterpillar 3516 reciprocating piston engines linked to one generator each. The engines burn landfill gas collected from the adjacent Miramar Landfill as well as digester gas generated in the MBC digesters. The combined output of these four generators is 6.4 megawatts of electricity. MBC uses approximately 2.4 megawatts and the rest is exported to the utility power grid via the MBC switchgear. Waste heat from the engine jacket water cooling system provides most of the energy necessary to heat the digesters and to provide comfort heating for the buildings. Backup boilers provide extra heating capacity when necessary.

Operations and Staffing. The MBC is staffed 24 hours per day, 7 days a week. Currently, plant personnel include:

- 19 operators who are dedicated to MBC,
- 21 maintenance personnel who service the MBC, the Peñasquitos Pump Station and the East Mission Gorge Pump Station,
- 2 engineering personnel who support the MBC and the North City WRP,
- 1 clerical personnel who supports the MBC and the Wastewater Treatment and Disposal Division administration, and
- 1 lab technician who supports the MBC laboratory.

The day shift (Monday through Friday) consists of the Plant Superintendent, a senior wastewater operator supervisor, a process control supervisor, and five operators. The maintenance staff is divided into two crews:

- Breakdown Maintenance crew for emergency repairs.
- Preventive Maintenance crew for routine equipment maintenance.

All laboratory work for process control and regulatory compliance is performed onsite or at certified laboratories run by PUD's Environmental Monitoring and Technical Services Division.

Operator Training. A formal training program has been implemented for the MBC staff that addresses both operational process control concepts and task based duties. As appropriate, lessons are presented regarding building systems and process support systems.

In the operational process control classes, operations personnel learn unit processes, intended functions, and how to operate the processes in the most efficient manner. Process evaluation techniques are also part of the training, which focus on how to utilize and interpret data generated from the sampling, analysis, and monitoring programs to maximize quality product and minimize costs. Training also focuses on upstream and downstream facilities so operators can understand how each can impact the unit operations at the MBC. Responses to changes in upstream or downstream operations are also addressed. Task based training consisted of both classroom and hands-on or field training. Sampling, analysis, monitoring/adjustments, and equipment operation (startup, shut down) are addressed. Additional courses are provided to address training for operation of the MBC thickeners and digesters.

A.7 SOUTH BAY WRP AND OCEAN OUTFALL

Overview. The South Bay WRP was brought online in 2001 to treat wastewater from portions of the southern region of the Metro System service area. The South Bay WRP is an advanced wastewater treatment facility that produces recycled water that complies with requirements of

Title 22, Division 4 of the *California Code of Regulations* for unrestricted body contact (e.g. disinfected tertiary recycled water).

Figure A-14 (page A-55) presents the layout of the South Bay WRP. Figure A-15 (A-56) presents a schematic of South Bay WRP processes. The hydraulic capacity of the South Bay WRP is 18 mgd, and the plant can produce up to 15 mgd of tertiary treated recycled water. Table A-12 (page A-57) presents design criteria for South Bay WRP treatment processes. The main liquid treatment train consists of:

- influent pumping,
- screening,
- grit removal,
- primary sedimentation,
- sideline flow equalization,
- air activated sludge process with an anoxic selector zone,
- secondary clarification,
- chemical addition for coagulation,
- tertiary filtration through deep bed mono-media filters, and
- UV disinfection.

South Bay WRP tertiary treated effluent is directed to a regional recycled water conveyance system for reuse. Use of South Bay WRP recycled water totaled approximately 3,600 acre-feet per year (an average of 3.2 mgd) during 2013. Recycled water production at the South Bay WRP averaged 4.9 mgd during April-October 2013. South Bay WRP flows in excess of recycled water demands receive secondary treatment and are discharged through the South Bay Land Outfall (SBLO) and South Bay Ocean Outfall (SBOO).

Plant Inflow. As discussed in Section A.2, raw wastewater in southern portion of the Metro System is intercepted at the Grove Avenue Pump Station and Otay Valley Pump Stations and directed to the South Bay WRP for treatment. Section A.9 summarizes chemical use, application points, typical dose rates, and the purposes of chemical addition at the South Bay WRP.

Headworks. Influent wastewater flow is metered and conveyed to mechanically-cleaned bar screens and an aerated grit removal system. The headworks facility shares a common cast-in-place concrete structure with the primary sedimentation basins. Screening, screening compaction, grit classification and scum concentration are located in the headworks building. Grit from the aerated grit chambers is dewatered and transported to a landfill for disposal.

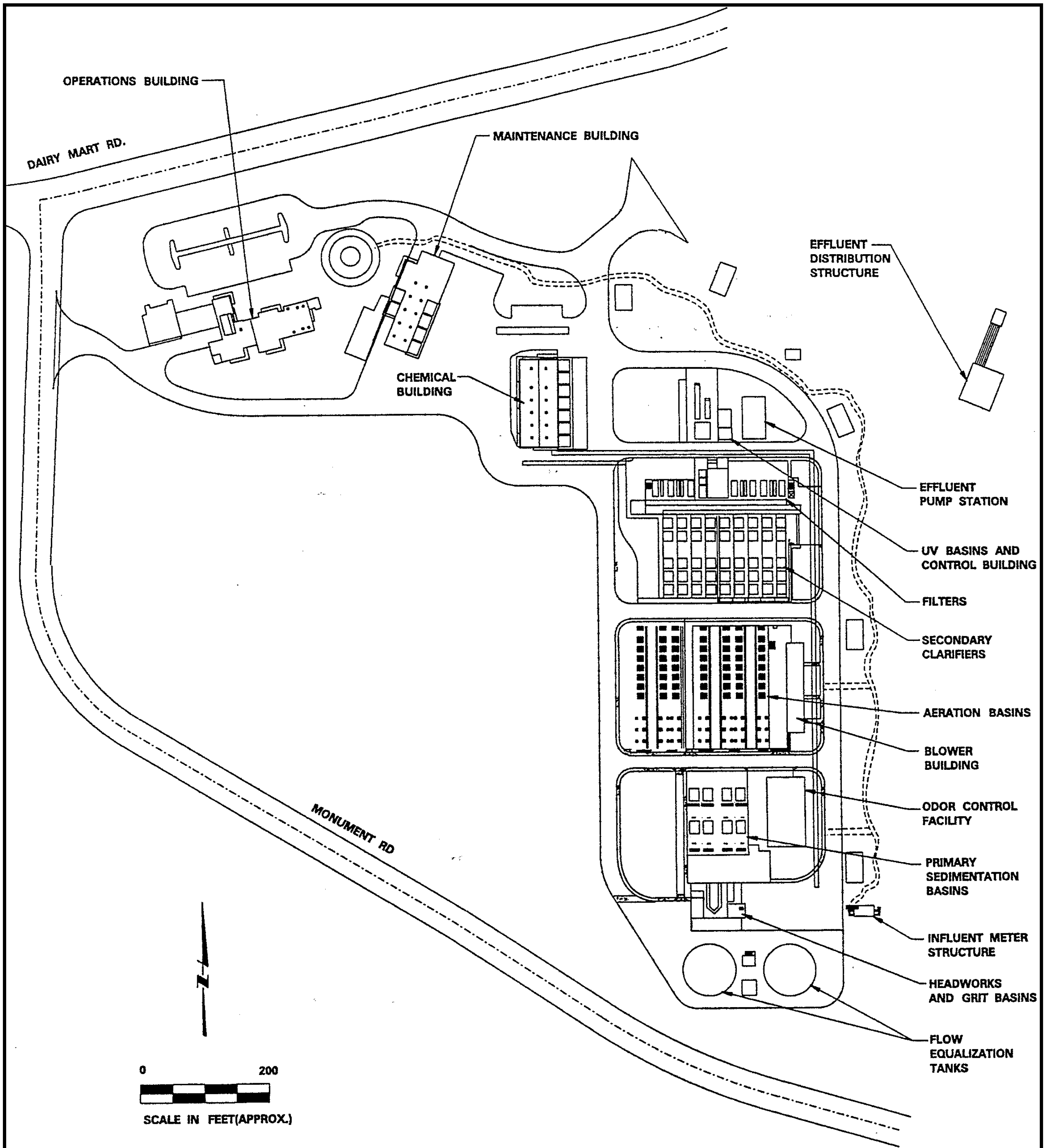


Figure A-14
South Bay Water Reclamation Plant Site Layout

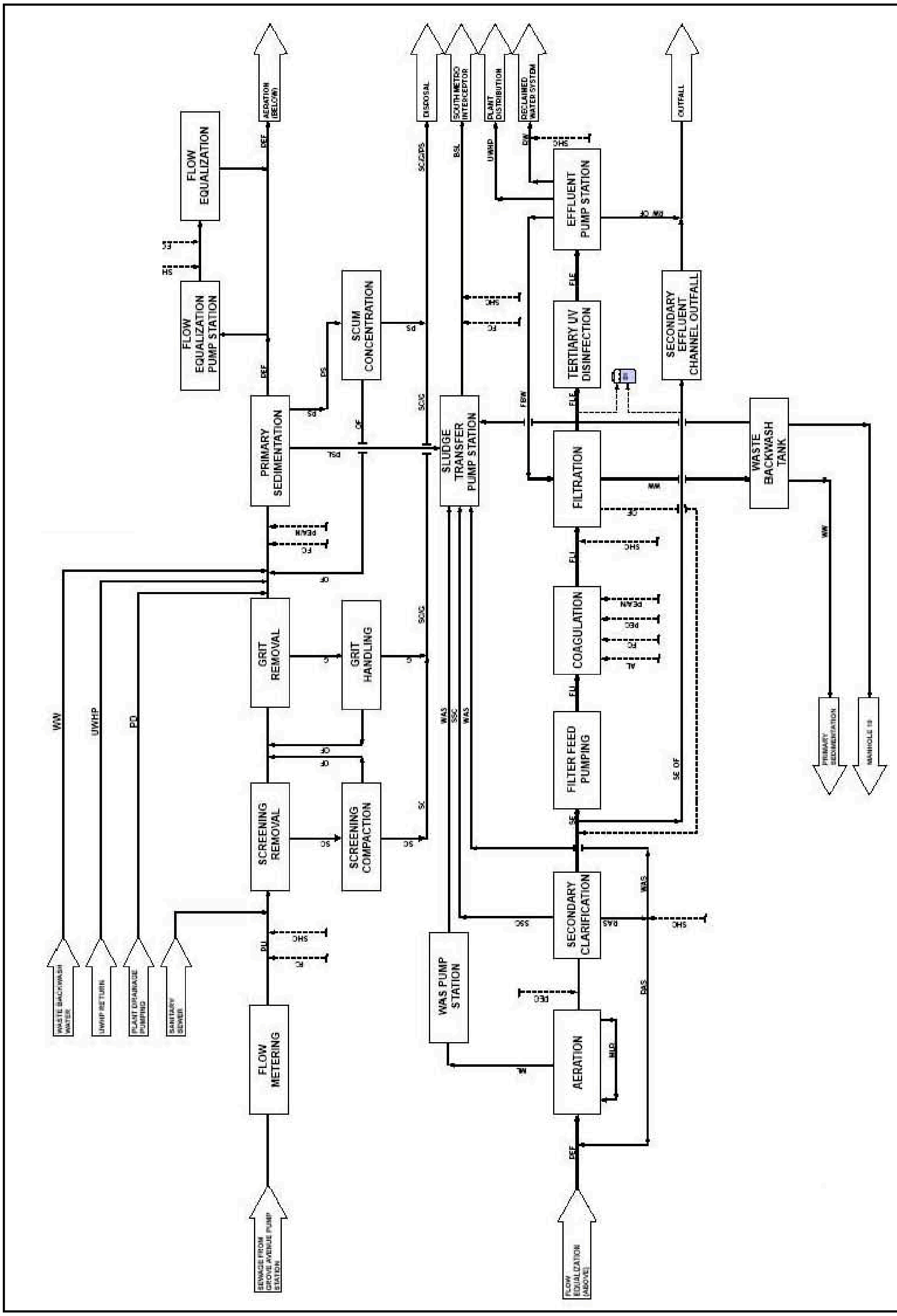


Figure A-15
South Bay Water Reclamation Plant Process Schematic

Table A-12
Design Criteria and Loadings
South Bay Water Reclamation Plant[1]

Process	Units	Parameter Value	
		Average	Peak
PLANT INFLUENT			
Flow	mgd	15	18
Total Suspended Solids	mg/l	270	--
	lbs/day	33,800	--
Biochemical Oxygen Demand	mg/l	300	--
	lbs/day	37,555	--
SCREENING			
Number of Mechanical Screens	--	2	2
Channel Width	feet	3.0	3.0
Channel Depth	feet	4.42	4.42
GRIT REMOVAL			
Type: Aerated Grit Removal	--	--	--
Total Number of Units	--	2	2
Unit Width	feet	15	15
Unit Length	feet	30	30
Average Water Depth	feet	10	10
Total Volume per Unit	cubic feet	120,000	120,000
Surface overflow rate (all units in service)	gpd/square foot	1,646	1,947
Surface overflow rate (one unit out of service)	gpd/square foot	2,058	2,438
PRIMARY SEDIMENTATION			
Type: Rectangular - Conventional	--	--	--
Design Influent Flow	mgd	16.46	19.47
Design Load: Total Suspended Solids	lbs/day	70,990	--
Design Load: Biochemical Oxygen Demand	lbs/day	76,960	--
Total Number of Units	--	5	5
Unit Width	feet	20	20
Unit Length	feet	100	100
Average Unit Depth	feet	12	12
Surface Overflow Rate (all units in service)	gpd/square foot	1,646	1,947
Surface Overflow Rate (one unit out of service)	gpd/square foot	2,058	2,438
Detention Time - All units in service	minutes	79	66
Detention Time (one unit out of service)	minutes	63	53
Design Percent Removal: Biochemical Oxygen Demand	%	30	--
Design Percent Removal: Total Suspended Solids	%	60	--
FLOW EQUALIZATION BASINS			
Type: Circular Prestressed Tanks	--	--	--
Number of Units	--	2	2
Diameter, each	feet	80	80
Maximum Nominal Depth	feet	19	19
Maximum Storage Volume, All Basins	cubic feet	191,000	191,000
Percent of Average Primary Effluent Flow	%	19	--

Table A-12
Design Criteria and Loadings
South Bay Water Reclamation Plant[1]

Process	Units	Parameter Value	
		Average	Peak
PRIMARY EFFLUENT/RAS MIX BASIN			
Volume	cubic feet	11,060	11,060
Detention Time (Based on plant effluent plus RAS)	minutes	2.5	2.5
Mixing Power Input	HP/1,000 cubic feet	1.2	1.2
AERATION BASINS			
Reactor Type: Air Activated w/Anoxic Selectors	--	--	--
Design Influent Flow (Equalized primary influent)	mgd	15.34	18.0
Design Load: Total Suspended Solids	lbs/day	53,870	--
Design Load: Biochemical Oxygen Demand	lbs/day	28,400	--
Total Number of Basins	--	8	8
Basin Width	feet	25	25
Basin Depth	feet	15	15
Number of Anoxic Cells per Basin	--	3	3
Anoxic Cells w/Standby Aeration	--	2	2
Anoxic Cell Length	feet	16.7	16.7
Number of Aerobic Zones per Basin	--	1	1
Number of Aeration Grids per Basin	--	4	4
Length of Aeration Grid	feet	30	30
Total Aerobic Zone Length Per Basin	feet	140	140
Total Basin Length (Anoxic and Aerobic)	feet	190	190
Total Anoxic Volume	cubic feet	180,000	180,000
Total Aerobic Volume	cubic feet	504,000	504,000
Total Basin Volume	cubic feet	684,000	684,000
Anoxic Volume as Percent of Total Basin	%	26	20
Anoxic Detention Time	hours	2.1	1.8
Aerobic Detention Time	hours	5.9	5.0
Anoxic + Aerobic Detention Time	hours	8.0	6.8
Mixed Liquor Suspended Solids (MLSS)	mg/l	2,800	--
Mixed Liquor Volatile Suspended Solids (MLVSS)	mg/l	2,240	--
Mean Cell Residence Time	days	5.3	2.8
Waste Activated Sludge (WAS) mass rate	lbs/day	41,050	--
WAS Concentration (based on wasting MLSS)	mg/l	7,000	--
WAS Flow	mgd	0.7	--
WAS Ratio: TSS/BOD_5 Removed	--	0.8	--
Net Actual Oxygen Demand	lbs/day	64,500	--
SECONDARY CLARIFICATION			
Type: Rectangular - Conventional	--	--	--
Influent Flow (plant effluent only)	mgd	30.9	44.8
Return Activated Sludge (RAS) Flow	mgd	20.5	29.8
RAS Concentration	mg/l	6,180	7,500

Table A-12
Design Criteria and Loadings
South Bay Water Reclamation Plant[1]

Process	Units	Parameter Value	
		Average	Peak
Mixed Liquor Flow (less WAS)	mgd	24.76	29.21
Mixed Liquor TSS Concentration	mg/l	2,800	--
Total Number of Units	--	9	9
Unit Width	feet	20	20
Unit Depth	feet	130	130
Nominal Unit Depth	feet	15	15
Total Area	square feet	23,400	23,400
Total Volume	cubic feet	351,000	351,000
Surface Overflow Rate (all units in service)	gpd/square foot	656	--
Surface Overflow Rate (one unit out of service)	gpd/square foot	--	856
Solids Loading Rate w/MLSS waste (all units in service)	lbs/square foot/day	24.7	--
Solids Loading Rate (one unit out of service)	lbs/square foot/day	--	32.8
TERTIARY FILTRATION			
Type: Monomedia	--	--	--
Design Influent Flow	mgd	15	--
Total Number of Units	--	7	7
Unit Width	feet	15	15
Unit Length	feet	30	30
Unit Depth	feet	19	19
Total Area	square feet	3,150	3,150
Filtration Rate (one unit out of service)	gpm/square foot	3.31	--
Filtration Rate (two units out of service)	gpm/square foot	3.86	--
WASTE BACKWASH TANK			
Type: Rectangular & Concrete	--	--	--
Maximum Instantaneous Flow	gpm	22,220	22,220
Number of Units	--	1	1
Volume per Backwash Event	million gallons	0.1	0.26
Backwash Water per Day	mgd		3.6
Overflow Rate	gpm	1,610	2,520
Maximum Depth	feet	30	30
Volume	million gallons	0.66	0.66
	cubic feet	87,690	87,690
Volume as % Daily Backwash Volume	%	28	18
TERTIARY DISINFECTION			
Type: Ultraviolet (UV) Disinfection	--	--	--
Design Flow	mgd	15	15
Influent Turbidity	NTU	2	2
Total Number of Disinfection Channels	--	1	1
Width	feet	82	82
Depth	feet	140	140

Table A-12
Design Criteria and Loadings
South Bay Water Reclamation Plant[1]

Process	Units	Parameter Value	
		Average	Peak
Length	feet	68	68
Volume	cubic feet	5,420	5,420
Residence Time (theoretical)	hours	3.9	3.9
Residence Time (estimated)	hours	3.5	3.5
UV Lamps: med. Pressure/high intensity mercury	--	--	--
Wavelength	nanometers	253.7	253.7
Number of Banks	--	4	4
Modules per Bank	--	11	11
Lamps per Module	--	8	8
Lamps per Bank	--	88	88
Total Number of Lamps	--	352	352
Lamp Arc Length	inches	10	10
Lamp Life	Hours	5,000	5,000
Lamp Output	µWatts/sec/sq. cm	140,000	140,000
Minimum Exposure Time	seconds	3.4	3.4
UV Channel Unobstructed Approach Length	feet	8	8
UV Channel Unobstructed Downstream Length	feet	8	8
UV Intensity Probes	--	4	4
Fluid Transmittance Probes	--	1	1

Primary Sedimentation. The South Bay WRP primary treatment facilities receive wastewater that has been treated to remove screenings and grit. Settled solids are withdrawn from the primary sedimentation tanks and conveyed to the Sludge Transfer Pump Station. The primary sludge, together with secondary scum and waste activated sludge, is pumped to the SMI for subsequent removal at the Point Loma WWTP. Primary scum production is minimal, and accumulation is not economical for hauling. As a result, scum is combined with return sludge and discharged to the SMI for removal at the Point Loma WWTP. Primary effluent flow is metered and the flow to the aeration facilities is controlled to maintain equalized flow. Excess primary effluent flows by gravity to the flow equalization pump station. The primary sedimentation facilities share a cast-in-place concrete structure with the headworks facility and the equalization pumping facilities.

Flow Equalization. The flow equalization facilities consist of the flow equalization pump station and two storage tanks. The flow equalization pump station adjoins the primary effluent channel. The storage tanks are located south of the headworks building.

Aeration Basins and Blower Building. The South Bay WRP uses the air activated sludge process with an anoxic selector zone. The aeration basins are cast in place reinforced concrete tanks. The aerobic portion of each basin operates as a single pass, plug flow reactor capable of achieving full nitrification. The nitrified mixed liquor is returned to an anoxic zone at the influent end of the basins for denitrification.

The blower building is an above ground single story building located adjacent to the aeration basins that houses the aeration air blowers along with the channel blowers and service and instrument air supply system. The waste activated sludge pump station is integral with the aeration basins structure. The WAS wet well receive either mixed liquor from the mixed liquor channel or returned activated sludge pumped from the secondary clarifiers. WAS pumps are located in a dry pit adjacent to the WAS wet well and will pump WAS to the interim sludge pump station.

Secondary Clarification. The secondary clarification process removes suspended solids from the mixed liquor process flow from the aeration basins. Supernatant clarified effluent flows out of the clarifiers through launders. The clarified effluent is either pumped to the tertiary treatment facilities or is discharged to the SBOO. Settled solids are collected in a sludge hopper in each clarifier, thickened by gravity, then pumped from the hoppers to the aeration process (as RAS) or are discharged as WAS back into the Metro System for treatment at the Point Loma WWTP.

The secondary sedimentation facilities share a cast-in-place concrete structure with the tertiary filtration facilities. The secondary effluent channel adjoins the filter influent channel. The space below the channels between the clarifiers and the filters houses the return activated sludge pumps and the filter piping. The tertiary intermediate pump station and the plant drainage pump station are integral with the clarifier/filter structure. The WAS pump station is located in the aeration basins structure.

Tertiary Filters. Depending upon recycled water demands, some or all of the secondary effluent flow is pumped to the tertiary filtration system. Filter influent is pretreated with alum or ferric chloride and/or polymer chemical addition and static mixing for coagulation. The effluent is filtered using deep bed mono-media filters of cast-in-place concrete construction. The filters are backwashed with air and water. Backwash water is pumped to the filters from the effluent pump station. Waste backwash water is temporarily held in a waste backwash storage tank adjacent to the filters and pumped back to the primary sedimentation influent channel at a constant rate.

The filtration facilities share a common cast-in-place concrete structure with the secondary clarifiers. The secondary effluent channel adjoins the filter influent channel. The return activated sludge pump and the filter gallery share a common space in the structure under the channels. The filter feed pump station is located on the eastern side of the secondary clarifier structure at the secondary effluent channel. The filters, waste backwash water storage tank, coagulation room, air scour blower room, and filter control room are part of the filtration structure. The filter backwash pumps and the possible future filter surface wash pumps are located in the effluent pump station.

Ultraviolet Disinfection. South Bay WRP recycled water is disinfected using an ultraviolet (UV) disinfection process. The medium-pressure, high intensity UV disinfection process was designed in accordance with the State Water Resources Control Board Division of Drinking Water (formerly California Department of Public Health) UV Disinfection Guidelines for Wastewater Reclamation. Sodium hypochlorite is added before UV disinfection to prevent algae growth in the UV stream and maximize the effectiveness of the UV treatment.

Air Emissions/Odor Control. The South Bay WRP odor control system includes two-stage scrubber system consisting of a packed tower chemical scrubber followed by an activated carbon scrubber. The chemical scrubber removes 90 percent or more of the H_2S concentration. Caustic and hypochlorite solutions are used as the principle scrubbing agents in the packed tower scrubber. This unit is followed by an activated carbon scrubber using a dual bed. The activated carbon scrubber consistently removes 95 percent of the remaining H_2S and most other organic odors remaining after wet chemical scrubbing.

Solids Disposal. Solids generated by the South Bay WRP treatment processes are discharged back into the SMI via an 8-inch diameter pipeline for conveyance to and removal at the Point Loma WWTP.

South Bay Ocean Outfall. The SBOO is jointly-owned by the City of San Diego and the U.S. Section of the International Boundary and Water Commission (IBWC). The outfall discharges wastewater from both the South Bay WRP and from the IBWC International Wastewater Treatment Plant.

The outfall has an average daily flow capacity of 174 million gallons per day (mgd) and a peak flow capacity of 333 mgd. The City of San Diego has purchased use of up to 40 percent of the outfall capacity (up to 74 mgd average daily flow capacity and 133 mgd of peak flow capacity). The remaining outfall capacity will be used by the IBWC International Wastewater Treatment

Plant. The South Bay Ocean Outfall includes an underground tunnel from the western terminus of the South Bay Land Outfall to roughly 13,500 feet offshore, where it surfaces and continues along the sea floor ending in a Y-shaped structure and two diffuser legs approximately 3.5 miles offshore at a depth of about 95 feet.

A.8 CENTRALIZED WASTEWATER OPERATIONS CONTROL

The City's Central Operations and Management Center (COMC) features a distributed control system that integrates monitoring and control of the treatment, storage, metering, and pumping facilities in the Metro System and the City of San Diego's wastewater system. Ultimately, more than 200 facilities will be monitored and controlled either from the Distributed Control System at each facility or from the COMC control room.

The COMNET system integrates all facility support automation systems such as fire alarm, management information systems, electronic operations and maintenance manuals, card access systems, process control training simulators, and energy management systems. Presently, Metro System facilities that are monitored and controlled from COMC include:

- North City WRP,
- South Bay WRP,
- Grove Avenue Pump Station,
- Otay River Pump Station, and
- Peñasquitos Pump Station.

Additionally, COMC has the capability to monitor and control the following facilities on an as-needed basis:

- Pump Stations 1, 2, 64, 65,
- MBC, and
- Point Loma WWTP.

A SCADA (supervisory control and data acquisition) system is integrated within the monitoring and control system. This system currently monitors 76 of the City of San Diego's municipal pump stations and monitors and controls valve stations using spread-spectrum radio communication. In the future, this system will include all of the City's pump stations and a total of more than 100 facilities.

COMC is located at the Metropolitan Operation Center II in Kearny Mesa. A Department Information Network, using a City-owned fiber optic cable network, provides remote monitoring, control and communications of all remote facilities from COMC. Although each facility also has a control room, COMC has full control capability for each facility, and has an operator on duty 24-hours a day to provide either back-up for the facility operators, or full remote control without a local operator.

COMC has two custom-designed operations consoles, with 10 Microsoft Windows-based computer workstations, printers, and telephone and radio communications. Four 72-inch light-emitting diode (LED) displays on the front wall of the control room provide additional monitoring. The operator workstations provide graphical representations of the treatment process at each facility. Real-time information is continuously displayed and updated every second.

To aid in operator training, and to provide quick identification of process areas, many of the screen graphics use realistic isometric (three-dimensional) drawings of the buildings, with cutaway views of the equipment inside. Altogether, more than 1200 graphics are available, organized with links between graphics to make retrieval and access easy.

A.9 METRO SYSTEM FACILTIES CHEMICAL USE

The City during the past several years has proceeded with phased implementation of a proprietary technology called PRI-SC (Peroxide Regenerated Iron Sulfide Control). The PRI-SC system involves coordinated chemical addition at key points within the Metro System to achieve the following goals:

- improved solids removal at the Point Loma WWTP,
- more effective odor control,
- reduced iron and solids emissions to PLOO, and
- reduced system-wide chemical costs.

The conceptual basis of the PRI-SC system is to utilize iron for sulfide control, and to utilize hydrogen peroxide (H_2O_2) to regenerate ferrous or ferric iron from the spent iron salts. Figure A-16 (page A-65) schematically presents this process. To initiate the cycle, ferrous chloride is added at upstream Metro System pumping stations (see Figure A-17 on page A-65) for sulfide control. Currently, ferrous chloride addition has been implemented within the City of Del Mar and at Pump Station 65, the Peñasquitos Pump Station, the East Mission Gorge Pump Station, and Pump Station 1.

The second part of the process involves adding hydrogen peroxide at downstream points to regenerate the iron for use in sulfide control and to enhance settling and solids removal at the Point Loma WWTP. In this way, iron added at upstream pump stations for odor control is regenerated and becomes available for odor control in the downstream portion of the collection system and to enhance flocculation in the Point Loma WWTP primary treatment clarifiers. As shown in Figure A-17, hydrogen peroxide is currently added at the North City WRP, Pump Station 2, and the Point Loma WWTP.

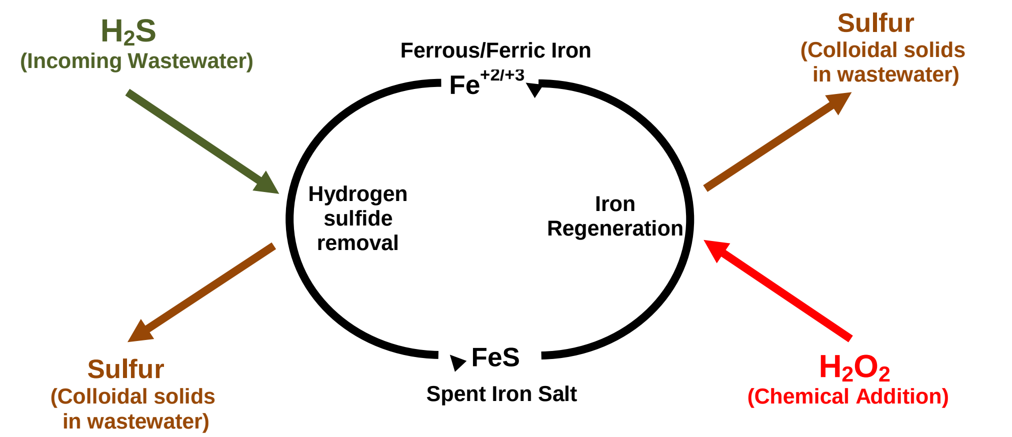


Figure A-16
PRI-SC Iron Regenerative Cycle

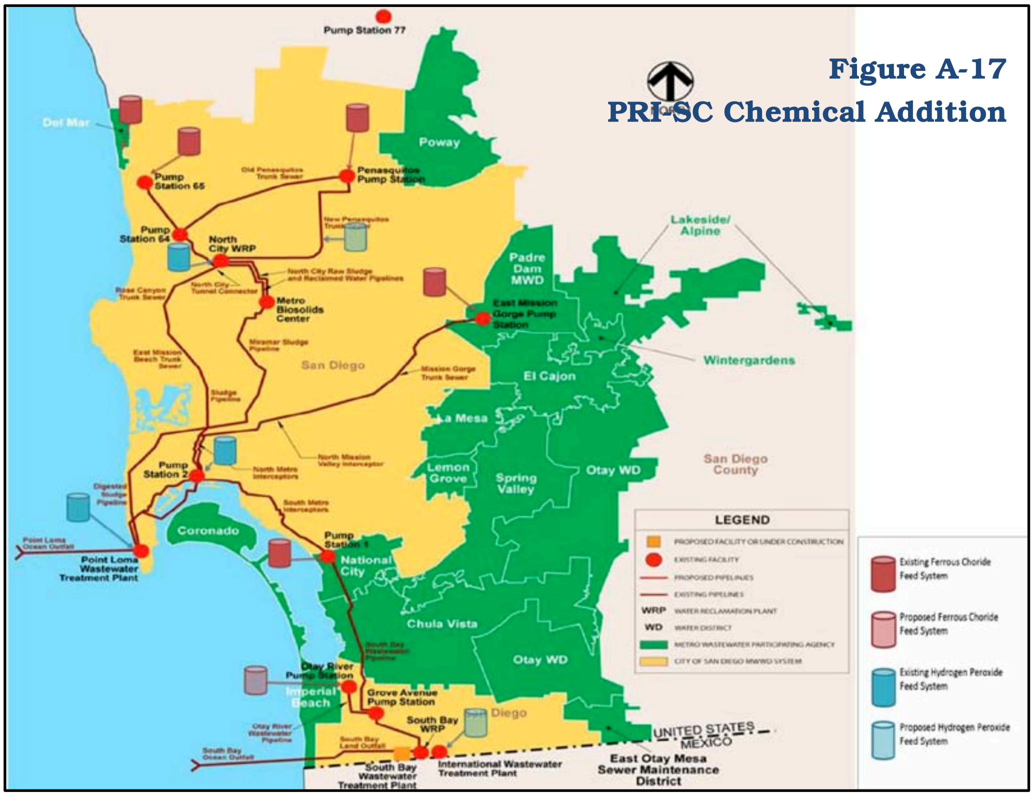


Figure A-17
PRI-SC Chemical Addition

Table A-13 (page A-67) summarizes current chemical application at the Metro System pump stations. Table A-14 (page A-68) summarizes chemicals used at Metro System treatment and solids handling facilities. Chemical application rates shown in Tables A-13 and A-14 reflect experience gained during the past few years as the City has fine tuned the PRI-SC chemical addition process to maximize odor control, maximize solids removal rates, minimize chemical costs, and minimize ocean discharges of iron salts.

The system-wide PRI-SC chemical addition program has resulted in noticeable improvement in solids removal at the Point Loma WWTP during the past few years. By mid-2012, the chemical additional process had been sufficiently adjusted to consistently achieve Metro System system-wide solids removal rates in excess of 90 percent (a TSS removal rate normally associated with secondary treatment). Additionally, Point Loma WWTP effluent TSS concentrations since mid-2012 have been consistently maintained below 30 mg/l (an effluent concentration normally associated with secondary treatment). With the success of the PRI-SC operations to date, the City is developing plans (see Appendix B) to expand chemical addition locations within wastewater collection system tributary to the Point Loma WWTP. PRI-SC operations are also proposed within the wastewater collection system tributary to the South Bay WRP.

A.10 ISO 14001 CERTIFICATION

The International Organization for Standardization (ISO) 14001 Environmental Management System is the world's first internally recognized standard for environmental management. ISO 14001 certification demonstrates that an organization has implemented a standardized system to identify and mitigate against environmental impacts associated with everyday processes and activities.

The Metro System's O&M Division in 1999 became the first municipal wastewater treatment organization in the nation to receive the prestigious ISO 14001 Certification. Currently, all PUD operating divisions and wastewater facilities are ISO 14001 Certified. As part of this standardized system, multiple environmental programs have been established within the PUD to support regulatory compliance, pollution prevention, and ongoing program assessment and improvement. Examples of PUD programs implemented through this process include recycling and waste minimization, biosolids beneficial reuse, energy conservation, chemical use reduction, emergency management, and water conservation. The ISO 14001 Standard also addresses planning and preparedness for abnormal or emergency conditions involving operation and maintenance of all Metro System facilities.

Conformance to the ISO 14001 standard is monitored by an independent external audit certification agency on an annual basis. The PUD provides staff and resources to ensure continued ISO 14001 Environmental Management System certification.

Table A-13
Summary of Chemical Use at Metro System Pump Stations

Chemical	Application Point	Purpose	Typical Dosage
PUMP STATION 1			
Ferrous Chloride	Influent wet well	Sulfide control in wastewater	4700 gpd
Sodium Hydroxide	Odor scrubber(s)	Odor control	2-3 gpd
Sodium Hypochlorite	Odor scrubber(s)	Odor control	0.5 - 1 gpd
PUMP STATION 2			
Hydrogen Peroxide	Influent wet well	Iron salt regeneration to enhance Point Loma WWTP coagulation	900 gpd
Sodium Hydroxide	Odor scrubber(s)	Odor control	5 gpd
Sodium Hypochlorite	Odor scrubber(s)	Odor control	25 - 30 gpd
PUMP STATION 64			
Sodium hypochlorite	Odor scrubber(s)	Odor control	25 gpd
Sodium Hydroxide	Odor scrubber(s)	Odor control	5 gpd
PUMP STATION 65			
Ferrous chloride	Influent wet well	Sulfide control	400 gpd
Sodium hypochlorite	Odor scrubber(s)	Odor control	30 gpd
Sodium Hydroxide	Odor scrubber(s)	Odor control	5 gpd
EAST MISSION GORGE PUMP STATION			
Ferrous chloride	Influent wet well	Odor control force main	1000 gal/week
Sodium hypochlorite	Odor scrubber(s)	Odor control	3-5 gpd
PENASQUITOS PUMP STATION			
Ferrous chloride	Influent wet well	Odor control force main	500 gpd
Sodium hydroxide	Odor scrubber(s)	Odor control	1 gpd
Sodium hypochlorite	Odor scrubber(s)	Odor control	3-5 gpd

Table A-14
Chemical Use at Metro System Treatment and Solids Handling Facilities

Chemical	Application Point	Purpose	Typical Dosage
METRO BIOSOLIDS CENTER			
Ferric chloride	Feed flow/centrifuges	Flocculation and scale control	0 - 500 gpd
Ferrous chloride	Digester in service	Control of hydrogen sulfide gas	500 gpd
Mannich polymer	Feed flow/centrifuges	Flocculation	4,500 gpd
Sodium hydroxide	Wet scrubbers	Odor control, adjust ORP[2]	200 gpd
Sodium hypochlorite	Wet scrubbers	Odor control, adjust pH	120 gpd
NORTH CITY WRP[1]			
Hydrogen peroxide	Influent wet well	Iron salt regeneration for coagulation	400 gpd
Anionic Polymer	Aeration Effluent Channel	Turbidity control	60 lbs/day
Sodium Hydroxide	Influent PS/headworks/primary	Odor control	30 gpd
Ferrous Chloride	Sludge pump station	Odor control	500 gpd
Hydrochloric Acid 31%	Influent PS /headworks/primary	Odor control	7.8 gpd
Sodium Hypochlorite	Influent PS/headworks/primary	Odor control	300 gpd
Sodium Hypochlorite	Filter effluent	NC disinfection	1,500 gpd
POINT LOMA WWTP			
Hydrogen Peroxide	Y structure upstream	Iron salt regeneration for coagulation	700 gpd
Anionic Polymer	Flumes to sedimentation basins	Flocculation	200 gpd
Caustic Soda	Odor tower wet scrubber	Odor control, adjust ORP[2]	ORP[2] > 575
Ferric Chloride	Parshall flumes	Coagulation	2,900 gpd
Ferrous Chloride	Sludge blending tank	Hydrogen sulfide control at digesters	3,800 gpd
Salt	Water softener	Odor control	500 lbs/day
Sodium Hypochlorite	Odor tower wet scrubber	Odor control, adjust ORP[2]	ORP[2] > 575
Sodium Hypochlorite	Effluent channel	Effluent disinfection	7,000 gpd
SOUTH BAY WRP			
Alum (poly-alum)	Tertiary filters main influent line	Coagulant aid/turbidity control	0 - 5 gpm
Sodium Hydroxide	Odor control wet scrubbers	Odor control	> 9.0 pH units
Sodium Hypochlorite	Odor control wet scrubbers	Odor control, adjust ORP[2]	ORP[2] > 575
Sodium Hypochlorite	UV influent channel	Algae control	500 gpd
Sodium Hypochlorite	Header lines	Odor control	100 gpd
Cationic Polymer	RAS header lines	Flocculation	0 - 30 gpd
Sodium Hypochlorite	RAS header lines	Filament control	1 - 2 gpd

1 Does not include chemicals used as part of advanced water treatment facilities for the Water Purification Demonstration Project.
2 ORP indicates oxygen reduction potential.

Appendix B.1
PLANNED METRO SYSTEM FACILITIES IMPROVEMENTS

Renewal of NPDES CA0107409

APPENDIX B.1

PLANNED METRO SYSTEM FACILITIES IMPROVEMENTS

San Diego Public Utilities Department

January 2015

APPENDIX B.1

PLANNED METRO SYSTEM FACILITIES IMPROVEMENTS

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AWP	advanced water purification
BOD	biochemical oxygen demand
CIP	Capital Improvements Program
DDW	State Water Resources Control Board, Division of Drinking Water
DPR	direct potable reuse
EIR	Environmental Impact Report
EPA	United States Environmental Protection Agency
GIS	geographic information system
I&I	inflow and infiltration
IAP	Independent Advisory Panel
IPR	indirect potable reuse
JPA	Joint Powers Authority
MBC	Metro Biosolids Center
MER	mass emissions rate
Metro System	San Diego Metropolitan Sewerage System
mgd	million gallons per day
mg/l	milligrams per liter
mt/year	metric tons per year
North City WRP	North City Water Reclamation Plant
PLOO	Point Loma Ocean Outfall
Point Loma WWTP	Point Loma Wastewater Treatment Plant
PRI-SC	Peroxide Regenerated Iron Sulfide Control
PUD	City of San Diego Public Utilities Department
Regional Board	California Regional Water Quality Control Board, San Diego Region
SANDAG	San Diego Association of Governments
South Bay WRP	South Bay Water Reclamation Plant
TSS	total suspended solids
WPDP	Water Purification Demonstration Project

APPENDIX B.1

PLANNED METRO SYSTEM FACILITIES IMPROVEMENTS

ABSTRACT

This appendix summarizes planned facilities improvements to the San Diego Metropolitan Sewerage System (Metro System). In submitting this application for renewal of 301(h) modified secondary treatment standards for the Point Loma Wastewater Treatment Plant (Point Loma WWTP), the City is committing to reducing both flows and solids discharged to the ocean by implementing a joint water/wastewater facilities plan called *Pure Water San Diego*. *Pure Water San Diego* establishes the goal of producing potable water for the San Diego Region while offloading flows and loads from the Point Loma WWTP. The *Pure Water San Diego* plan envisions implementing 83 million gallons per day (mgd) of potable reuse water by December 31, 2035. To demonstrate the City's commitment to advance the State's water recycling goals, this NPDES application proposes an initial schedule of *Pure Water San Diego* implementation tasks for inclusion as enforceable permit conditions within the renewed Point Loma WWTP NPDES permit. Proposed enforceable tasks for the next five years would focus on the initial 15 mgd potable reuse component of the *Pure Water San Diego* program. In addition to the *Pure Water San Diego* program, other planned near-term Metro System facilities improvements include upgrading grit removal facilities at the Point Loma WWTP, upgrading equipment at Pump Station 2, and implementing refinements to the system-wide chemical addition program.

B.1.1 FACILITIES PLANNING OVERVIEW

As described in Appendix A, the Metro System provides for the conveyance, treatment, reuse, and disposal of wastewater within a 450-square-mile service area. The City of San Diego Public Utilities Department (PUD) serves as operator of the Metro System and as the planning agency for assessing Metro System facilities needs. Participating agency input to Metro System planning and operation is provided through the Metro Wastewater Joint Powers Authority (see Appendix A for Metro System participating agencies).

As planning and operating agency of the Metro System, the PUD regularly prepares and updates plans for Metro System facilities. Three key planning efforts have been completed since 2012 which led to the development of the proposed *Pure Water San Diego* program. These planning efforts include:

- the 2012 *Metropolitan Wastewater Plan*,
- the 2012 *Recycled Water Study*, and the
- 2013 *Water Purification Demonstration Project*.

2012 Metropolitan Wastewater Plan. The 2012 *Metropolitan Wastewater Plan* focuses on backbone Metro System collection and treatment facilities, and presents guidance on potential Capital Improvement Program (CIP) projects required to handle future Metro System flows and loads. To accomplish this, the 2012 *Metropolitan Wastewater Plan*:

- presents updated Metro System population and wastewater flow projections through year 2050,
- evaluates the adequacy of existing Metro System treatment and conveyance facilities to handle projected flows and loads,
- identifies recommended Metro System facilities improvements (and the probable timing of the required improvements) required to handle future flows and loads,
- prioritizes future CIP projects, and
- presents cost information for inclusion in future CIP budgets.

In essence, the 2012 *Metropolitan Wastewater Plan* evaluates Metro System facilities that would be required if past wastewater planning practices were to be continued (e.g. implementing existing upstream non-potable recycled water use and discharging all other flow to the Point Loma WWTP for treatment and ocean discharge). With the adoption of the City's *Pure Water San Diego* program, the City has chosen a different wastewater planning direction than that described within the 2012 *Metropolitan Wastewater Plan*. The 2012 *Metropolitan Wastewater Plan*, however, provides value in (1) forecasting future Metro System flows and loads, and (2) assessing backbone Metro System facilities improvements that can be implemented to support facilities proposed as part of the *Pure Water San Diego* program.

2012 Recycled Water Study. The City of San Diego in 2009 entered into a cooperative agreement with San Diego Coastkeeper and the San Diego Chapter of the Surfrider Foundation to initiate a study that would serve as a guidance document in helping policy leaders make important decisions regarding water reuse and the region's water and wastewater infrastructure. Objectives of the *Recycled Water Study* included:

- identifying opportunities to increase recycled water use,
- evaluating the extent to which recycling could reduce Point Loma WWTP discharge flows to the ocean, and
- evaluating implementation costs and benefits associated with the recycled water opportunities.

The study was conducted through a public participation process that included stakeholder participation in technical workshops, regularly scheduled status meetings, and stakeholder review of all technical memoranda and the project report. Stakeholders participating in the study included:

- City of San Diego,
- San Diego Coastkeeper,
- San Diego Chapter of the Surfrider Foundation,
- Metro System Participating Agencies,
- an Independent Rates Oversight Committee, and
- the San Diego County Water Authority and its member agencies.

The *Recycled Water Study* (presented as Appendix B.2) concluded that only limited opportunities existed for expanding the current 11 mgd (million gallons per day) of non-potable reuse within the service areas of the North City Water Reclamation Plant (North City WRP) and South Bay Water Reclamation Plant (South Bay WRP). The study concluded that additional non-potable demands were geographically dispersed, and that it would not be cost-effective to expand the non-potable water conveyance system to serve such a geographically diverse non-potable customer base. While expansion of the existing non-potable conveyance system was not deemed economically feasible, the study identified an additional 7 mgd of non-potable demand that could be served by existing non-potable water conveyance infrastructure.

The *Recycled Water Study* also evaluated two forms of indirect potable reuse (IPR): groundwater recharge IPR and surface reservoir augmentation IPR. The study concluded that opportunities were limited for using recycled water to recharge groundwater basins due to lack of capacity of local groundwater basins and lack of sufficient groundwater basin data on which to assess compliance with State of California recycled water groundwater recharge regulations implemented by the State Water Resources Control Board Division of Drinking Water (DDW).

Reservoir augmentation IPR, on the other hand, was concluded as representing a significant opportunity for creating a new local water supply while at the same time reducing wastewater discharges to the ocean. Two City of San Diego reservoirs (San Vicente Reservoir and Otay

Reservoir) were deemed large enough to represent viable candidates as reservoir augmentation sites which could comply with DDW guidance regarding reservoir detention time.

The *Recycled Water Study* developed and evaluated five Integrated Reuse Alternatives. Each of the potential alternatives involved expanding non-potable recycled water use to 18 mgd, while producing approximately 83 mgd of purified water for use in augmenting recharge to San Vicente Reservoir (68 mgd) and Otay Reservoir (15 mgd). Figure B.1-1 and Table B.1-1 summarize the five Integrated Reuse Alternatives.

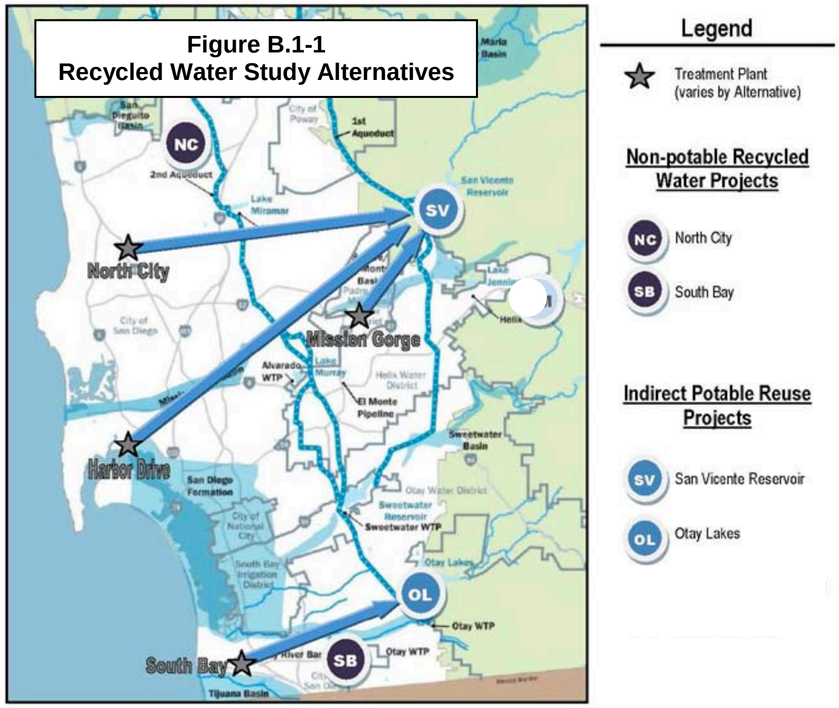


Figure B.1-1
Recycled Water Study Alternatives

Table B.1-1
Summary of Integrated Reuse Alternatives - 2012 Recycled Water Study[1]

Alternative[1]	Proposed Production Capacity (mgd)						
	Non-Potable Recycled Water		Advanced Purification Treatment for Reservoir Augmentation				
	North City[2]	South Bay[3]	North City[4]	Harbor Drive[4]	Camino Del Rio[4]	Mission Gorge[4]	South Bay[5,6]
A1	9	9	27	See note[7]	41[7]	--	15
A2	9	9	27	41[8]	--	--	15
B1	9	9	15	See note[7]	53[7]	--	15
B2	9	9	15	53[8]	--	--	15
B3	9	9	15	46[8]	--	7	15

1 Integrated Reuse Alternatives involving both expansion of non-potable reuse and implementation of potable reuse were developed through a stakeholder screening process as part of the *Recycled Water Study* (City of San Diego, 2012).
2 Non-potable recycled water use to be served by the North City WRP and the North City non-potable conveyance system.
3 Non-potable recycled water use to be served by the South Bay WRP and the South Bay non-potable conveyance system.
4 Purified water would be directed to San Vicente Reservoir. See Figure B.1-1 above.
5 Purified water would be directed to Otay Reservoir. See Figure B.1-1 above.
6 To provide adequate flow to the South Bay WRP to support the proposed reuse, some Metro System flows currently being directed to the Point Loma WWTP would be diverted to the South Bay WRP (South Bay Diversion).
7 Alternatives A1 and B1 involve constructing a recycled water treatment facility at the City-owned Harbor Drive site and conveying the recycled water to an advanced purification treatment facility located at a City-owned site in Mission Valley on Camino Del Rio.
8 Combined recycled water and advanced purification treatment facility would be constructed at the City-owned Harbor Drive site.

The *Recycled Water Study* concluded that each of the Integrated Reuse Alternatives would accomplish the objectives of reducing PLOO discharge flows while enhancing the region's water supply portfolio. Key study conclusions included:

Reliability and Local Control. Creating purified water from local recycled water supplies would create an uninterruptable water source.

Enhanced Sustainability. Creating a local purified water supply would be more sustainable and environmentally friendly than importing water.

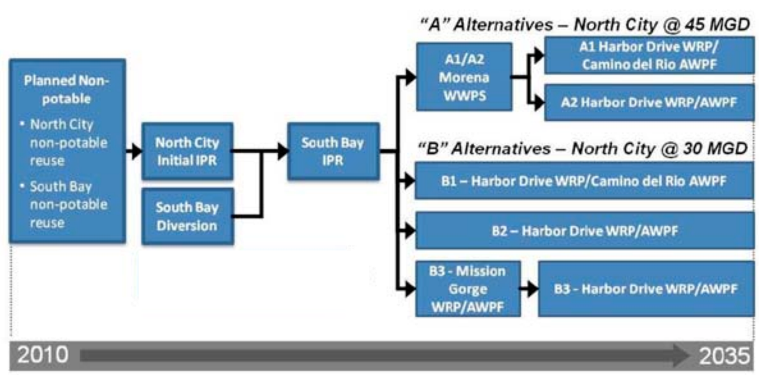
Improved Water Quality. Purified water would reduce salinity concentrations in San Vicente and Otay Reservoirs and would result in reduced salinity concentrations in the treated potable supply

Long-term Cost Control. The water purification concept would increase the Region's ability to control long-term water and wastewater costs and better insulate the Region from future cost increases in imported water costs and future restrictions on the availability of imported water supplies.

Stakeholder Support. Local reuse solutions identified within the *Recycled Water Study* are supported by rate oversight and environmental stakeholder representatives.

Favorable Water Costs. Taking into account cost savings associated with reduced salinity in the water supply, reducing wastewater system costs, and saving associated with maintaining the Point Loma WWTP as a chemically enhanced primary treatment plant, purified water produced by the program would be more economical than future imported water costs.

Figure B.1-2
Recycled Water Study Implementation Plan



The *Recycled Water Study* presented a phased approach (see Figure B.1-2) that proposed sequentially focusing on (1) expanding non-potable reuse that could be served by existing non-potable conveyance infra-structure, (2) implementing the first 15 mgd of purified water treatment at the North City WRP, (3) diverting sufficient flow to the South Bay WRP to support implementing an additional 15 mgd of purified water treatment at the South Bay WRP, and (4) expanding overall purified water treatment capacity to 83 mgd by implementing one of the "A" or "B" alternatives. The *Recycled Water Study* determined that this proposed 83 mgd capacity represented the potential potable reuse capacity that was consistent with initial facilities planning, stake-holder input, cost and benefit analyses, regional water demand analyses, and DDW guidance on IPR reservoir augmentation. To achieve this ultimate potable reuse capacity, the *Recycled Water Study* developed an implementation plan for moving forward with:

- increasing public and stakeholder involvement,
- demonstrating the technical, economic, and regulatory feasibility of reservoir augmentation IPR,
- developing and refining a proposed financial plan,
- preparing required technical support studies,
- addressing environmental, permitting and regulatory issues,
- exploring the future potential for direct potable reuse,
- evaluating and refining project alternatives and implementation schedules, and
- supporting City and Participating Agency review and consideration of proposed alternatives, financial plans, and reuse implementation schedules.

Water Purification Demonstration Project. Reservoir augmentation with purified water was an integral component of the Integrated Reuse Alternatives assessed as part of the *Recycled Water Study*. Concurrent with completing the 2012 *Recycled Water Study,* the City of San Diego initiated the multi-year Water Purification Demonstration Project (WPDP), which evaluated the feasibility of augmenting water supplies in San Vicente Reservoir with purified water produced by an advanced water purification (AWP) facility. Elements of the WPDP included:

- installing and operating a 1 mgd demonstration-scale AWP facility at the North City WRP site,
- conducting a comprehensive monitoring program that assesses the quality of purified water, the reliability and effectiveness of AWP treatment, and purified water conformance with applicable water quality requirements,
- developing a hydrodynamic limnology model of San Vicente Reservoir to evaluate hydrodynamic and water quality effects of reservoir augmentation under a wide range of hydrologic conditions,
- implementing a comprehensive public outreach and education program,
- developing conceptual design criteria and costs for full-scale AWP and conveyance facilities,
- identifying applicable regulatory requirements, and
- identifying a path forward for achieving regulatory approval for full-scale reservoir augmentation.

An Independent Advisory Panel (IAP) provided oversight and expert peer review of the technical, scientific, and regulatory aspects of the WPDP. The IAP, organized by the National Water Research Institute, consisted of 10 academics and professionals with extensive expertise in the science of water reuse, chemistry, microbiology, advanced treatment, engineering, water and wastewater operations, regulatory requirements, limnology, toxicology, and public and environmental health.

Regulatory staff from DDW and the California Regional Water Quality Control Board (Regional Board) participated in IAP meetings and technical workshops. Both the IAP and regulators provided guidance for:

- framing the purified water reservoir augmentation concept,
- developing the scope for technical studies, modeling studies, and monitoring required to assess WPDP feasibility,
- reviewing and interpreting the results of the technical studies, modeling, and monitoring, and
- identifying pathways for securing required regulatory approvals.

The concept for a full-scale purified water reservoir augmentation project at San Vicente Reservoir was based on guidance from DDW and the IAP. Key elements of the purified water concept are illustrated in Figure B.1-3.

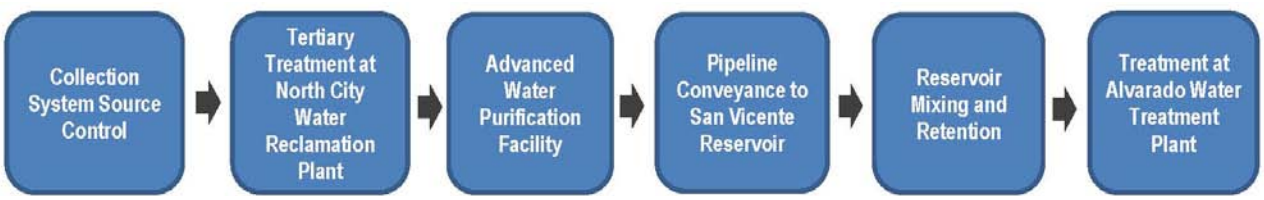


Figure B.1-3 WPDP Reservoir Augmentation Concept

The full-scale water purification concept addressed within the WDPD involves producing 15 mgd of purified water from an advanced purification treatment facility located at the North City WRP site. Purified water would be conveyed to San Vicente Reservoir through a dedicated pipeline for storage. Withdrawn reservoir waters would then undergo conventional potable water treatment.

To support development of the full-scale water purification concept, the 1 mgd AWP demonstration facility at the North City WRP featured three advanced treatment processes: membrane filtration, reverse osmosis treatment, and ultraviolet disinfection/advanced oxidation. Water quality testing and monitoring at the AWP facility included more than 9,000 tests at various points in the treatment process for 342 different water quality and microbial parameters.

The WPDP final project report is attached as Appendix B.3. Key conclusions presented within the WPDP project report include:

Source Control. To support water purification and comply with applicable DDW requirements, the existing Metro System pretreatment program can be modified to address an expanded list of contaminants that may have public health relevance, including industrial chemicals, pharmaceuticals, and other constituents of concern.

Treatment Performance. The comprehensive WPDP monitoring program demonstrated that the purified water meets all applicable water quality standards.

Treatment Reliability. Reliability and quality assurance monitoring of each water purification process can assure the integrity of each treatment process and ensure that only the highest quality purified water is produced.

Energy Use. A full-scale reservoir augmentation project at San Vicente Reservoir would require approximately the same amount of energy and generate green house gas emissions comparable to an equivalent quantity of imported water.

Reservoir Storage. Adding purified water to San Vicente Reservoir would not affect natural hydrologic characteristics of the reservoir, stratification, or mixing. Blending and retention of purified water in San Vicente Reservoir would provide a substantial environmental barrier sufficient to meet regulatory requirements.

Regulatory Compliance. The WPDP concept will comply with applicable drinking water standards and discharge requirements established by DDW and the Regional Board.[1,2,3]

The WPDP effort demonstrated the overall feasibility of the purified water treatment and reservoir augmentation concepts addressed in the 2012 *Recycled Water Study* and provided the City of San Diego, Metro System Participating Agencies, and regional stakeholders with information on which to frame the *Pure Water San Diego* water and wastewater facilities planning approach proposed herein.

B.1.2 PURE WATER SAN DIEGO PROGRAM

Program Goals. *Pure Water San Diego* is a joint water and wastewater facilities program that seeks to achieve the reuse goals identified within the 2012 *Recycled Water Study* through implementation of full-scale potable reuse water purification facilities. As noted in the "Basis of

1 In a letter dated September 7, 2012, DDW provided concept approval for the proposed 15 mgd full-scale water purification concept developed as part of the WPDP that included advanced purification treatment at the North City WRP and discharge to San Vicente Reservoir.

2 Regional Board Resolution No. R9-2011-0069 (adopted in October 2011) expressed Regional Board support for the implementation of purified water reservoir augmentation at San Vicente Reservoir.

3 In a letter dated February 2013, the Regional Board and U.S. Environmental Protection Agency (EPA) established the framework for how a proposed 15 mgd full scale water purification reservoir augmentation project would be permitted and regulated, and acknowledged Regional Board and EPA support for considering a full-scale purified water project at San Vicente Reservoir.

Application" (Volume (II), the *Pure Water San Diego* program is the result of collaboration between the City of San Diego, Metro Wastewater JPA, and a diverse array of regional stakeholders. The City, Metro Wastewater JPA, and regional stakeholders have agreed to cooperate to:

- implement a comprehensive potable reuse program that would achieve an ultimate goal of 83 mgd of potable reuse (the maximum potable reuse that would be consistent with current DDW regulatory guidance),
- sufficiently reduce influent flows and solids loads to the Point Loma WWTP so that ultimate Point Loma Ocean Outfall (PLOO) TSS mass emissions are reduced to levels at or below those that would have occurred if the Point Loma WWTP at 240 mgd design flow were to achieve secondary treatment TSS concentration standards,
- support the City's application for renewed 301(h) modified limits for TSS and BOD for the Point Loma WWTP, and
- support the City's pursuit of administrative or legislative efforts to codify that, as a result of implementing the comprehensive *Pure Water San Diego* program, the PLOO discharge is recognized as equivalent to secondary treatment for purposes of compliance with the Clean Water Act (secondary treatment equivalency).

Table B.1-2 presents *Pure Water San Diego* program goals for potable reuse for the next 20 years. As shown in the table, *Pure Water San Diego* targets implementing 15 mgd of potable reuse by December 31, 2023 (the full scale water purification project addressed within the WPDP). The program also targets implementing 83 mgd of potable reuse by December 31, 2035 (the goal expressed by the Integrated Reuse Alternatives addressed within the *Recycled Water Study*).

Table B.1-2
Potable Reuse Implementation Goals[1]

Phase	Targeted Goal: Cumulative Potable Reuse Capacity	Target Implementation Date
1	15 mgd	December 31, 2023[3]
2	30 mgd[2]	December 31, 2027[3]
3	83 mgd[2]	December 31, 2035[3]

1 Implementation of the targeted potable reuse capacity goals is subject to (1) timely environmental approval of the *Pure Water San Diego* program and associated projects, (2) timely regulatory approval of proposed reuse facilities and projects program that comprise the *Pure Water San Diego* program, and (3) continued approval of future 301(h) modified NPDES permits for the Point Loma WWTP or approval of secondary equivalency status for the Point Loma WWTP.

2 Cumulative total purified water production capacity of potable reuse facilities.

3 Target implementation dates may be subject to modification based on regulatory approval schedules, environmental review issues, or legal challenges to the proposed program or projects (see footnote 1).

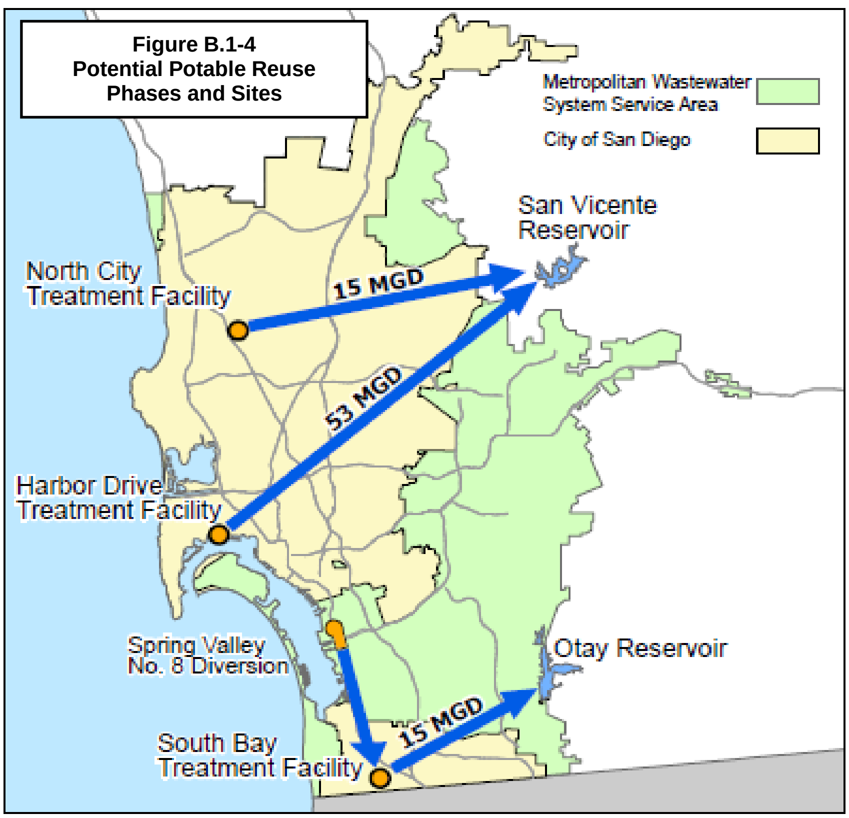
Phase 1 of the *Pure Water San Diego* program involves implementation of the 15 mgd full-scale water purification project addressed within the WPDP (see Appendix B.3). Key facilities required to implement this initial 15 mgd purified water element include:

- an AWP facility located at the North City WRP capable of producing 15 mgd of purified water, and
- a conveyance system (pipeline, pumping station, and ancillary facilities) to deliver purified water from the North City WRP.

Phase 2 of the *Pure Water San Diego* program (to be implemented by December 31, 2027) would involve implementing an additional 15 mgd of potable reuse. Options to be considered as part of this 15 mgd expansion include:

- 15 mgd expansion of the AWP facility at the North City WRP, or
- constructing a 15 mgd AWP facility at the South Bay WRP.

Studies are currently underway to assess feasibility issues associated with implementing an additional 15 mgd of potable reuse as part of these Phase 2 options.



Phase 3 (to be implemented by December 31, 2035, would involve an additional 53 mgd of potable reuse in the North City region. As described within the 2012 *Recycled Water Study*, a number of options are available for achieving the 53 mgd Phase 3 reuse goal. Figure B.1-4 schematically presents an example of one of the ways in which the *Pure Water San Diego* reuse goals may be achieved. (Figure B.1-4 depicts *Recycled Water Study* Integrated Reuse Alternative B1).

Regardless of the location of future Phase 2 and Phase 3 potable reuse facilities, combined non-potable and potable reuse under the *Pure Water San Diego* program would total 101 mgd by December 31, 2035. Figure

While the Integrated Reuse Alternatives developed within the 2012 *Recycled Water Study* represent a potential template for future *Pure Water San Diego* program planning, refinement or revision of potable reuse alternatives presented within the *Recycled Water Study* may occur as a result of environmental studies and pre-design planning studies. Revision of the reuse options may also be warranted once DDW develops and implements final IPR state-wide reservoir augmentation regulations, scheduled for release by December 31, 2016.[4] Additionally, modification of the *Pure Water San Diego* potable reuse planning direction may be warranted as DDW proceeds with its mandated feasibility assessment of direct potable reuse (DPR).[5]

Enforceable Time Schedule Milestones: 2015-2020. To demonstrate the City's commitment to regulators and regional stakeholders to implement the *Pure Water San Diego* program and offload Point Loma WWTP inflows and solids loads, the City proposes that the renewed 301(h) NPDES permit incorporate an enforceable time schedule governing implementation of *Pure Water San Diego* environmental review and facilities design tasks to support implementation of the initial 15 mgd water purification project addressed within the WPDP.

Table B.1-3 (page B.1-12) presents the proposed enforceable time schedule tasks that would be achieved within the five-year period of the renewed five-year NPDES permit. To support the overall goal of implementing 15 mgd of potable reuse by the end of year 2023, the City proposes to complete environmental review and final design of the 15 mgd purified water treatment and conveyance facilities by January 2020.

The City of San Diego has already initiated efforts directed toward achieving the milestones presented in Table B.1-3. Since completion of the *Recycled Water Study* and WPDP, the PUD has worked to refine *Pure Water San Diego* planning goals and reuse alternatives. Additionally, PUD has continued operation of the 1 mgd WPDP demonstration facility and has continued water purification public outreach efforts. Further, in November 2014, the City retained an outside Engineering Services team to assist PUD staff in the multi-year effort to plan and implement *Pure Water San Diego* program facilities.

4 Section 13562(a)(1) and Sections 13564-13565 of the *California Water Code* establishes a deadline of December 31, 2016 for DDW to adopt regulations for surface water augmentation (pending recommendations from an expert panel).

5 Sections 13563 and 13566 of the *California Water Code* require DDW to report to the California Legislature by December 31, 2016 on the feasibility of developing statewide direct potable reuse criteria.

Table B.1-3
Pure Water San Diego Potable Reuse Tasks, 2015 -2020[1]

Category	Task[1]	Implementation Date[1,2]
Pure Water San Diego Environmental Review	Issue Notice of Preparation for Program Environmental Impact Report (EIR)	January 31, 2015
	Publish Draft Program EIR for Public Review	January 31, 2017
	Certify Final Program EIR	January 31, 2018
North City Projects	Notice to Proceed-Final Design of 15 mgd pipeline from the North City WRP	January 31, 2017
	Issue Notice to Proceed on final design of a 15 mgd Potable Reuse Purification Facility (advanced water treatment facility) for the North City WRP site.	May 31, 2017
	Complete Design of 15 mgd purified water pipeline from the North City WRP	October 31, 2019
	Complete Design of 15 mgd Potable Reuse Purification Facility (advanced water treatment facility)	January 31, 2020

1 Implementation task proposed for inclusion as an enforceable provision of NPDES CA0109409 to demonstrate the City's commitment to offloading Point Loma WWTP wastewater flows, increasing reuse of the City's wastewater, and reducing Point Loma WWTP flows and mass emissions discharged to the Pacific Ocean.
2 Task to be completed no later than the listed implementation dates.

Pure Water San Diego Tasks: 2020-2025. As noted, the *Pure Water San Diego* represents a long-term (20-year) commitment to implementing phased increases in potable reuse. While initial efforts in the first five years (2015-2010) will focus on implementing the first 15 mgd phase of the *Pure Water San Diego* program, the City (supported by its Engineering Services team) will continue to monitor DDW development of IPR and DPR regulations, and will evaluate and refine plans required to maximize public health protection and implement the potable reuse goals of the *Pure Water San Diego* program in a cost-effective manner.

During the upcoming NPDES cycle, the City will be refining future required *Pure Water San Diego* planning and implementation tasks and schedules. When the upcoming five-year NPDES permit cycle (approximately 2015-2020) is nearing completion, the City will provide EPA and the Regional Board with a proposed series of *Pure Water San Diego* program tasks for inclusion as enforceable NPDES permit provisions for the following NPDES five-year cycle (years 2020-2025), either as part of an NPDES application based on:

- compliance with secondary equivalency requirements that have been administratively or legislatively established for the Point Loma WWTP, or
- renewal of modified secondary treatment requirements for TSS and BOD for the Point Loma WWTP pursuant to Sections 301(h) and 301(j)(5) of the Clean Water Act.

Example tasks that may be scheduled for completion within the second five year permit period (years 2020-2025) might include:

- constructing required North City purified water conveyance facilities,
- completing construction, start-up testing, and initiating full operation of the 15 mgd AWP facility at the North City WRP site,
- monitoring development of state-wide regulations governing IPR and DPR and assessing opportunities for direct potable reuse,
- completing studies and regulatory evaluations to assess the feasibility of implementing a 15 mgd water purification facility at either the South Bay WRP or an expanded purification facility at the North City WRP,
- completing initial planning and design of facilities required to support achieving the Phase 2 goal of achieving a cumulative potable reuse goal of 30 mgd by the end of 2027 (e.g. adding an additional 15 mgd of potable reuse capacity), and
- refining advance facilities plans for Phase 3 (53 mgd of additional potable reuse).

Goals for Offloading the Point Loma WWTP. In addition to creating a drought-proof uninterruptable new source of water supply, each successive phase of the *Pure Water San Diego* program will offload flows and solids loads from the Point Loma WWTP. As noted in the "Basis of Application" (Volume II), it is estimated that by the end of year 2027 sufficient potable reuse facilities will be on-line to insure that the discharge of TSS mass emissions (on a wet weather annual average basis) from the Point Loma WWTP will be less than what would be permitted for the discharge if the plant were operating at full capacity (no upstream potable reuse and flow offloads) and complying with the Clean Water Act secondary treatment standards.

Table B.1-4 (page B.1-14) summarizes projected step-wise reductions in PLOO TSS mass emissions that are targeted within the next 20 years. As shown in Table B.1-4, the program goal is to cap PLOO mass emissions at 9,942 metric tons per /year by year 2028 and beyond. This 9,942 metric tons per year TSS mass emission rate would be achieved with a combination of (1) Point Loma WWTP solids offloading resulting from upstream potable reuse and treatment facilities, and (2) maintaining chemically enhanced primary treatment at the Point Loma WWTP (no conversion of the Point Loma WWTP to traditional secondary treatment).

B.1.3 PROJECTED WASTEWATER FLOWS AND LOADS

Metro System facilities planning and the scheduling for implementing *Pure Water San Diego* phases will, in part, be driven by wastewater flow and solids loading. Metro System wastewater flows and solids loading projections are developed using a comprehensive hydraulic model of the Metro System service area.

Table B.1-4
Targeted PLOO TSS Mass Emission Goals

Year	TSS Mass Emission Rate Limit[1] (metric tons per year)
2014	13,598[2]
2015 thru 2025	12,000[3]
2026 thru 2027	11,500[4,5]
2028 forward	9,942[4,5,6]

1 TSS mass emission rate (MER) for the Point Loma WWTP discharge to the Pacific Ocean via the Point Loma Ocean Outfall.
2 Existing TSS MER limit for year 2014 established within Order No. R9-2009-0001.
3 TSS MER limit requested in this 301(h) application for renewal of NPDES CA0107409. The TSS MER limit would be 12,000 metric tons per year in years 1 through 4 of each five year NPDES cycle, and would be reduced to 11,999 metric tons per year in the final year of the permit.
4 Compliance with proposed reduced TSS MER limit is to be achieved through future offloading the Point Loma WWTP by implementing upstream potable reuse projects as part of the *Pure Water San Diego* program.
5 Program goal would become an enforceable TSS MER limit in either (1) future 301(h) modified NPDES permits or (2) future NPDES permits based on approval of secondary equivalency status for the Point Loma WWTP. (Note: Establishing the secondary equivalency status of the Point Loma WWTP may require administrative or legislative action.)
6 Secondary equivalency TSS MER limit capped forever going forward. This 9,942 metric ton per year MER is the same MER that would apply to a 240 mgd Point Loma WWTP discharge at a 30 mg/l TSS concentration limit (secondary treatment concentration limit).

Metro System Hydraulic Model. The City of San Diego regularly updates projected future Metro System flows and loads through a comprehensive GIS-based (geographic information system) hydraulic model of Metro System and City of San Diego wastewater collection facilities. The model superimposes SANDAG (San Diego Association of Governments) Series 12 population and employment projections on grid levels as small as a city block to generate projected dry weather and wet weather flows. Wastewater loads are based on a projected residential unit wastewater generation rate of 72.1 gallons per capita per day (gpcd), and an employment unit wastewater generation rate of 22.3 gpcd. The model also computes system-wide TSS and BOD loads on the basis of observed historic influent data and treatment facilities performance.

Projected Dry Weather Flows. Average annual Metro System flows under dry weather conditions are estimated on the basis of historic data and a 60+ year precipitation data base. Table B.1-5 (page B.1-16) presents average annual flows under dry weather conditions for the period 2015 through 2036. Table B.1-2 also presents projected PLOO discharge flows for this 20 year period.

As shown in Table B.1-5, average annual PLOO discharge flows are projected to increase from 160 mgd during year 2015 to approximately 170 mgd by year 2020.

It should be noted that wet weather and dry weather flows estimated within the hydraulic model are conservative by design, as the hydraulic model is used as a facilities planning tool to ensure that collection and treatment capacity is available to handle projected flows and loads. Indicating this degree of conservatism, the model projects year 2015 dry weather PLOO discharge flows at 160 mg/l, while actual PLOO discharge flows the past two years have averaged on the order of 145 mgd.

Table B.1-5 also presents projected TSS and BOD loads for the Metro System and the PLOO discharge for the period 2015 through 2036. As shown in the table, the model is conservative in estimating PLOO TSS mass emissions. PLOO TSS effluent concentrations and mass emissions for year 2015 are respectively projected at 40 mg/l and approximately 27,600 pounds per day. Observed PLOO TSS concentrations and mass emissions during the past two years were averaged approximately 20 percent less than these estimated values.

Projected Wet Weather Flows. Collection system inflow and infiltration (I&I) is primarily a function of hydrology and collection system service area. On the basis of historic precipitation and observed Metro System wastewater flows, average annual I&I is estimated to average 4 to 5 percent of the average annual dry weather flow, but can range to over 9 percent during significant wet years.

While the City maintains an aggressive program to limit I&I, historic data indicate a slight trend of increasing I&I that correlates to increases in the mileage of total Metro System and Participating Agency collection systems. To be conservative, the hydraulic model assumes that wet weather I&I annually increase by 1.5 percent per year over the next 20 years. Average annual Metro System flows under 10-year return wet weather conditions are estimated on the basis of historic data and a 60+ year precipitation data base. Table B.1-6 (page B.1-17) presents average annual flows under 10-year return wet weather conditions for the period 2015 through 2036.

Table B.1-6 also presents projected Point Loma WWTP TSS and BOD loads under 10-year return wet weather flow conditions for the period 2015 through 2036, as simulated in the Metro System hydraulic model.

Table B.1-5
Projected Dry Weather Metro System Flows, 2015-2035

Year	Metro System Population[1]	Total Metro System			Proposed PLOO Discharge						
		Average Flow[2] (mgd)	Total Metro System Mass Load[3] (lbs/day)		Average Flow[4] (mgd)	Mass Emissions[5] (pounds per day)		Mass Emissions[5] (metric tons/year)		Effluent Concentration[5] (mg/l)	
			TSS	BOD		TSS	BOD	TSS	BOD	TSS	BOD
2015	2,268,160	174	430,995	430,995	160	52,885	166,624	8,754	27,582	40	125
2016	2,303,357	177	437,930	437,930	162	53,820	169,256	8,909	28,017	40	126
2017	2,338,554	180	444,866	444,866	164	54,755	171,888	9,064	28,453	40	126
2018	2,373,750	182	451,801	451,801	166	55,691	174,521	9,219	28,889	40	126
2019	2,408,947	185	458,737	458,737	168	56,626	177,153	9,373	29,325	40	127
2020	2,444,144	188	465,672	465,672	170	57,561	179,785	9,528	29,760	41	127
2021	2,455,214	189	467,901	467,901	170	57,863	180,630	9,578	29,900	41	127
2022	2,466,284	190	470,131	470,131	171	58,164	181,475	9,628	30,040	41	127
2023	2,477,353	190.7	472,360	472,360	172	58,466	182,320	9,678	30,180	41	127
2024[6]	2,488,423	191.3	473,846	473,846	157[6]	55,781	172,268	9,234	28,516	43	132
2025	2,499,493	192	475,580	475,580	157	56,020	172,905	9,273	28,621	43	132
2026	2,521,834	194	479,296	479,296	159	56,502	174,420	9,353	28,872	43	132
2027	2,544,175	195	483,011	483,011	160	56,984	175,935	9,433	29,123	43	132
2028[7]	2,566,515	197	487,965	487,965	128[7]	43,845	135,676	7,258	22,459	41	127
2029	2,588,856	199	491,681	491,681	130	44,319	137,238	7,336	22,717	41	127
2030	2,611,197	200	495,396	495,396	131	44,792	138,799	7,415	22,976	41	127
2031	2,632,759	202	499,359	499,359	133	45,297	140,464	7,498	23,251	41	127
2032	2,654,320	203	503,322	503,322	135	45,802	142,129	7,582	23,527	41	127
2033	2,675,882	205	507,286	507,286	136	46,306	143,795	7,665	23,803	41	127
2034	2,697,443	206	511,249	511,249	138	46,811	145,460	7,749	24,078	41	127
2035	2,719,005	208	515,212	515,212	139	47,316	147,125	7,832	24,354	41	127
2036[8]	2,750,420	211	522,643	522,643	95[8]	30,767	85,537	5,093	14,159	39	108

1 Based on SANDAG Series12 population projections.
2 Dry weather average annual Metro System flows projected on the basis of unit residential wastewater generation rate of 72.1 gpcd and an employment unit generation rate of 22.3 gpcd. Projections from City of San Diego PUD (2014).
3 Projections conservatively based the highest waste strengths observed during the past 5 years. TSS and BOD concentrations are projected to increase in future years as ongoing conservation reduces per capita flow but per capita TSS and BOD contributions remain unchanged.
4 Flows discharged to the PLOO, as reduced by (1) upstream recycled water production and use, (2) diversion of flows to the South Bay WRP, and (3) production and use of purified water. Projected PLOO flows include reverse osmosis reject (brine) from upstream advanced water purification facilities constructed as part of the *Pure Water San Diego* program. (See footnotes 6, 7, and 8)
5 Upper estimate value conservatively based on maintaining historic Point Loma WWTP TSS removal rates while influent concentrations of TSS (see footnote 3) are projected to increase due to water conservation. Actual TSS mass emissions are projected to be less than those projected above; Point Loma WWTP TSS concentrations averaged 30-35 mg/l during most months within the past three years.
6 Point Loma discharge flows and loads reduced through implementation of 15 mgd of upstream potable reuse. Based on targeted *Pure Water San Diego* potable reuse implementation goal for December 31, 2023. Implementation date may be influenced economic conditions, population, and water conservation.
7 Point Loma WWTP discharge flows and loads are reduced by implementation of an additional 15 mgd of upstream potable reuse (total cumulative potable reuse of 30 mgd). Based on achieving the targeted *Pure Water San Diego* potable reuse implementation goal for December 31, 2027. Implementation date may be influenced economic conditions, population, and water conservation.
8 Point Loma WWTP discharge flows and loads are reduced by implementation of an additional 53 mgd of upstream potable reuse (total cumulative potable reuse of 83 mgd). Based on achieving the targeted *Pure Water San Diego* potable reuse implementation goal for December 31, 2035. Implementation date may be influenced economic conditions, population, and water conservation.

Table B.1-6
Projected 10-Year Return Wet Weather Metro System Flows, 2015-2035

Year	Metro System Population[1]	Total Metro System			Proposed PLOO Discharge						
		Average Flow[2] (mgd)	Total Metro System Mass Load[3] (lbs/day)		Average Flow[4] (mgd)	Mass Emissions[5] (pounds per day)		Mass Emissions[5] (metric tons/year)		Effluent Concentration[5] (mg/l)	
			TSS	BOD		TSS	BOD	TSS	BOD	TSS	BOD
2015	2,268,160	207	512,735	512,735	192	63,387	200,512	10,493	33,191	40	125
2016	2,303,357	210	521,157	521,157	194	64,529	203,676	10,682	33,715	40	126
2017	2,338,554	214	529,579	529,579	197	65,671	206,841	10,871	34,239	40	126
2018	2,373,750	217	538,000	538,000	199	66,814	210,005	11,060	34,763	40	127
2019	2,408,947	221	546,422	546,422	201	67,956	213,170	11,249	35,287	40	127
2020	2,444,144	224	554,844	554,844	204	69,098	216,334	11,438	35,810	41	127
2021	2,455,214	225	556,495	556,495	204	69,338	216,874	11,478	35,900	41	127
2022	2,466,284	225	558,146	558,146	205	69,578	217,414	11,517	35,989	41	127
2023	2,477,353	226	559,797	559,797	205	69,818	217,954	11,557	36,079	41	128
2024[6]	2,488,423	227	562,274	562,274	191[6]	67,242	208,413	11,131	34,499	42	131
2025	2,499,493	228	564,751	564,751	192	67,557	209,453	11,183	34,671	42	131
2026	2,521,834	230	569,705	569,705	194	68,188	211,535	11,287	35,016	42	131
2027	2,544,175	232	574,659	574,659	196	68,819	213,617	11,392	35,361	42	131
2028[7]	2,566,515	234	579,613	579,613	165[7]	55,520	174,188	9,190	28,834	40	126
2029	2,588,856	236	584,567	584,567	167	56,151	176,270	9,295	29,178	40	126
2030	2,611,197	238	589,521	589,521	169	56,782	178,351	9,399	29,523	40	126
2031	2,632,759	240	594,475	594,475	171	57,413	180,433	9,504	29,868	40	126
2032	2,654,320	242	599,429	599,429	173	58,044	182,514	9,608	30,212	40	126
2033	2,675,882	244	604,383	604,383	175	58,676	184,596	9,713	30,557	40	126
2034	2,697,443	246	609,337	609,337	177	59,307	186,677	9,817	30,901	40	126
2035	2,719,005	248	614,291	614,291	179	59,938	188,759	9,922	31,246	40	126
2036[8]	2,750,420	250	619,245	619,245	134[8]	43,431	126,608	7,189	20,958	39	113

1 Based on SANDAG Series12 population projections.

2 Projected wet-weather (10-year return frequency) annual Metro System flows. Projections from San Diego PUD (2014).

3 Projections conservatively based the highest observed waste strengths during the past 5 years. TSS and BOD concentrations are projected to increase in future years as ongoing conservation reduces per capita flow but per capita TSS and BOD contributions remain unchanged.

4 Flows discharged to the PLOO, as reduced by (1) upstream recycled water production and use, (2) diversion of flows to the South Bay WRP, and (3) production and use of purified water. Projected PLOO flows include reverse osmosis reject (brine) from upstream advanced water purification facilities constructed as part of the *Pure Water San Diego* program. (See footnotes 6, 7, and 8)

5 Upper estimate value conservatively based on maintaining historic Point Loma WWTP TSS removal rates while influent concentrations of TSS (see footnote 3) are projected to increase due to water conservation. Actual TSS mass emissions are projected to be less than those projected above; Point Loma WWTP TSS concentrations averaged 30-35 mg/l during most months within the past three years

6 Point Loma discharge flows and loads reduced through implementation of 15 mgd of upstream potable reuse. Based on targeted *Pure Water San Diego* potable reuse implementation goal for December 31, 2023. Implementation date may be influenced economic conditions, population, and water conservation.

7 Point Loma WWTP discharge flows and loads are reduced by implementation of an additional 15 mgd of upstream potable reuse (total cumulative 30 mgd of potable reuse). Based on achieving the targeted *Pure Water San Diego* potable reuse implementation goal for December 31, 2027. Implementation date may be influenced economic conditions, population, and water conservation.

8 Point Loma WWTP discharge flows and loads are reduced by implementation of an additional 53 mgd of upstream potable reuse (total cumulative potable reuse of 83 mgd). Based on achieving the targeted *Pure Water San Diego* potable reuse implementation goal for December 31, 2035. Implementation date may be influenced economic conditions, population, and water conservation.

As shown in Table B.1-6, PLOO 10-year return wet weather flows are 20 percent higher than the corresponding projected dry weather flows shown in Table B.1-5. TSS and BOD mass emission loads are also projected to be 20 percent higher under 10-year return wet weather conditions than corresponding dry weather conditions. PLOO 10-year return flows are projected at 192 mgd for year 2015 and 204 mgd for year 2020.

Facilities Planning Implications. Metro System flow and solids loading projections (Tables B.1-5 and B.1-6) indicate that the proposed *Pure Water San Diego* reuse goals (see Table B.1-2 on page B.1-9) are consistent with offloading the Point Loma WWTP and achieving the mass emission goals illustrated in Table B.1-4 (page B.1-14). Table B.1-7 (page B.1-19) depicts a potential scenario of how achieving the *Pure Water San Diego* reuse goals could result in sufficient offloading of Point Loma WWTP flow and solids loads to ensure compliance with the mass emission goals.

Phase 1: Initial 15 mgd of Potable Reuse. As shown in Tables B.1-5 and B.1-6, implementation of the first phase (15 mgd of potable reuse) by December 31, 2023 would result in a reduction in PLOO discharge flows, as North City WRP wastewater flows currently conveyed to the Point Loma WWTP would be diverted to recycled water treatment, advanced purified treatment, and potable reuse. This first 15 mgd of potable reuse, however, would not significantly reduce PLOO TSS mass emissions, as waste solids from the North City WRP are transmitted to the Metro Biosolids Center for treatment.

Phase 2: 15 mgd of Additional Potable Reuse. As noted, Phase 2 would involve 15 mgd of additional potable reuse capacity, either with an expanded North City AWP facility or an AWP facility at the South Bay WRP. If the South Bay WRP option were to be implemented, for example, Point Loma WWTP solids loads would be reduced by:

- expanding the capacity of the South Bay WRP to support 9 mgd of non-potable demand and implement 15 mgd of potable reuse,
- constructing solids processing facilities (South Sludge Processing Facility) to process solids at the South Bay WRP to eliminate current practice of conveying South Bay WRP waste solids to the Point Loma WWTP for treatment, and
- diverting sufficient Metro System flows to the South Bay WRP to support the proposed increase in South Bay WRP reuse.

Table B.1-7
Potential Example of How Targeted PLOO TSS Mass Emission Goals May be Achieved[1]

Year	Pure Water San Diego Program Phase		Annual TSS Mass Emissions (metric tons/year)		
	Cumulative Potable Reuse[2] (mgd)	Required Facilities/Reuse Operations	Dry Weather Projection[3]	Wet Weather Projection[4]	Goal[5]
2024	15	• 15 mgd North City advanced purification facility[6] • North City purified water conveyance facilities[6] • 15 mgd potable reuse[6]	9,234	11,131	12,000
2028	30	• Pump station and conveyance facilities to divert Metro System flows to support increased reuse at the South Bay WRP[7,8] • Expansion of South Bay WRP[7,9] • Southern Sludge Processing Facility[7,10] • 15 mgd South Bay advanced purification facility[7] • South Bay purified water conveyance facilities[7] • 15 mgd potable reuse[7]	7,258	9,190	11,500
2036	83	• Additional wastewater treatment capacity upstream from the Point Loma WWTP[11] • Solids handling and conveyance facilities to support the wastewater treatment[11] • 53 mgd advanced purification facility[11] • Purified water conveyance facilities[11] • 53 mgd of additional potable reuse[11]	5,093	7,189	9,942

1 Example based on achieving 15 mgd of Phase 2 potable reuse through constructing a water purification facility at the South Bay WRP and diverting sufficient flow to the South Bay WRP to support the increased reuse.

2 Cumulative potable reuse to be achieved by the listed year. See Table B.1-2 on page B.1-9.

3 Projected TSS mass emission rate under dry flow conditions for the listed year from Table B.1-5 on page B.1-16.

4 Projected TDS mass emission rate under 10-year return wet weather flow conditions, as presented in Table B.1-6 on page B.1-17.

5 TSS mass emission goal presented in Table B.1-4 on page B.1-14.

6 Facility improvements required to implement the initial phase of 15 mgd of potable reuse by December 31, 2023. Design, environmental, and planning tasks for 2015-2020 required to support implementation of these facilities improvements by December 31, 2023 are presented in Table B.1-3 (page B.1-12).

7 Facility improvements required to implement the second phase of 15 mgd of potable reuse by December 31, 2027. Additional study will be required to determine the location of potable reuse facilities, to evaluate the feasibility of South Bay WRP potable reuse, to finalize facilities capacity, and to address environmental compliance issues. The above table summarizes facilities required to implement 15 mgd of Phase 2 reuse by constructing a purified water facility at the South Bay WRP and diverting a sufficient quantity of Metro System flow to the South Bay WRP to support the proposed increased reuse.

8 Integrated Reuse Alternatives presented in the 2012 *Recycled Water Study* recommend diverting wastewater flows from the South Metro Interceptor immediately downstream from Spring Valley Trunk Sewer SV8 in order to support additional South Bay WRP reuse. Additional study will be required to finalize South Bay capacities and facilities.

9 If the South Bay WRP option is implemented to achieve the Phase 2 potable reuse goals, expansion of the existing 15 mgd South Bay WRP will be required to support 9 mgd of non-potable demands and implement 15 mgd of potable reuse. Additional study will be required to refine required plant sizing and design criteria.

10 Existing South Bay WRP solids are directed to the Point Loma WWTP for treatment. New solids processing facilities at the South Bay WRP would be constructed (Southern Sludge Processing Facility) to allow for onsite-handling and processing of waste solids and eliminate the existing South Bay WRP discharge of waste solids to the Point Loma WWTP.

11 Ultimate facilities required to implement 53 mgd of additional potable reuse in the North City area by December 31, 2035. Additional study will be required to refine and select wastewater treatment facilities, solids processing facilities, advanced purification treatment facilities, and associated conveyance facilities.

Phase 3: 53 mgd of Additional Potable Reuse. As noted, a number of potential options are available for implementing the 53 mgd of additional potable reuse under Phase 3. Additional study will be required to finalize the potable reuse sites and options. Regardless of the location of Phase 3 potable reuse facilities, significant reductions in both PLOO flow and solids loading would occur by December 31, 2035, as a significant fraction of the flow and load currently going to the Point Loma WWTP would be diverted to upstream treatment, advanced purification treatment, and potable reuse. Additionally, waste solids from the upstream treatment facilities (e.g. Harbor Drive, Camino Del Rio, or Mission Gorge sites) would be directed to MBC for processing.

B.1.4 NEAR-TERM METRO SYSTEM IMPROVEMENTS

In addition to the long-term facilities planning associated with the *Pure Water San Diego* potable reuse program, the City will continue its ongoing Capital Improvements Program of maintaining and upgrading wastewater pump stations, conveyance facilities, and treatment facilities. Several key Metro System near-term improvements are summarized below.

Point Loma WWTP Grit Improvements Project. The City is in the process of a comprehensive renovation/upgrade of the Point Loma WWTP grit removal facilities. Grit improvements completed to date include replacing the grit agitation air blowers and supply air piping and raising the height of the influent screening channel slide gates. Remaining grit improvements that are currently under construction and scheduled for completion in 2015 include:

- demolishing and reconstructing the south grit tanks,
- constructing a pump gallery for the south grit tanks,
- demolishing the original headworks building, grit processing equipment and agitation air blowers,
- constructing a new grit building that features drive-through, load-out grit disposal,
- providing Teacups™, Snails™ and new grit storage hoppers in the new processing facility, and
- expanding the ferric chloride feed facility to serve the flume channels to the south grit tanks.

Pump Station 2 Reliability Improvements. Improvements are scheduled to be completed at Pump Station 2 to comply with EPA Class I reliability requirements and improve surge control protection. Proposed improvements are scheduled for completion by the end of 2017, and include:

- a new generator building,
- replacing two natural gas engines with 2,250 horsepower motors and variable frequency drives,
- installing two 4-megawatt generators providing the flexibility to allow either generator to run any of the eight main Pump Station No. 2 pumps, and
- installing supporting mechanical, electrical, and control components, including pump controls designed to prevent surges.

Chemical Addition Improvements. As documented in Appendix A, the City during the past several years has proceeded with phased implementation of a proprietary technology called PRI-SC (Peroxide Regenerated Iron Sulfide Control). The PRI-SC system involves coordinated chemical addition at key points within the Metro System to achieve for following goals:

- improved solids removal at the Point Loma WWTP,
- more effective odor control,
- reduced iron and solids emissions to PLOO, and
- reduced system-wide chemical costs.

The conceptual basis of the PRI-SC system is to utilize ferrous chloride at upstream locations within the Metro System for sulfide control, and to utilize hydrogen peroxide (H_2O_2) at downstream locations to regenerate ferrous or ferric iron for use in sulfide control and to enhance settling and solids removal at the Point Loma WWTP. Figure B.1-5 (page B.1-22) presents current chemical addition points within the Metro System.

The system-wide PRI-SC chemical addition program has resulted in noticeable improvement in solids removal at the Point Loma WWTP during the past few years. Building on this success, the City is proceeding with plans to implement hydrogen peroxide addition capability to the New Peñasquitos Trunk Sewer to enhance odor control and solids removal at the North City WRP. The City is also proceeding with plans (see Figure B.1-5) to implement PRI-SC operations within the tributary area of the South Bay WRP that would include ferrous chloride addition at the Grove Avenue Pump Station and hydrogen peroxide addition at the South Bay WRP.

Point Loma WWTP Chlorine Residual Monitoring. As discussed in Appendix A, the City implements sodium hypochlorite disinfection at the Point Loma WWTP to reduce effluent pathogen concentrations and ensure compliance with receiving water body contact recreational standards established within Order No. R9-2009-0001.

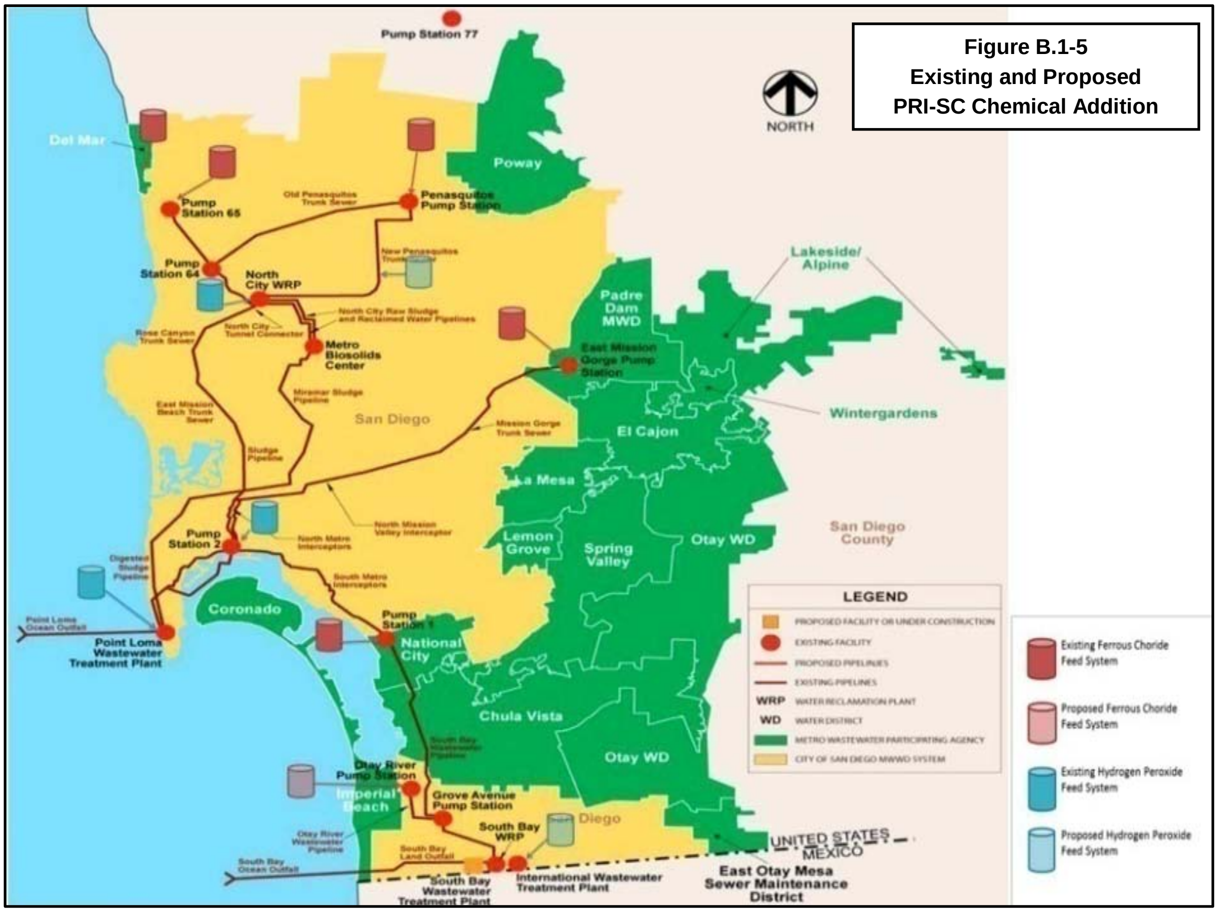


Figure B.1-5
Existing and Proposed
PRI-SC Chemical Addition

To ensure compliance with *California Ocean Plan* chlorine residual receiving water standards, Order No. R9-2009-0001 requires the City to monitor for chlorine residual at monitoring station EFF-001. Special Provision VI.C.6.a of Order No. R9-2009-0001 requires the City to implement continuous chlorine residual monitoring, as follows:

> *6.a. Continuous Monitoring for Residual Chlorine. To ensure compliance with WQBELs for total chlorine residual, continuous monitoring of the effluent is required. Within 180 days of the effective date of this permit, the Discharger shall begin continuous monitoring for total chlorine residual in the effluent. Until that time, at least four grab samples per day, representative of the daily discharge, shall be collected immediately prior to entering the PLOO and analyzed for total chlorine residual.*

In accordance with the requirements of this provision, the City coordinated with vendors to install continuous chlorine monitoring equipment at Monitoring Station EFF-001. The installed equipment, however, continuously experienced failures, necessitating City staff to implement four-grab samples per day as a backup. Subsequent investigations by the City and vendors revealed that the failures were associated with suspended solids in the effluent clogging the narrow flow chamber for the probe.

A variety of substitute analyzers were considered during the past several years with no positive results until the City finally found a vendor who made a custom modification by enlarging their flow-through probe chamber. The customized probe appeared to resolve the issue, and the continuous monitoring system initially appeared to be operating as designed. City staff, however, became aware that after a period of operation, the continuous monitoring probe would inexplicably become inactive. An investigation into this issue ultimately revealed that the software internal to the probe was programmed to turn the probe off after sustained periods when no chlorine residual was detected. Additionally, it was discovered that the longer the probe measures a zero chlorine residual, the longer it takes for the probe to recover, reset, and begin actively providing continuous chlorine residual measurements.

The Point Loma WWTP disinfection system is specifically designed to have zero chlorine residual at the monitoring location, so this automatic probe shutdown feature (which, again, is internal to the probe) prevents proper operation of the installed continuous monitoring equipment. The vendor indicates that the near-continuous zero chlorine residual in the Point Loma WWTP effluent contrasts significantly from the normal wastewater plant monitoring environment where chlorine residual is present at varying levels. As a result, the probe shutdown problem (apparently common to other probes on the market) affects few water/wastewater agencies.

The vendor has recently identified a potential solution, however, that involves re-programming the probe to artificially read a pre-programmed (non-zero) baseline residual so that the lack of chlorine residual will not result in probe shutdown. As part of this solution, whenever an actual residual is detected, the program algorithm subtracts out the difference between the artificially applied baseline amount and the total reported by the probe to compute the actual observed residual.

The City, its vendor, and the Inland Empire Utilities Agency (another agency affected by the probe shutdown problem) have been coordinating to address this problem. A prototype re-programmed probe is currently being tested at the Inland Empire Utilities Agency. If these tests prove successful, a new metering system (including a modified probe chamber sized for the Point Loma WWTP effluent), will be constructed and installed at the Point Loma WWTP. In the meantime, in accordance with direction received from Regional Board staff, the City has continued to implement the "back up" plan of collecting four daily grab samples and analyzing the samples according the protocols previously developed with the Regional Board staff.

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California Regional Water Quality Control Board, San Diego Region (Regional Board). Correspondence dated February 7, 2013 titled: "Indirect Potable Reuse/Augmentation Project at San Vicente Reservoir." 2013.

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Appendix B.2
2012 RECYCLED WATER STUDY

Renewal of NPDES CA0107409

Recycled Water Study

Prepared for

City of San Diego

July 2012

SAN DIEGO RECYCLED WATER STUDY

Prepared for

City of San Diego, Public Utilities Department

July 2012

Project No. 137921

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RECYCLED WATER STUDY
BROWN AND CALDWELL | B&V • CDM

Preface

This Recycled Water Study is the culmination of a two year process to develop a new vision for water reuse in the San Diego region. The Study's alternatives were developed through a participatory process involving work sessions and Stakeholder meetings. The combined contributions of the Stakeholders were invaluable in developing alternatives that considered diverse perspectives, concepts and approaches. The culmination of the Stakeholder efforts included a Study review workshop, held on March 22, 2012. At the conclusion of the workshop, attendees were complimentary of the Study process and supportive of the content included in this Report. This page recognizes the efforts of the Stakeholder participants that contributed substantially to this effort.

Stakeholders

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Jill Witkowski
San Diego Coastkeeper

What Are Key Terms Used in this Study?

The following key terms are defined due to their frequent use and their importance in understanding the concepts involved in this Study. A more comprehensive glossary is included in the Study.

Water Reuse: Water reuse is a broad term used to describe the process of converting wastewater to a valuable water resource through treatment processes. Water reuse includes non-potable recycled water development and indirect potable reuse involving integration with drinking water supplies.

Non-potable Recycled Water: Synonymous with Non-potable Reclaimed Water, State of California Title 22 Water, and tertiary treated water. Non-potable recycled water is a form of water reuse that includes primary, secondary and tertiary treatment to produce water suitable for a variety of applications, most notably for landscaping irrigation and industrial uses. Further treatment is required for integration with drinking water systems – see indirect potable reuse.

Purified, Advanced Purified, or Advanced Treated Water: Purified, advanced purified, or advanced treated water undergoes advanced treatment processes to convert non-potable recycled water to a highly purified water quality, suitable for augmentation to an untreated drinking water source. Advanced purified water is currently used for indirect potable reuse projects.

Indirect Potable Reuse: Indirect potable reuse is the planned use of advanced purified water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system, or the planned placement of recycled water into a surface water reservoir used as a source of domestic drinking water supply.

Direct Potable Reuse: The planned introduction of advanced purified water either directly into a public water system, or into an untreated water supply, immediately upstream of a water treatment plant.

Wastewater: Wastewater is generally used to describe sewage that comes from homes, industry or businesses. Wastewater is collected and treated at wastewater treatment plants. In San Diego, some wastewater is currently reclaimed as non-potable recycled water; however, the majority is treated and discharged to the ocean. Wastewater is needed for water reuse. Wastewater does not include stormwater in San Diego. Stormwater is collected in separate systems and typically not treated before discharge to streams and the ocean.

Uninterruptible Water Supply: Indirect potable reuse water is considered uninterruptible because it is not influenced by drought, water rights, or other supply interruptions such as the decision to decrease Southern California water supply because of endangered species in the California Bay-Delta.

Untreated Water (sometimes referred to as Raw Water): Water that is collected and stored in local surface water reservoirs and groundwater basins prior to treatment at a potable (drinking) water treatment plant. Untreated water examples include Colorado River water, water from the California Bay-Delta, and runoff from local rainfall.

Potable or Drinking Water: Potable water is water that meets the EPA's Safe Water Drinking Act and California Water Code requirements. Residents and businesses receive potable water at their water meter connection, and its use is unrestricted.

EXECUTIVE SUMMARY

Background

In August 2009, the City of San Diego (City), along with key stakeholders, initiated the Recycled Water Study (Study) as part of a Cooperative Agreement (included in Appendix A) between the City and two environmental groups. This Study is intended to serve as a guidance document in helping policy leaders make the important decisions ahead regarding water reuse and the region's water and wastewater infrastructure.

Why Is Water Reuse Important to San Diego?

***Water Reuse in San Diego**. Water reuse is an important component in San Diego's water supply portfolio.*

Water is important to the health, safety, and quality of life of people living in the San Diego region. Historically, the region's 3.1 million residents have received a majority of their water supply from imported sources, including the California Bay-Delta (Bay-Delta) and the Colorado Rivers (conveyed via the California Aqueduct and the Colorado River Aqueduct, respectively). Currently, 80 percent of the San Diego region's water supply is imported. Local supplies and conservation account for the remaining 20 percent of the total supply. The region's reliance on imported water causes San Diego's water supply to be vulnerable to impacts from shortages and susceptible to price increases. In 2008, water supplied from the Bay-Delta was restricted to protect endangered fish species. In addition, drought conditions in Southern California further impacted water supply availability. With the region's population projected to reach 3.9 million people by 2030, demands will increase and strain these limited water supplies. Water reuse has been proven as a safe, reliable, locally controlled and sustainable option for the region.

What Other Drivers Affected this Study?

In 2010, the United States (U.S.) Environmental Protection Agency (EPA) allowed the City to continue to operate the Point Loma Wastewater Treatment Plant (Point Loma Plant) as a chemically enhanced primary treatment facility under a modification to its National Pollutant Discharge Elimination System (NPDES) Permit. The 2010 permit allows the City to operate in this fashion for five years until 2015, when the permit must be renewed. During the 2008-2010 permit modification process, two environmental organizations entered into a Cooperative Agreement with the City to conduct this Recycled Water Study. In accordance with the Cooperative Agreement, both of these organizations provided their support to the U.S. EPA's decision to grant the modification. The City's responsibility per the Cooperative Agreement is to execute this Study, which is also consistent with the City's long-term goals and objectives.

Water reuse programs provide valuable water supplies by using resources that otherwise are sent to the ocean. The decisions to invest in a water reuse program, or alternative large-scale wastewater system upgrades, will affect the rates, reliability, and regional assets for decades. The fundamental focus of this study was to develop water reuse alternatives and then weigh the alternatives against other options – with particular focus on the water supply benefits and the cost savings through reduced wastewater systems operations and improvements.

Recycled Water Study Chapter Summary

Chapter 1 — **Study Overview.** Provides background and objectives of the San Diego Recycled Water Study, as well as describes the Study process and defines participating Stakeholders and Team Members, Study components, and important terminology used throughout the Study.

Chapter 2 — **Water Reuse Need and Related Activities.** Presents the dynamic water supply conditions in San Diego and the opportunity to implement water reuse as a local supply through related key studies and activities such as the 2005 Water Reuse Study and 2010 Recycled Water Master Plan Update.

Chapter 3 — **Study Process and Evaluation Approach.** Describes, in detail, the elements of the participatory Study process and defines the guidelines and criteria against which the potential recycled water opportunities were assessed.

Chapter 4 — **Key Facilities, Water Demands and Wastewater Flows.** Summarizes the principal elements of San Diego's current water, wastewater, and recycled water infrastructure systems that impact water reuse planning, and provides the related demands and flows from these systems.

Chapter 5 — **Non-potable Recycled Water Opportunities.** Describes the technical basis and foundation for developing the non-potable recycled water opportunities that were considered, such as existing and future demands, seasonal considerations, and locations and capacities of existing water recycling facilities.

Chapter 6 — **Indirect Potable Reuse Opportunities.** Describes the technical basis and foundation for developing the indirect potable reuse opportunities that were considered in the Study, including reservoir augmentation and groundwater recharge, and other potential benefits of indirect potable reuse.

Chapter 7 — **Area Concepts.** Provides detailed, comparable options, including both non-potable recycled water opportunities and indirect potable reuse opportunities, to develop comprehensive water reuse plans within three key Study areas.

Chapter 8 — **Integrated Reuse Alternatives.** Evaluates the water reuse concepts presented in Chapter 7 based on Study goals, as well as provides a comparable financial evaluation for key alternatives, including a description of the financial model and its components.

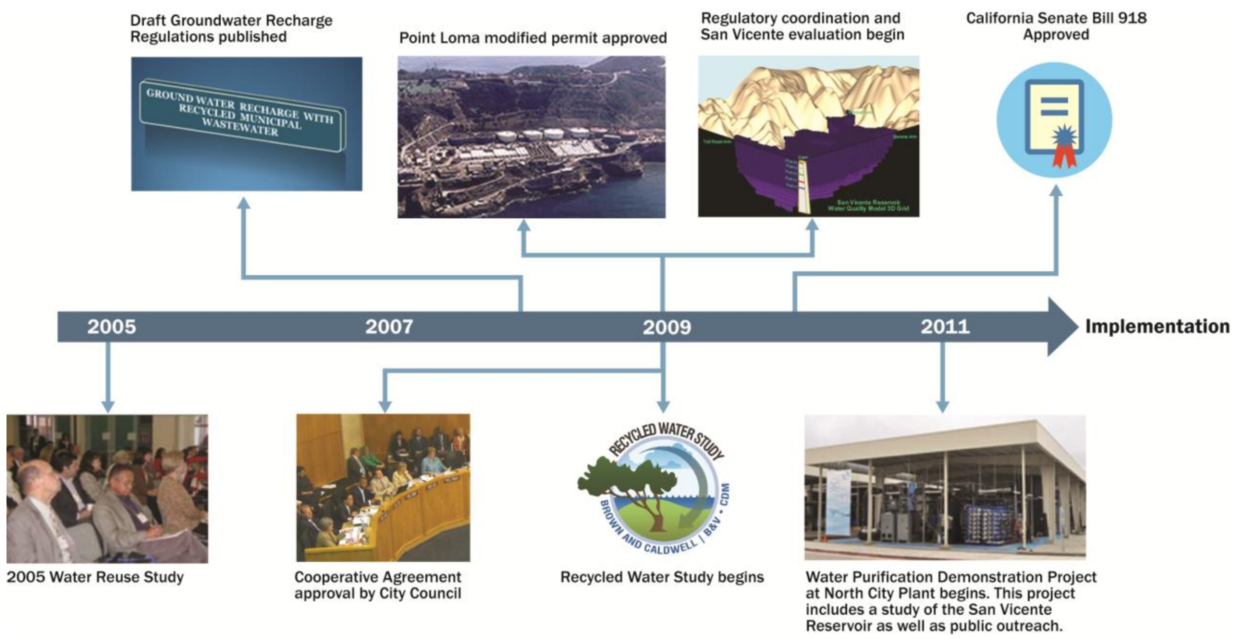
Chapter 9 — **Study Outreach and Approvals.** Describes the Study presentations given to stakeholder groups and approving bodies.

Supporting Material Summary

GLOSSARY	Defines important terminology and acronyms used throughout the Study.
APPENDIX A	**Cooperative Agreement.** Provides a copy of the signed agreement between the City of San Diego, the San Diego Coastkeeper, and the San Diego Chapter of the Surfrider Foundation to conduct a Recycled Water Study.
APPENDIX B	**Point Loma Plant Conclusions.** Provides data and conclusions on the Point Loma Plant based on the results of the Study, including an allocation of flows, discussion on chemically enhanced primary treatment, and projected 2050 mass emission rates under various scenarios.
APPENDIX C	**Summary of Regulations That Affect Water, Wastewater and Recycled Water.** Provides an overview of the key regulatory considerations for water, recycled water and wastewater, and includes anticipated regulatory criteria related to indirect potable reuse sizing.
APPENDIX D	**California Senate Bill 918.** Provides background on State of California Department of Public Health requirements for developing uniform criteria for groundwater recharge, reservoir augmentation and direct potable reuse.
APPENDIX E	**Siting Analysis Documents.** Provides siting information on the Harbor Drive, Camino del Rio and Morena sites, City ownership, and an alternatives analysis performed by the City.
APPENDIX F	**Conceptual Cost Estimates for the Integrated Reuse Alternatives.** Provides infrastructure sizing and costs for each Integrated Reuse Alternative component.
APPENDIX G	**National Water Resource Institute (NWRI) White Paper On Direct Potable Reuse**
APPENDIX H	**Recycled Water Study Cost Methodology FAQ.** An informative, frequently asked question (FAQ) style document on how the direct and indirect wastewater cost reductions/credits/savings were calculated.
APPENDIX I	**Participating Agency White Paper on Reuse Concepts**
APPENDIX J	**Comment/Response Form.** Provides responses to Stakeholder comments made during the Study.
APPENDIX K	**Conceptual Metro System Flow Schematics.** Graphics showing the reuse alternatives and accounting of flows throughout the system.
APPENDIX L	**Metro JPA Letter**
APPENDIX M	**City Council Resolution**

How Does This Study Fit into Other On-going Efforts?

The overarching objective of this Study is to develop and clearly present integrated reuse alternatives that the public and policy-makers can review and select from to guide the future of the reuse program located within the Metropolitan Sewerage System Service Area. The alternatives were evaluated to meet City, Participating Agency, and Project Stakeholder reuse goals through a 2035 planning horizon. This Study is one part of a comprehensive regional program to evaluate and develop water reuse in San Diego.



Who Participated in the Study?

The Stakeholders for this Project are comprised of the San Diego Coastkeeper, the San Diego Chapter of the Surfrider Foundation, and the Participating Agencies of the Metropolitan Wastewater Joint Power Authority (Metro JPA), who have capacity rights in the Metropolitan Sewerage System pursuant to the provisions of the 1998 *Regional Wastewater Disposal Agreement Between the City of San Diego and the Participating Agencies in the Metropolitan Sewerage System.* The San Diego County Water Authority (SDCWA), the agency that has primary responsibility for water supply planning efforts, and the Independent Rates Oversight Committee, are also Stakeholders in the Study. The primary Project Team consisted of City staff from the Public Utilities Department and a consulting team from Brown and Caldwell, Black & Veatch, and CDM.

PROJECT STAKEHOLDERS

Environmental Groups
- San Diego Coastkeeper
- Surfrider Foundation, San Diego Chapter

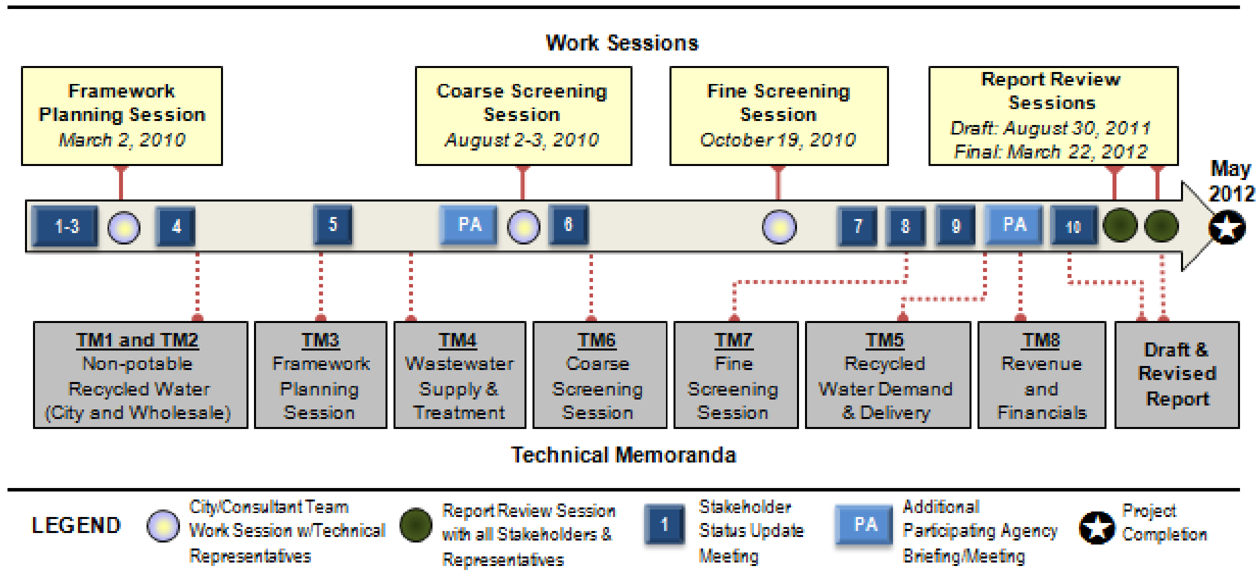
Oversight Groups
- Independent Rates Oversight Committee (IROC)

Regional Water Supplies
- San Diego County Water Authority (SDCWA)

Participating Agency Members
- City of Chula Vista
- City of Coronado
- City of Del Mar
- City of El Cajon
- City of Imperial Beach
- City of La Mesa
- City of National City
- City of Poway
- Lemon Grove Sanitation District
- Otay Water District
- Padre Dam Municipal Water District
- San Diego County Sanitation District
  - Alpine Sanitation District
  - Lakeside Sanitation District
  - Spring Valley Sanitation District
  - Winter Gardens Sewer Maintenance District

What Was the Study Process?

The Study includes a number of technical evaluations and coordination steps to identify and evaluate reuse alternatives within the City as well as areas served by the Participating Agencies. Throughout the Study, regular Stakeholder Status Update Meetings were held to present progress and to receive input and feedback on the activities. Eight technical memoranda were developed to document information.



How Were Alternatives Developed?

Alternatives were developed through a participatory process. Stakeholder Status Update Meetings and five work sessions were used to frame, develop, refine, and communicate the Alternatives included in this Study.

Work Sessions. *The Coarse Screening and Fine Screening Sessions included presentations, team exercises, and facilitated discussions. The sessions leveraged the group's creativity and diverse perspectives to improve the quality of the Alternatives presented in the Study.*

What Issues and Opportunities Helped Determine the Water Reuse Target?

The water reuse target, similar to past efforts, was based on Study goals, Stakeholders' input, and findings from technical analyses. The goal of the 2005 Water Reuse Study was to maximize the available capacities at the North City and South Bay Plants, which coincided with a target of approximately 20 mgd for future water reuse projects. This 2012 Study was initiated with a broader basis: to consider the water reuse goal to be limited *only* by the amount of wastewater available in the Metro Service Area. This is a more comprehensive goal, providing the potential to reuse ten times more water than previous targets, with approximately 200 mgd projected to be available in the Metro Service Area on an average dry weather year in 2035. During the Study, the following four measures evolved as primary drivers for establishing the water reuse target:

Four Measures that Established the Water Reuse Target:

- **Measure 1: Value of Water.** Reliable water supplies are needed for San Diego.
- **Measure 2: Water Quality.** Reuse can improve the ocean water quality. Indirect potable reuse can significantly reduce salinity levels benefiting ratepayers.
- **Measure 3: Project Size vs. Costs.** Water reuse targets should be based on project sizing that considers costs and regulatory limits.
- **Measure 4: Reuse Program Induced Savings.** The water reuse program sizing should consider reduced capital and operating costs in the drinking water and wastewater systems.

Measure 1: Value of Water. Multiple forces are driving water reuse in Southern California. Water reuse projects produce high-quality, reliable, uninterruptible local water to the region, serving the same purpose as imported untreated water. Imported untreated water rates will continue to rise, and conveyance system improvements will be needed to deliver imported water to the region's water treatment plants - unless the supply is supplemented with new local supplies. Indirect potable reuse can fulfill this need and, over time, do so at lower costs – especially when reduced capital and operating costs at the Point Loma Plant are considered. Savings would likely increase further if the regulatory framework for Direct Potable Reuse is finalized, allowing direct delivery to the region's potable water treatment plants. Based on these considerations, the reuse target for this study, especially the indirect potable reuse portion, should be maximized.

Measure 2: Water Quality Benefits. Two water quality considerations were taken into account in establishing a water reuse target: ocean water quality and imported water salinity. Both are important, and both would be significantly improved through implementation of the water reuse projects identified in this Study. For example, blending advanced purified water with imported water in San Vicente Reservoir and Otay Lakes could reduce salinity levels by 50 percent. On land, the reservoirs that receive the advanced purified water, the residents that use the water, and the soil that is irrigated with the water would all benefit from having water with up to half the current salinity levels. Residents would benefit from softer water and extended lives of household appliances such as water heaters, dishwashers, clothes washers and faucets. Ocean water quality would also improve by removing and diverting solids to the Metropolitan Biosolids Center. Based on these considerations, the water reuse target for this Study should be maximized.

Measure 3: Beneficial Project Size versus Costs. Project sizing was considered a limiting factor in developing the water reuse target. Non-potable recycled water projects, while beneficial for targeted areas (such as Otay Water District's planned system expansion), did not have enough demand potential to use a substantial portion of the available wastewater. It also became apparent that developing indirect potable reuse projects to use all wastewater available in the Metro System would not be practical or provide the right balance of costs and benefits. Therefore, the water reuse target based on project constraints and permit considerations was approximately 80 to 120 mgd (upper end based on estimated regulatory flow limits to the San Vicente Reservoir in conjunction with the South Bay Spring Valley No. 8 Diversion).

Measure 4: Reuse Program-Induced Savings, Offsets. San Diego has the potential to create a valuable new water supply cost effectively due to the reuse program's benefit of reducing capital and operating costs in the downstream wastewater system and water quality improvements benefitting the water systems. The largest cost savings generated by the reuse program is reduced capital and operational costs at the Point Loma Plant. Leading up to the Fine Screening Sessions, a reuse target of approximately 100 mgd was established to achieve cost savings by avoiding certain upgrades at the Point Loma Plant. At 100 mgd, and based on dry weather flows, certain treatment processes were avoided. This target was later re-evaluated against a scenario in the City's September 2011 Draft Wastewater Master Plan that included a 10-year wet weather return flow event in establishing 2050 annual average daily flows. While the specific upgrades at the Point Loma Plant and the diversions to South Bay changed when coordinated with the September 2011 Draft Wastewater Master Plan, the Integrated Reuse Alternative costs remained relatively unaffected, and therefore no changes to the Alternatives were made.

Savings at the Point Loma Plant. *Savings at the Point Loma Plant played an important role in establishing reuse targets. The land available at Point Loma Site is constrained, and any upgrades incur high costs.*

Cost Methodology

A detailed financial evaluation was performed for each Integrated Reuse Alternative considered in this Study. The financial evaluation was prepared to ultimately help decision-makers compare the costs of different water reuse approaches and to aid in making decisions about whether to invest in the water reuse system. The guiding principles for the evaluation included:

Transparency. Provide transparent costing of alternatives.

Input and Access. Provide multiple opportunities at workshops and Stakeholder meetings to review, discuss, and debate project costs.

Comparative and Comprehensive Alternatives Costs. Prepare a comparative financial evaluation of the Integrated Reuse Alternatives and include financing costs.

Cost Context. Compare the water reuse alternative costs to other options facing the City and Participating Agencies.

How were costs calculated, and was cost sharing discussed?

The financial evaluation process included the following steps:

Unit Costs. Unit costs were developed from over 50 sources of information, including 23 bid summaries, two agency estimating tools, 14 project cost estimates, actual operating costs, and insight and experience from three national consulting firms.

Alternative Costs. Capital costs and operational and maintenance (O&M) costs were compiled in an interactive model. Costs were thoroughly developed and reviewed in five interactive workshops and a series of Status Update Meetings with the Project Stakeholders.

Financial Model Costs. Capital and O&M costs for each alternative were entered into a net present value (NPV) financial model that included financing costs and other variables. The financial model assumptions were closely coordinated with the City's financial staff to match typical City financing assumptions. The model was also vetted with the project stakeholder group (including the Participating Agencies' independent financial model expert).

Cost Framework. A cost framework for sharing project costs between the City and Participating Agencies was outlined in the Study. Multiple options were outlined based on an interactive workshop with project stakeholders.

How are costs presented in the Study?

Costs are presented in dollars per acre foot ($/AF). The costs are broken down into Gross Costs and Net Costs as defined below. Net Costs are broken out further into three tiers or thresholds to provide a breakout for different conditions and to display values at each calculation step. The following summarizes the cost methodology. The resulting Alternative Costs are presented later in this Executive Summary.

What are Gross Costs?

Gross Costs include the capital and O&M costs for completing and operating the recycled water projects. The Gross Cost financial evaluation included a sensitivity analysis using the following three variables: project contingencies (ranging from 20 to 40 percent), Grants (ranging from 10 to 30 percent), and Metropolitan Water District/San Diego County Water Authority Local Resource Program (LRP) credits (ranging from $100/AF to $450/AF). The Favorable Scenario assumed the best case (20 percent contingency, 30 percent grants, $450/AF LRP). The Unfavorable Scenario assumed the worst case (40 percent contingency, 10 percent grants, $100/AF LRP). This sensitivity analysis was performed since stakeholder opinions varied on what the proper assumption should be. For the Study, the Stakeholder group agreed to use an average of these values.

Gross Cost Variables

Item	Description	Favorable Scenario	Unfavorable Scenario	Average
Grants	To help offset the costs associated with projects, the City can apply for grants to help finance a portion of the capital projects.	30%	10%	20%
Local Resource Program	To help offset the costs associated with new water projects, the City has participated in the Local Resource Program offered by MWD and the Local Water Supply Development funding provided by the SDCWA (these two programs are collectively referred to herein as the LRP).	$450/acre-foot, 20 years	$100/acre-foot, 20 years	$275/acre-foot, 20 years
Project Contingency	A project contingency was added to the construction costs of all alternatives to account for unanticipated project costs.	20%	40%	30%

What are Net Costs?

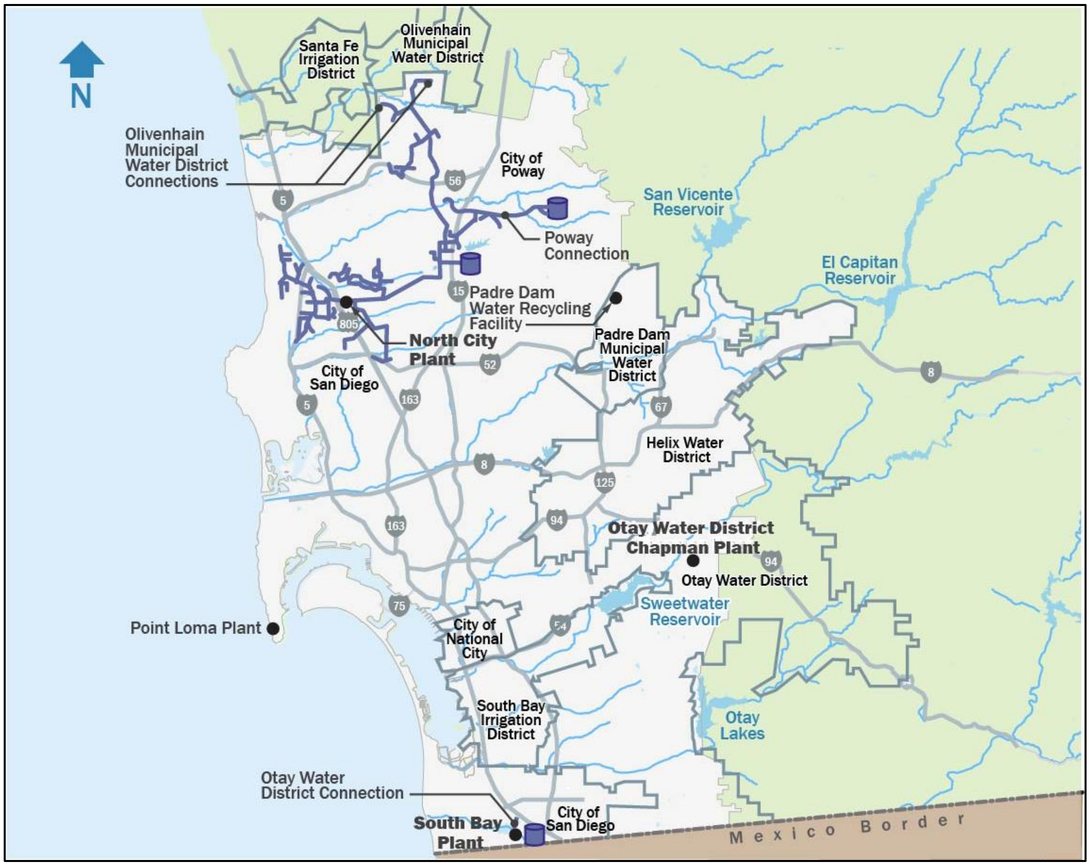
Net Costs are considered "real" or "true" costs for the purposes of comparing reuse projects to imported untreated water and other alternative water sources. Net Costs account for savings, offsets and credits that occur as a result of the reuse projects. For example, constructing a new reuse plant upstream of the Point Loma Plant reduces flows to the Point Loma Plant, resulting in lower capital and operational costs at the Point Loma Plant. These reduced costs are subtracted from the Gross Costs to get the Net Costs or "true" program cost. This is similar to the Orange County Groundwater Replenishment System, which was responsible for substantial savings by avoiding costly outfall improvements. The variables considered with the Net Cost calculations are described in the table on the next page. The Study also includes a Cost Methodology Summary in Appendix H. The Cost Methodology Summary is presented in an informative, frequently asked question (FAQ) format. This document summarizes direct and indirect wastewater savings calculations and includes a graphical comparison of the key wastewater facilities included in this Study with the facilities included in the City's September 2011 Draft Wastewater Master Plan.

Net Cost Variables		
Component	**Description**	**Savings**
Tier 1 - Direct Wastewater System Savings • Reduction of flows to downstream facilities • Remaining Point Loma capacity is upgraded to Secondary	The Study's Alternatives achieve the goal of offloading flows away from the Point Loma Plant, resulting in reduced capital and operating costs at downstream wastewater facilities. The direct wastewater system savings were calculated by comparing the size of the Point Loma Plant proposed in the City's September 2011 Draft Wastewater Master Plan (adjusted to a secondary treatment option to the smaller Point Loma Plant size (which includes secondary treatment) in this Study (assuming the reuse projects in this Recycled Water Study are implemented). The cost difference is the savings directly attributable to these reuse projects. Key savings include: ▪ Smaller Point Loma Plant facilities (less flow is treated at the Point Loma Plant) ▪ Smaller wet weather equalization basin (less flow reaches the Point Loma Plant) ▪ Less pumping at Pump Station No. 2 (less flow is diverted to the Point Loma Plant) ▪ Less pumping at Pump Station No. 1 (more reuse occurs at the South Bay Plant since more flow is diverted away from Pump Station No. 1)	$557 million (capital savings) $27.6 million/year (operation and maintenance savings)
Tier 2 - Salt Reduction Credit • Water quality improvements to water & wastewater systems due to indirect potable reuse • Homeowner and business benefits not included in total	Similar to the 2005 Water Reuse Study, a salt credit was considered to account for the benefits of salinity reduction in the watershed. The salt credit basis is from the 1999 Salinity Management Study (MWD, USBR). The quantitative credit shown is the financial benefits of extending the life of the municipal water and wastewater treatment systems from having lower salinity levels in the water and wastewater flows. The San Vicente and Otay Lakes Reservoirs could see dramatic reductions in salinity levels from the proposed indirect potable reuse projects. Downstream agency facilities, including drinking water treatment plants and the Harbor Drive advanced water purification facilities, would benefit from this reduced salinity. In addition to the benefit shown, there is a benefit to water customers, since water heaters, clothes washers, dishwashers, and fixtures will also last longer with lower salinity levels. The combined savings included in the City's 2005 Water Reuse Study was $250/AF. The $100/AF value used in this Study only accounts for the estimated municipal treatment equipment savings.	$100/acre foot (not including customer savings)
Tier 3 - Indirect Wastewater System Savings • Remaining Point Loma capacity maintained at CEPT • Quantifies savings if this approach is attributable to the reuse program	The Point Loma Plant will either continue to use chemically enhanced primary treatment (CEPT) or will require upgrades to secondary treatment. This Study does not provide an opinion on whether CEPT or secondary treatment processes should be employed at the Point Loma Plant. However, it is prudent to summarize the reduced Point Loma Plant-related capital and operational costs if CEPT status could be maintained for the remaining Point Loma Plant capacity after reuse projects and with the South Bay Diversion. The indirect wastewater savings are therefore calculated as the avoided secondary treatment costs at the Point Loma Plant.	$463 million (capital savings) $13.0 million/year (operation and maintenance savings).
Qualitative Water System Savings	The local, regional and statewide water systems were considered for potential savings from increasing water reuse. Since quantitative costs could not be developed with current available information, qualitative benefits were considered, particularly at the regional and statewide level. The region's local water treatment plants treat water from local runoff (which is limited) and imported untreated water from the SDCWA and MWD (which is subject to cutbacks and higher price fluctuations). Indirect potable reuse projects provide a reliable, uninterruptable untreated water equivalent that would help supply the local water treatment plants that ratepayers have invested in over the past decade. Indirect potable reuse projects may defer or eliminate the need to expand the imported untreated water conveyance system needed to serve these treatment plants. The SDCWA Master Plan (currently underway) may help quantify what these benefits are in future updates to this Study. In addition, Stakeholders emphasized an additional benefit related to the need to fix water supply conditions in the California Bay-Delta (which has the potential for substantial cost impacts for Southern California). Water reuse projects reduce the burden on importing water from the Bay-Delta, providing an additional benefit for these projects.	Quantitative benefits are speculative, therefore this category is currently considered qualitatively

What is the Existing Recycled Water System?

The City operates two water reclamation plants as part of the Metro System: the North City Plant and the South Bay Plant. Two additional reclamation plants (each separately owned and operated by a Participating Agency and separate from the Metro System) also offload flows before reaching the Metro System. The City also operates a non-potable recycled water system comprised of two service areas—the Northern Service Area and the Southern Service Area—supplied with recycled water from the North City and South Bay Plants, respectively. Three wholesale purchasers of recycled water for the City are located within the service area: City of Poway and Olivenhain Municipal Water District (Northern Service Area) and Otay Water District (Southern Service Area).

Recycled Water System in the San Diego Service Area			
Treatment Plant	**Year Commissioned**	**Design Capacity**	**Description**
North City Water Reclamation Plant 	1997	30 mgd	Part of City of San Diego's Metro System. Treats wastewater generated in the Northern San Diego Region, including Cities of Del Mar and Poway, and the communities of Mira Mesa, Rancho Penasquitos, Scripps Ranch, and Rancho Bernardo. Tertiary-treated water is distributed to surrounding communities for irrigation and industrial uses. Excess wastewater ultimately flows to the Point Loma Plant.
South Bay Water Reclamation Plant 	2002	15 mgd	Part of City of San Diego's Metro System. Located in the Tijuana River Valley near the international border. Tertiary-treated wastewater is distributed to surrounding areas for non-potable recycled water use.
Padre Dam Water Recycling Facility 	1967	2.0 mgd	Owned and operated by Padre Dam Municipal Water District and treats wastewater from the City of Santee, portions of the City of El Cajon, and the unincorporated community of Lakeside. Treated wastewater that is not recycled for irrigation and industrial use is discharged to the Santee Lakes and ultimately reaches the San Diego River. Padre Dam, in conjunction with Helix Water District, is evaluating the ability to expand the plant as part of indirect potable reuse project in the El Monte Valley.
Ralph W. Chapman Water Recycling Facility 	1988	1.1 mgd	Owned and operated by Otay Water District. Recycled water is used for irrigation in Eastlake, Otay Ranch, Rancho Del Rey, and other areas of Chula Vista.



Existing Recycled Water Facilities

What Projects Will Affect Future Reuse in San Diego?

The City's 2005 Water Reuse Study recommended an indirect potable reuse project at the North City Plant that would deliver water to the San Vicente Reservoir. To begin implementing this project, the City completed construction of the Advanced Water Treatment Facility, a component of the Water Purification Demonstration Project, in 2011 at the North City Plant. This project, and the corresponding modeling study of the San Vicente Reservoir, will provide data on the health, safety, and water quality of advanced treated recycled water. A separate project, the San Vicente Dam Raise, is currently underway and will increase the potential for integrated indirect potable reuse projects at this regional facility.

Water Purification Demonstration Project. *The City's Water Purification Demonstration Project will demonstrate how one million gallons per day can be purified using technology that is able to produce one of the most pristine sources of water available anywhere.*

San Vicente Dam Raise*. The San Vicente Reservoir expansion (architectural rendering shown above) and its integration with regional facilities make this reservoir an ideal candidate for indirect potable reuse.*

What Opportunities Were Considered for the Reuse Solutions?

Non-Potable Recycled Water Opportunities

Since the City has a non-potable system in place, focus was placed on expanding this system by locating new demands. The demands would then be met by expanding the distribution system from an existing plant or by constructing a new treatment facility closer to the demand. Both Citywide (increasing use within the City's service area) and wholesale (increasing supply to agencies adjacent to or already connected to the existing system) were considered through a market assessment. The market assessment showed where potential conversion customers were concentrated (for example, the Rancho Bernardo area). Based on the markets, distribution systems were developed to determine costs. An analysis of the results, including a direct comparison of an alternative both with and without service to the Rancho Bernardo area, showed that the construction costs to dual pipe an existing community and the administrative costs required to permit, coordinate, bill and provide backflow testing were higher than the indirect potable reuse approaches for new areas. Therefore, the non-potable recycled water opportunities carried forward were focused on maximizing the existing system where most economical. The non-potable recycled water demands carried forward can be summarized as the existing demands, planned demands, and future demands (which includes 3 mgd for expanded service from the South Bay Plant occurring between 2026 and 2040).

Indirect Potable Reuse Opportunities

Achieving a water reuse target with the potential to use all the Metro System service area resources reinforced the need to look for larger projects with improved economy of scale. Indirect potable reuse projects provided the needed scope and scale for this purpose. Two types of indirect potable reuse were considered: reservoir augmentation and groundwater recharge. Eleven regional reservoirs were initially considered. Three were advanced for more detailed evaluation: San Vicente Reservoir (with the current dam raise project), Otay Lakes, and Lake Hodges. Eight regional groundwater basins were reviewed, and two were carried forward for more detailed evaluation: El Monte Valley Basin and San Pasqual Basin. Advancing reservoirs/basins was based on the location, costs, potential project sizes, and ability to integrate into the water system.

Benefits of Indirect Potable Reuse

- Maximizes use of existing reclamation capacity
- Reduced capital and operating costs in downstream wastewater systems, particularly the Point Loma Plant
- Less seasonally limited than non-potable recycled water with fixed irrigation demands
- Superior ability to improve water quality by significantly reducing total dissolved solids/salinity

Successful Southern California Indirect Potable Reuse Projects

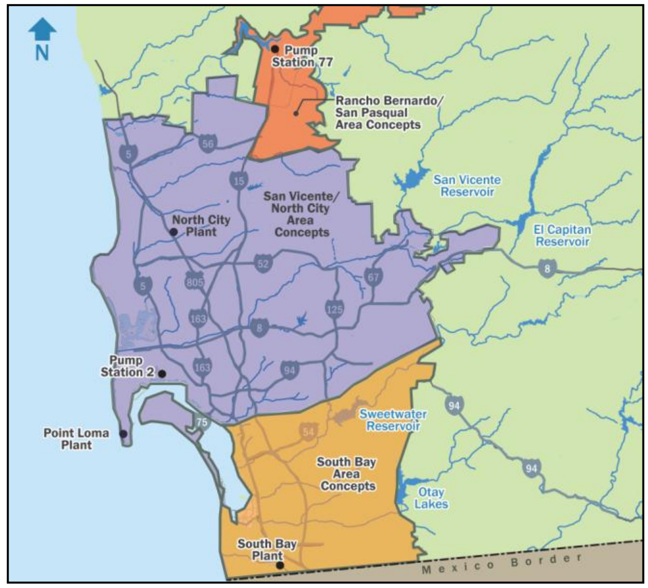
Orange County Water District's Groundwater Replenishment System. The Groundwater Replenishment System is the world's largest wastewater purification system for indirect potable reuse and it is located just north of San Diego in Orange County, California. The Orange County Groundwater Replenishment System can produce up to 70 mgd of highly purified recycled water that serves the water demands of nearly 600,000 residents.

Montebello Forebay. Located in Los Angeles County, the Montebello Forebay has been recharged dating back to 1960s. The area is currently recharged with 150,000 acre-feet of local, imported, and recycled water annually. Of the 5.6 million acre feet recharged into the basin since the 1960s, 26 percent was from recycled water sources.

West Coast, Dominguez Gap, and Alamitos Barriers. Los Angeles and Orange Counties also use seawater intrusion barriers to protect and supplement groundwater supplies. Recycled water is injected into wells along these basins to prevent high salinity seawater from reaching the groundwater basin supplies. The injected recycled water also supplements the groundwater that is extracted by wells and serves the drinking water system.

How Were Opportunities Compiled into Area Concepts?

Area Concepts were developed to provide detailed, comparable options for discussion at the Coarse Screening Session and Stakeholder Status Update Meetings, and were then refined and compiled into Integrated Reuse Alternatives. The Area Concepts were strategically selected, based on the locations of available wastewater, existing facilities, and delivery points (non-potable recycled water customers, surface water reservoirs, or groundwater basins).



Area Concepts. *Area Concepts were developed for three regions of the Metro Service Area. The Area Concepts were presented at the Coarse Screening Session.*

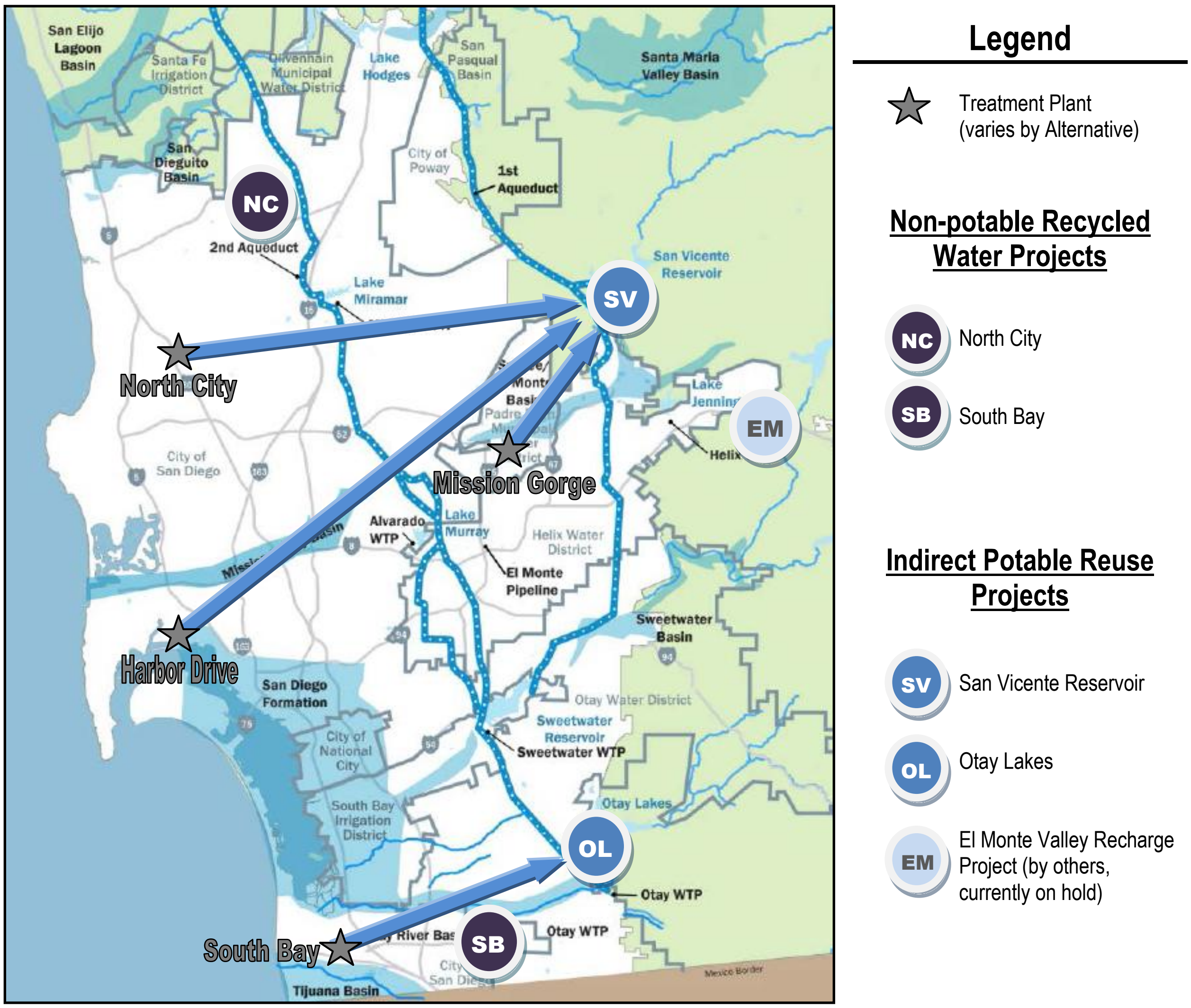
Opportunities were sized and then pieced together by laying out treatment and conveyance facilities. Cost information was also developed, with pumping costs being a particularly important component because of the variability of pumping costs for indirect potable reuse, non-potable water, and wastewater. The availability of this information allowed Stakeholders to compare the benefits of different approaches within each area. For example, Alternatives that required extensive wastewater pumping (which requires pumping approximately 30-percent more flow than advanced treated water), were identified as having added costs and risks compared to other Alternatives. This point led to development of the Harbor Drive Plant concept later in the Study.

Area Concept Summary

Area	Base Concept Presented at the Coarse Screening Session	Additional Considerations after Stakeholder Review
San Vicente/ North City	• Complete planned non-potable recycled water projects • Maximize indirect reuse of water produced at North City Plant with diversions from – Morena – Mission Valley • Treat and produce water at Mission Gorge • Account for El Monte Valley indirect potable reuse project	• Reduce pumping of wastewater by eliminating diversion of wastewater at Mission Valley • Treat and produce water at Harbor Drive site • Consider both split plant and consolidated plant at Harbor Drive and Mission Valley to minimize site needs • Consider additional costs and complexities related to expanded North City Plant beyond master-planned capacity of 45 mgd
South Bay	• Complete planned non-potable recycled water projects • Wastewater diversions from different locations along the South Metro Interceptor (depending on the option) • Consider serving additional non-potable recycled water demands • Indirect potable reuse of water produced at South Bay Plant	• Consider increased diversion totals by locating the diversion further North at the Spring Valley No. 8 connection
Rancho Bernardo/ San Pasqual	• Rancho Bernardo/I-15 Corridor, non-potable recycled water • San Pasqual indirect potable reuse (two variations)	• Determined that these options do not offload the Point Loma Plant and provide limited benefits to other opportunities • Consider private entities funding a majority of the improvements needed

How Were Area Concepts Refined into Integrated Reuse Alternatives?

Area Concepts were refined into Integrated Reuse Alternatives in the Fine Screening Session. Fine Screening Session participants considered a series of projects to meet the 100 mgd water reuse target. The non-potable recycled water demands and the indirect potable reuse project delivery locations that advanced to the Fine Screening Session are summarized in the two adjacent tables and are shown on the figure below.



Integrated Alternative Concepts

Non-potable Recycled Water. Expansion of the non-potable recycled water systems is planned primarily through 2015, with additional growth in South Bay through 2040 based on Otay Water District's projections, as shown below.

Non-Potable Recycled Water Projected Demands

Map Code	Agency	Existing 2009/2010		Planned 2010-2015		Planned (OWD) 2015-2026		Future (OWD) 2026-2040		Total	
		AFY	mgd	AFY	mgd	AFY	mgd	AFY	mgd	AFY	mgd
North City Plant											
NC	City of San Diego	6,394	5.7	1,959	1.7	0	0.0	0	0.0	8,353	7.4
	City of Poway	428	0.4	323	0.3	0	0.0	0	0.0	751	0.7
	Olivenhain MWD	642	0.6	458	0.4	0	0.0	0	0.0	1,100	1.0
	Total North City	**7,464**	**6.7**	**2,740**	**2.4**	**0**	**0.0**	**0**	**0.0**	**10,204**	**9.1**
South Bay Plant											
SB	City of San Diego	1,539	1.4	-639	-0.6	0	0.0	0	0.0	900	0.8
	Otay Water District	3,209	2.9	1,395	1.2	1243	1.1	3,363	3.0	9,210	8.3
	Total South Bay	**4,748**	**4.2**	**756**	**0.7**	**1,243**	**1.1**	**3,363**	**3.0**	**10,110**	**9.0**
North City and South Bay Plants											
	Total Combined	**12,212**	**10.9**	**3,496**	**3.1**	**1,243**	**1.1**	**3,363**	**3.0**	**20,314**	**18.1**

Notes: See Study Table 5-3 for notes. Demands shown are average annual demands. Reductions in demands for South Bay between 2010 and 2015 are associated with changes at the International Boundary and Water Commission Plant, which will no longer require non-potable recycled water for process uses.

Indirect Potable Reuse. Two surface water augmentation projects and a groundwater recharge project were advanced into the Fine Screening Session. In addition, the El Monte Valley Groundwater Augmentation Project (being planned by others) was assumed to occur and its impacts were taken into consideration.

Indirect Potable Reuse Projects Advanced

Map Code	Reservoir or Basin	Storage Capacity (acre-feet)	Reuse Potential		Key Considerations
			AFY	mgd	
Surface Water Reservoir Candidates Advanced to the Fine Screening Session					
SV	**San Vicente (w/ Dam Raise)** 	249,358	Up to 100,000	Up to 89	Recommended approach from 2005 Water Reuse Study. The dam raise, scheduled for completion between 2013 and 2014, will increase retention times and indirect potable reuse capacity potential, and provides the ability to distribute water throughout the region and to the largest water treatment plants.
OL	**Otay Lakes** 	49,849	Up to 25,000	Up to 22	Previous recommendation from 2005 Water Reuse Study, with proximity to South Bay Plant. Located adjacent to the 33 mgd (2035 capacity) Otay Water Treatment Plant.
Groundwater Augmentation Project by Others Considered					
EM	**El Monte Valley** (or similar project) 	10,000 to 50,000	5,000	4.5 to 5.0	The El Monte basin was evaluated by the Helix Water District and the Padre Dam Municipal Water District for an indirect potable reuse groundwater augmentation project. This project was coordinated with this Study since wastewater flows for this project affect downstream wastewater availability in the Metro System. Although this project is currently on hold, it or a similar project could further offload the wastewater system and provide valuable new water to the region. The status of this project is anticipated to be tracked as an Implementation Step.

Notes: See Study Tables 6-1 and 6-3 for notes. Demands shown are average annual demands.

What was the Rationale for Numbering the Integrated Reuse Alternatives?

The following summarizes the numbering system used. Each Alternative includes common South Bay components

Alternatives:

"A" Alternatives. The "A" Alternatives expand the North City Plant to 45 mgd (the site's master-planned capacity) using the Morena Diversion. The added capacity at North City allows the Harbor Drive Plant to be smaller than the "B" Alternatives.

"B" Alternatives. The "B" Alternatives maximize the existing North City Plant capacity at 30 mgd (which occurs once the initial 15 mgd indirect potable reuse project is complete). The smaller total at the North City Plant requires the Harbor Drive Plant to be larger than the "A" Alternatives.

Sub-Alternatives:

"1" Sub-Alternatives. Alternatives "A1" and "B1" differ from the "2" (A2, B2) and "3" (B3) alternatives by splitting the Harbor Drive water reclamation treatment processes and the advanced purification facility treatment into different sites (the advanced purification processes are located at the Camino Del Rio site described in Chapter 7). This adds a fourth plant site to these alternatives.

"2" Sub-Alternative. Alternatives "A2" and "B2" also relate to the Harbor Drive Plant. The "2" Alternatives place all the Harbor Drive water reclamation and advanced purification treatment processes at a combined plant along Harbor Drive (similar to how the proposed North City and South Bay Plants will be configured). The Harbor Drive Plant in these alternatives is larger, but the operation is efficiently consolidated to a single site.

"3" Sub-Alternative. Alternative "B3" is the same as Alternative "B2", except that it includes a small plant in Mission Gorge to collect, treat, and convey water to the San Vicente Reservoir. This adds a fourth plant, but it is the closest location to the San Vicente Reservoir.

Major Alternatives

"A" Alternatives =
North City at 45 mgd + South Bay with SV8 diversion

"B" Alternatives =
North City at 30 mgd + South Bay with SV8 diversion

Sub-alternatives Based on Siting Elements

"1" Alternatives
split plant between Harbor Drive & Camino del Rio

"2" Alternatives
combined Harbor Drive Plant

"3" Alternative
combined Harbor Drive plant and an additional plant at Mission Gorge

Summary of Integrated Reuse Alternative Elements

Integrated Reuse Alternatives were formed based on the project goals established by the project Stakeholders, the criteria developed at the Framework Planning Session, and the screening work performed at the Coarse Screening and Fine Screening Sessions, and subsequent Stakeholder Status Update Meetings. The following table summarizes the elements included in each Integrated Reuse Alternative.

Integrated Reuse Alternative Summary - Elements Included					
Elements in the Area Concept	**A1**	**A2**	**B1**	**B2**	**B3**
Elements from the North City/San Vicente Area Concept Themes					
Existing non-potable recycled water demands (6.7 mgd)	✓	✓	✓	✓	✓
Planned non-potable recycled water demands (2.4 mgd)	✓	✓	✓	✓	✓
North City Plant w/indirect potable reuse to San Vicente (15.0 mgd)	✓	✓	✓	✓	✓
Morena Diversion w/North City Plant expansion & indirect potable reuse to San Vicente (11.9 mgd)	✓	✓			
Harbor Drive Plant w/indirect potable reuse to San Vicente (capacity varies depending on the Alternative: 40.9 mgd for A1/A2; 52.8 mgd for B1/B2; and 46.0 mgd for B3)	✓	✓	✓	✓	✓
Harbor Drive consolidated WRP/AWPF plant		✓		✓	✓
Harbor Drive WRP/Camino Del Rio AWPF split plant	✓		✓		
Mission Gorge Plant w/indirect potable reuse to San Vicente (6.8 mgd)					✓
Elements from South Bay Area Concept C2					
Existing non-potable recycled water demands (4.2 mgd)	✓	✓	✓	✓	✓
Planned non-potable recycled water demands (1.8 mgd)	✓	✓	✓	✓	✓
Additional future non-potable recycled water demands (3.0 mgd)	✓	✓	✓	✓	✓
Spring Valley No. 8 Diversion to South Bay (31.1 mgd)	✓	✓	✓	✓	✓
South Bay indirect potable reuse to Otay Lakes (15.0 mgd)	✓	✓	✓	✓	✓

Note: Flows for non-potable recycled water and indirect potable reuse projects are average annual totals based on the output of the plant. Flows for the Spring Valley diversion are based on 2035 Dry Weather Flows. WRP = Water Reclamation Plant; AWPF = Advanced Water Purification Facility

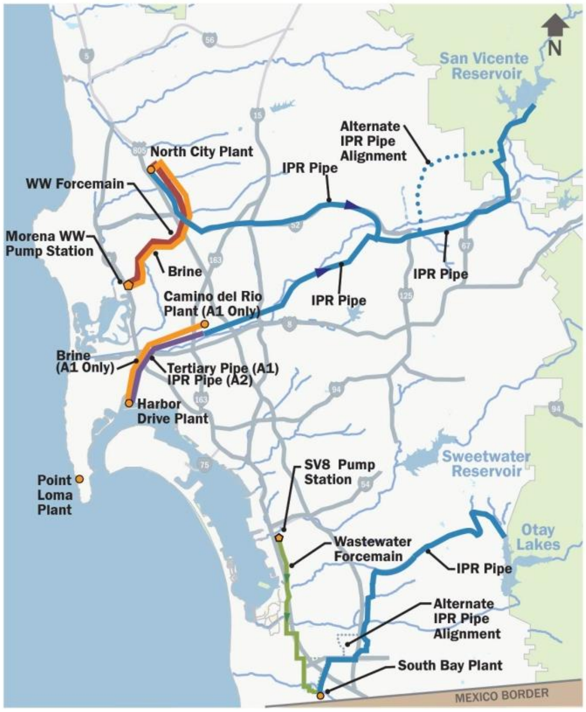
Summary of Financial Terms Used

A full description of financial terminology was included previously in this Executive Summary. The following table provides a summary to aid reviewing the Alternative Summary pages that follow.

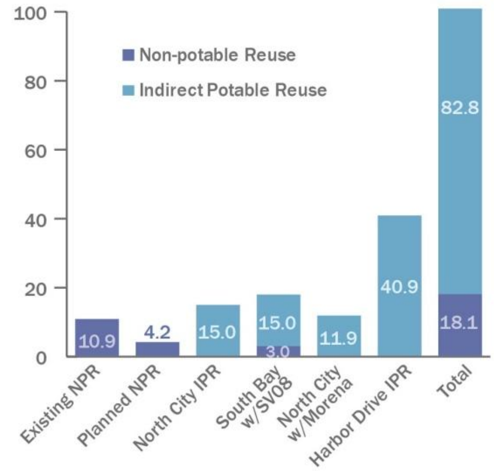
Cost Level	Description
Gross Costs	Gross costs include the capital and O&M costs for completing and operating the recycled water projects. It does not account for reduced capital and O&M expenses at downstream facilities or other benefits/credits.
Tier 1 Net Costs Direct Wastewater System Savings	With the proposed reuse program, flows to downstream facilities are less, resulting in lower capital and operating costs. Tier 1 shows the reuse cost with these adjustments. (Point Loma Plant, Pump Station 1, Pump Station 2).
Tier 2 Net Costs Salt Reduction Credit	The IPR projects substantially reduce salinity/TDS which lowers operating costs in the downstream water and wastewater systems (there is also a customer benefit treated qualitatively).
Tier 3 Net Costs Indirect Wastewater Savings (CEPT)	The reuse program will reduce mass emissions at Point Loma. This cost tier summaries the net costs if the reuse program contributes to maintaining chemically enhanced primary treatment at Point Loma.

Summary of Integrated Reuse Alternatives A1 and A2

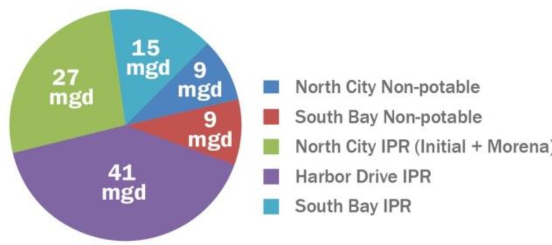
Facility Map



Reuse By Phase



Reuse Per Plant



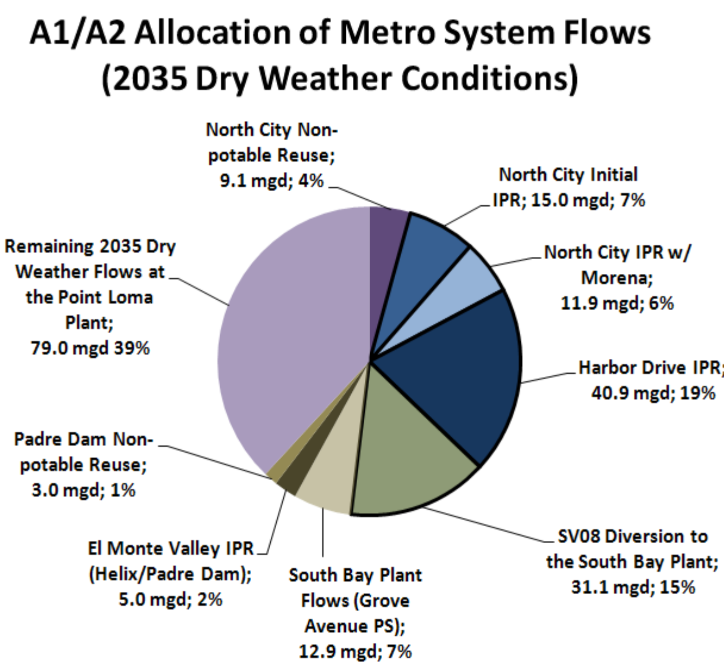


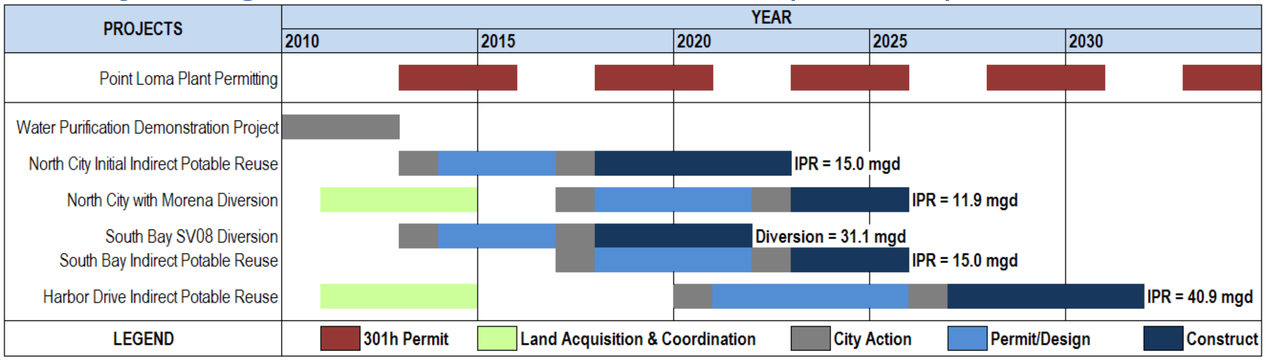
Figure 8-2
Integrated Reuse Alternatives A1 and A2

(upper left) – Displays the facilities included in Alternatives A1 and A2. A1 differs only in that the advanced treatment processes at the Harbor Drive Plant are located at the Camino del Rio site.

(Above) – The charts above includes reuse totals per project and per plant for both non-potable recycled water and indirect potable reuse.

(Left) – The pie chart to the left displays the allocation of Metro System flows estimated for the 2035 dry weather year flow scenario. The black bordered portions represent 99 mgd of offload provided by the facilities included in this Study. Wet weather allocations are presented in Appendix B.

Summary of Integrated Reuse Alternatives A1 and A2 (Continued)



Alternative A1/A2 Implementation Schedule

Note: The planned 21 mgd expansion of South Bay as part of the September 2011 Draft Wastewater Master Plan may allow deferring or eliminating the 26 mgd primary and secondary expansion included in this Study. South Bay plant sizing and capacities shall be coordinated with wastewater planning efforts and Point Loma permit discussions per the implementation steps.

Alternative A1/A2 New Water and Point Loma Offloading (Totals in mgd)

Start of Operations	New Water (mgd)					Wastewater Offload (mgd)		
	North City	Harbor Drive	Mission Gorge	South Bay	Cumulative	Reuse (N/I South Bay)	Diverted to South Bay	Cumulative
2023	15.0	0.0	-	0.0	15.0	15.0	0.0	15.0
2022	0	0.0	-	0.0	15.0	0.0	31.1	46.1
2026	11.9	0.0	-	0.0	26.9	11.9	0.0	58.0
2026	0.0	0.0	-	18.0	44.9	0.0	0.0	58.0
2032	0.0	40.9	-	0.0	85.8	40.9	0.0	98.9

Note: New water and wastewater offloading totals are based on the reuse projects included in the cost estimates for this Study. The totals do not include the proposed El Monte Groundwater Recharge IPR Project (5 mgd); existing and planned non-potable reuse for the North City Plant (9.1 mgd) and Padre Dam Plant (3.0 mgd); and the Grove Ave. Pump Station (12.9 mgd - which accounts for South Bay non-potable reuse thru 2026). South Bay new water totals include: 15 mgd for IPR and 3 mgd for non-potable reuse (Otay Water District, 2026 to 2040).Point Loma offload totals are based on 2035 Dry Weather Flows. Point Loma offloading due to South Bay is accounted for based on the diversion flows, not the new water created.

Alternative A1/A2 Capital and Annual O&M Costs

Item		2014 North City initial	2014 South Bay Diversion	2018 Morena	2018 South Bay IPR	2021 Harbor Drive (Alternative A1)	2021 Harbor Drive (Alternative A2)
Incremental Costs	Capital	$410,700,000	$20,700,000	$301,300,000	$455,400,000	$1,000,000,000	$1,012,200,000
	O&M	$17,600,000	$300,000	$13,100,000	$22,700,000	$51,000,000	$50,800,000
Cumulative Costs	Capital	$410,700,000	$431,400,000	$732,800,000	$1,188,200,000	$2,188,200,000	$2,200,400,000
	O&M	$17,600,000	$17,900,000	$31,000,000	$53,600,000	$104,700,000	$104,500,000

Note: Capital & O&M Costs shown above are from the Favorable financial model scenario, and include a 20-percent project contingency.

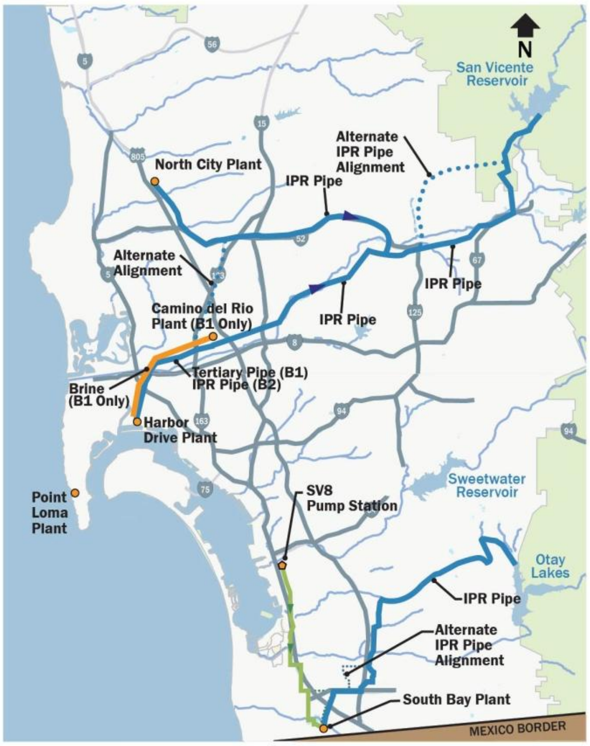
Alternative A1/A2 Reuse Water Cost Summary (2011 $/AF)

Cost Category	Alternative A1	Alternative A2
Gross Costs (Before Avoided Facilities and Other Offset Savings)	$1,900	$1,900
Tier 1 Net Costs (With Direct Wastewater System Savings)	$1,300	$1,300
Tier 2 Net Costs (With Salt Credit Plus Tier 1 Savings)	$1,200	$1,200
Tier 3 Net Costs (With Indirect Wastewater System Savings Plus Tier 1 and Tier 2 Savings)	$800	$800
2011 Untreated Imported Water Costs (for comparison purposes)	$904	$904

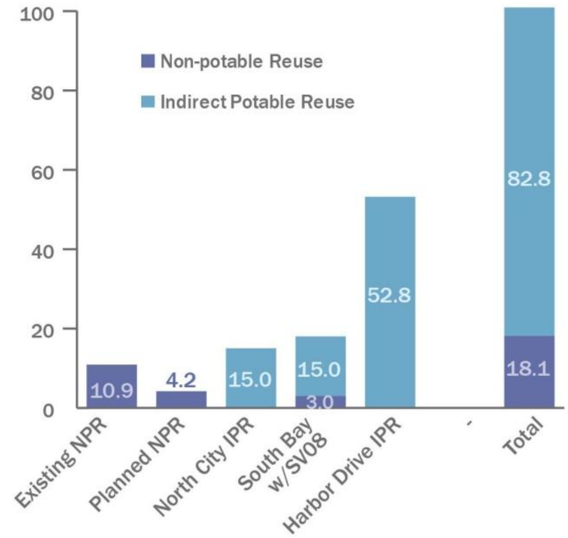
Note: The reuse water cost summary above represents average costs based on the Favorable and Unfavorable financial model scenarios. See Section 8.4 for more details on the financial evaluation and cost descriptions. Tier 1 savings includes wastewater projects no longer necessary due to the reuse projects and offloading included in this Study. Tier 2 savings accounts for savings due to water quality improvements. Tier 3 conceptualizes the savings that could occur if maintaining chemically enhanced primary treatment at the Point Loma Plant was made possible due to the reuse program proposed in this Study. Costs shown above are for comparison of untreated water options, and do not include potable water treatment plant costs.

Summary of Integrated Reuse Alternatives B1 and B2

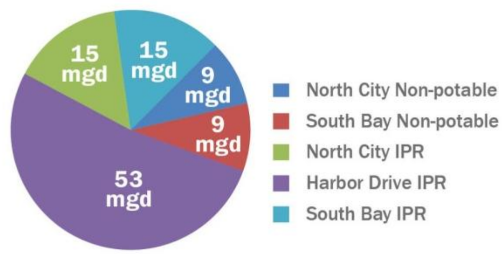
Facility Map



Reuse By Phase



Reuse Per Plant



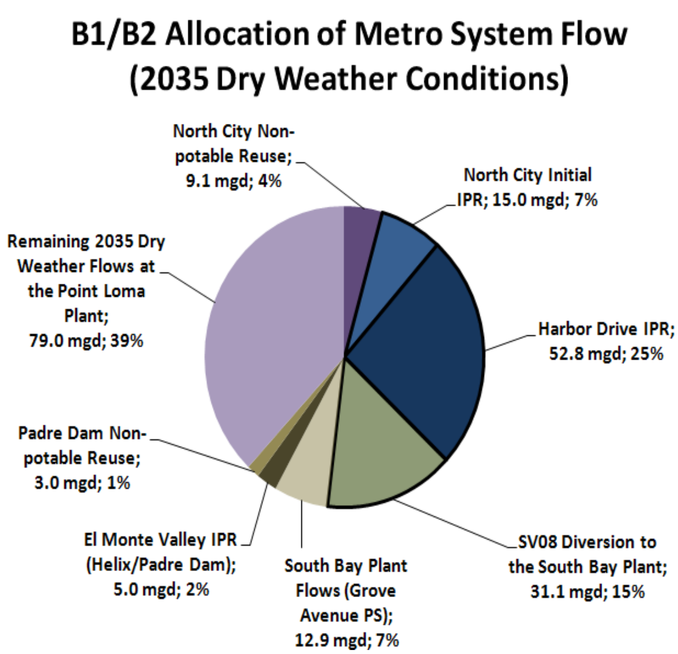


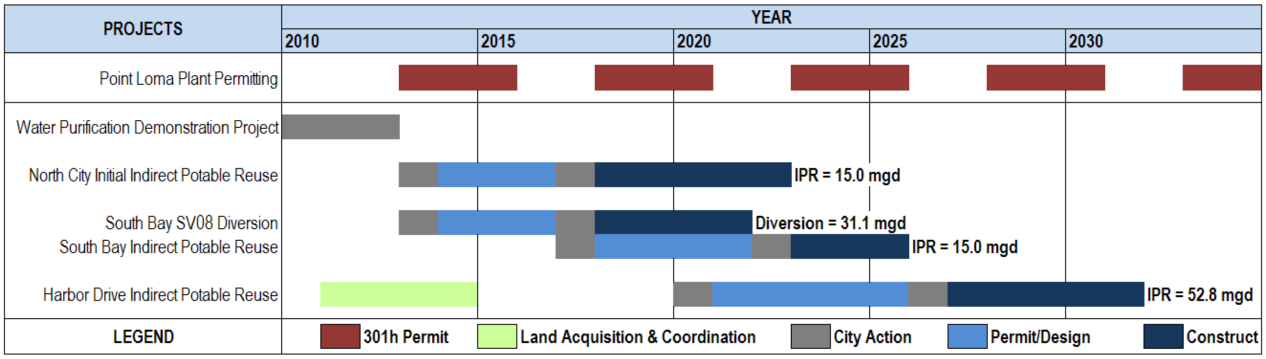
Figure 8-4.
Integrated Reuse Alternatives B1 and B2

(upper left) – Displays the facilities included in Alternatives B1 and B2. B1 differs only in that the advanced treatment processes at the Harbor Drive Plant are located at the Camino del Rio site.

(Above) – The charts above includes reuse totals per project and per plant for both non-potable recycled water and indirect potable reuse.

(Left) – The pie chart to the left displays the allocation of Metro System flows estimated for the 2035 dry weather year flow scenario. The black bordered portions represent 99 mgd of offload provided by the facilities included in this Study. Wet weather allocations are presented in Appendix B.

Summary of Integrated Reuse Alternatives B1 and B2 (Continued)



Alternative B1/B2 Implementation Schedule

Note: The planned 21 mgd expansion of South Bay as part of the September 2011 Draft Wastewater Master Plan may allow deferring or eliminating the 26 mgd primary and secondary expansion included in this Study. South Bay plant sizing and capacities shall be coordinated with wastewater planning efforts and Point Loma permit discussions per the implementation steps.

Alternative B1/B2 New Water and Point Loma Offloading (Totals in mgd)

Start of Operations	New Water (mgd)					Wastewater Offload (mgd)		
	North City	Harbor Drive	Mission Gorge	South Bay	Cumulative	Reuse (N/I South Bay)	Diverted to South Bay	Cumulative
2023	15.0	0.0	-	0.0	15.0	15.0	0.0	15.0
2022	0.0	0.0	-	0.0	15.0	0.0	31.1	46.1
2026	0.0	0.0	-	18.0	33.0	0.0	0.0	46.1
2032	0.0	52.8	-	0.0	85.8	52.8	0.0	98.9

Notes: New water and wastewater offloading totals are based on the reuse projects included in the cost estimates for this Study. The totals do not include the proposed El Monte Groundwater Recharge IPR Project (5 mgd); existing and planned non-potable reuse for the North City Plant (9.1 mgd) and Padre Dam Plant (3.0 mgd); and the Grove Ave. Pump Station (12.9 mgd - which accounts for South Bay non-potable reuse thru 2026). South Bay new water totals include: 15 mgd for IPR and 3 mgd for non-potable reuse (Otay Water District, 2026 to 2040).Point Loma offload totals are based on 2035 Dry Weather Flows. Point Loma offloading due to South Bay is accounted for based on the diversion flows, not the new water created.

Alternative B1/B2 Capital and Annual O&M Costs

Item		2014 North City initial	2014 South Bay Diversion	2018 South Bay IPR & 3 mgd non-potable	2021 Harbor Drive (Alternative B1)	2021 Harbor Drive (Alternative B2)
Incremental Costs	Capital	$340,700,000	$20,700,000	$455,400,000	$1,159,900,000	$1,168,300,000
	O&M	$17,300,000	$300,000	$22,700,000	$61,200,000	$60,500,000
Cumulative Costs	Capital	$340,700,000	$361,400,000	$816,800,000	$1,976,700,000	$1,985,100,000
	O&M	$17,300,000	$17,600,000	$40,300,000	$101,500,000	$100,800,000

Note: Capital & O&M Costs shown above are from the Favorable financial model scenario, and include a 20-percent project contingency.

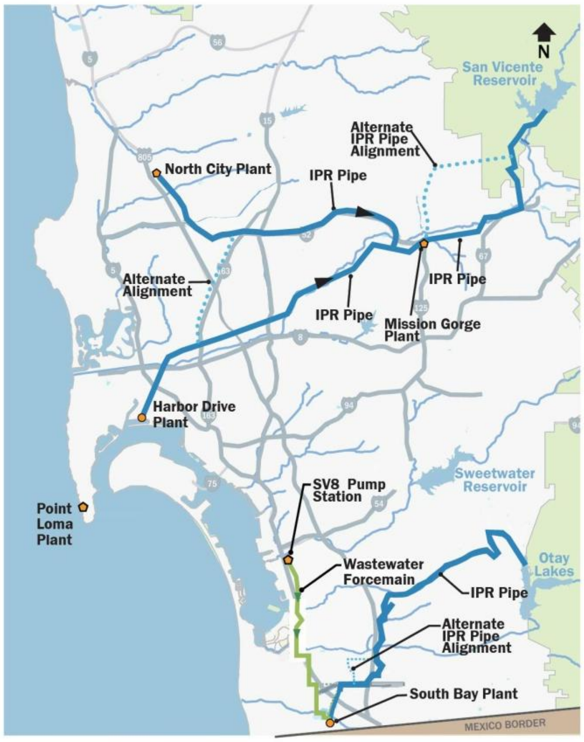
Alternative B1/B2 Unit Cost Summary (2011 $/AF)

Cost Category	Alternative B1	Alternative B2
Gross Costs (Before Avoided Facilities and Other Offset Savings)	$1,700	$1,700
Tier 1 Net Costs (With Direct Wastewater System Savings)	$1,100	$1,100
Tier 2 Net Costs (With Salt Credit Plus Tier 1 Savings)	$1,000	$1,000
Tier 3 Net Costs (With Indirect Wastewater System Savings Plus Tier 1 and Tier 2 Savings)	$600	$600
2011 Untreated Imported Water Costs (for comparison purposes)	$904	$904

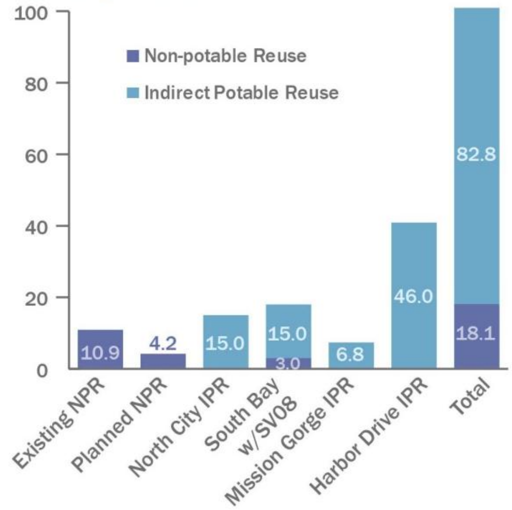
Note: The reuse water cost summary above represents average costs based on the Favorable and Unfavorable financial model scenarios. See Section 8.4 for more details on the financial evaluation and cost descriptions. Tier 1 savings includes wastewater projects no longer necessary due to the reuse projects and offloading included in this Study. Tier 2 savings accounts for savings due to water quality improvements. Tier 3 conceptualizes the savings that could occur if maintaining chemically enhanced primary treatment at the Point Loma Plant was made possible due to the reuse program proposed in this Study. Costs shown above are for comparison of untreated water options, and do not include potable water treatment plant costs.

Summary of Integrated Reuse Alternative B3

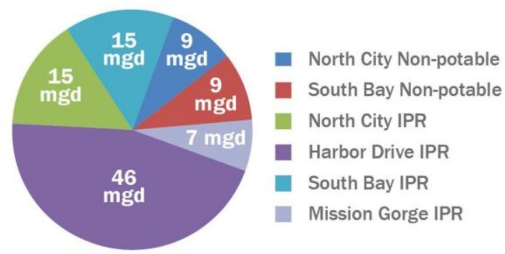
Facility Map



Reuse by Phase



Reuse Per Plant



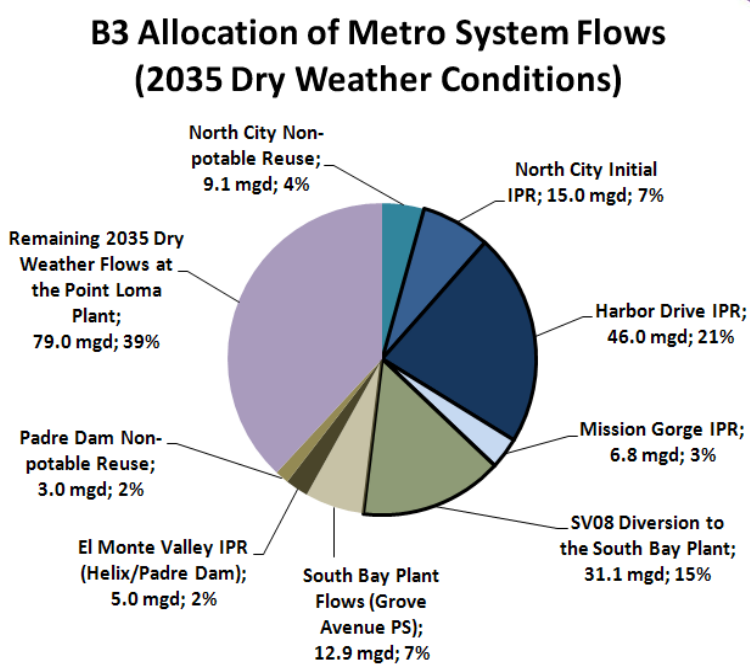


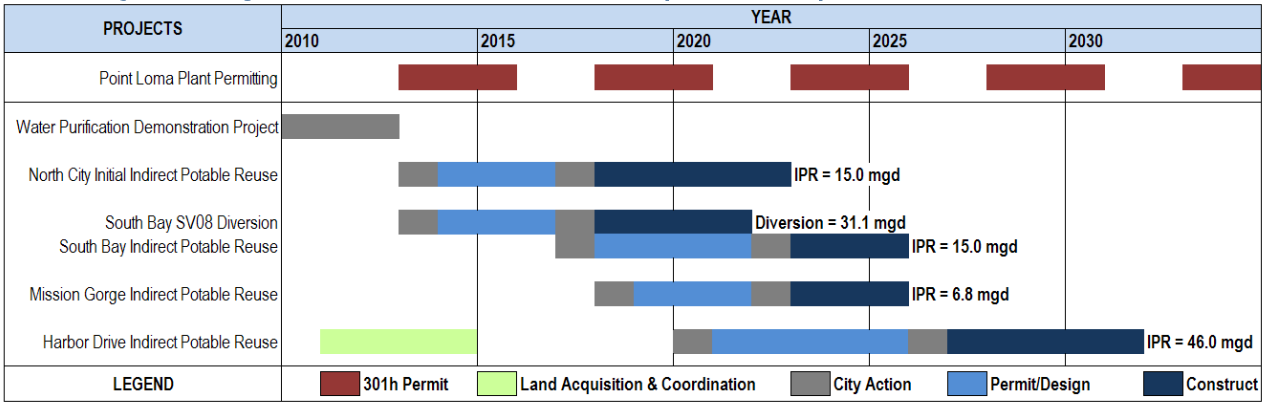
Figure 8-6.
Integrated Reuse Alternative B3

(upper left) – Displays the facilities included in Alternative B3. The Mission Gorge Plant is the only difference between this Alternative and Alternative B2.

(Above) – The charts above includes reuse totals per project and per plant for both non-potable recycled water and indirect potable reuse.

(Left) – The pie chart to the left displays the allocation of Metro System flows estimated for the 2035 dry weather year flow scenario. The black bordered portions represent 99 mgd of offload provided by the facilities included in this Study. Wet weather allocations are presented in Appendix B.

Summary of Integrated Reuse Alternative B3 (Continued)



Alternative B3 Implementation Schedule

Note: The planned 21 mgd expansion of South Bay as part of the September 2011 Draft Wastewater Master Plan may allow deferring or eliminating the 26 mgd primary and secondary expansion included in this Study. South Bay plant sizing and capacities shall be coordinated with wastewater planning efforts and Point Loma permit discussions per the implementation steps.

Alternative B3 New Water and Point Loma Offloading (Totals in mgd)

Start of Operations	New Water (mgd)					Wastewater Offload (mgd)		
	North City	Harbor Drive	Mission Gorge	South Bay	Cumulative	Reuse (N/I South Bay)	Diverted to South Bay	Cumulative
2023	15.0	0.0	0.0	0.0	15.0	15.0	0.0	15.0
2022	0.0	0.0	0.0	0.0	15.0	0.0	31.1	46.1
2026	0.0	0.0	0.0	18.0	33.0	0.0	0.0	46.1
2026	0.0	0.0	6.8	0.0	39.8	6.8	0.0	52.9
2032	0.0	46.0	0.0	0.0	85.8	46.0	0.0	98.9

Note: New water and wastewater offloading totals are based on the reuse projects included in the cost estimates for this Study. The totals do not include the proposed El Monte Groundwater Recharge IPR Project (5 mgd); existing and planned non-potable reuse for the North City Plant (9.1 mgd) and Padre Dam Plant (3.0 mgd); and the Grove Ave. Pump Station (12.9 mgd - which accounts for South Bay non-potable reuse thru 2026). South Bay new water totals include: 15 mgd for IPR and 3 mgd for non-potable reuse (Otay Water District, 2026 to 2040).Point Loma offload totals are based on 2035 Dry Weather Flows. Point Loma offloading due to South Bay is accounted for based on the diversion flows, not the new water created.

Alternative B3 Capital and Annual O&M Costs

Item		2014 North City initial	2014 South Bay Diversion	2018 South Bay IPR & 3 mgd non-potable	2019 Mission Gorge	2021 Harbor Drive
Incremental Costs	Capital	$332,600,000	$20,700,000	$455,400,000	$279,000,000	$1,073,200,000
	O&M	$17,300,000	$300,000	$22,700,000	$13,500,000	$55,000,000
Cumulative Costs	Cumulative Capital Cost	$332,600,000	$353,400,000	$808,800,000	$1,087,800,000	$2,160,900,000
	Cumulative O&M Cost	$17,300,000	$17,600,000	$40,300,000	$53,700,000	$108,700,000

Note: Capital & O&M Costs shown above are from the Favorable financial model scenario, and include a 20-percent project contingency.

Alternative B3 Unit Cost Summary (2011 $/AF)

Cost Category	Alternative B3
Gross Costs (Before Avoided Facilities and Other Offset Savings)	$1,900
Tier 1 Net Costs (With Direct Wastewater System Savings)	$1,300
Tier 2 Net Costs (With Salt Credit Plus Tier 1 Savings)	$1,200
Tier 3 Net Costs (With Indirect Wastewater System Savings Plus Tier 1 and Tier 2 Savings)	$800
2011 Untreated Imported Water Costs (for comparison purposes)	$904

Note: The reuse water cost summary above represents average costs based on the Favorable and Unfavorable financial model scenarios. See Section 8.4 for more details on the financial evaluation and cost descriptions. Tier 1 savings includes wastewater projects no longer necessary due to the reuse projects and offloading included in this Study. Tier 2 savings accounts for savings due to water quality improvements. Tier 3 conceptualizes the savings that could occur if maintaining chemically enhanced primary treatment at the Point Loma Plant was made possible due to the reuse program proposed in this Study. Costs shown above are for comparison of untreated water options, and do not include potable water treatment plant costs.

What are the Alternative Costs and How Do They Compare with Other Water Supply Costs?

The Integrated Reuse Alternative costs are summarized in the table below. The table includes a tiered breakout of summary level costs based on the Gross Costs and Net Costs categories described earlier in this Executive Summary. As shown, the costs for A1, A2 and B3 are nearly identical to each other, and slightly higher than B1 and B2. For the A1/A2 comparison to B1/B2, the increased costs occur mainly due to the additional wastewater facilities and pumping needed to divert flows from Morena to the North City Plant. For the B3 comparison to B1/B2, B3 adds an additional plant and does not have the same economy of scale that the B1 and B2 Alternatives have. Implementation steps are included later in this Chapter, which include steps to further develop the Alternatives and look for additional cost savings.

Cost Summary (2011 $/AF)				
Alternative	Average Gross Costs	Net Costs		
		Tier 1 - Direct Wastewater System Savings	Tier 2 - Salt Reduction Credit	Tier 3 - Indirect Wastewater System Savings
		Remaining Point Loma capacity upgraded to Secondary	*Water Quality Benefit to Water/Wastewater System*	*Remaining Point Loma capacity maintained at CEPT*
A1: North City 45 mgd; Split Harbor Dr. AWPF	$1,900	$1,300	$1,200	$800
A2: North City 45 mgd; Consolidated Harbor Dr. AWPF	$1,900	$1,300	$1,200	$800
B1: North City 30 mgd; Split Harbor Dr. AWPF	$1,700	$1,100	$1,000	$600
B2: North City 30 mgd; Consolidated Harbor Dr. AWPF	$1,700	$1,100	$1,000	$600
B3: North City 30 mgd; Consolidated Harbor Dr. AWPF; Mission Gorge AWPF	$1,900	$1,300	$1,200	$800

Notes:
- *All Alternatives include South Bay Option C2 expansion with the Spring Valley No. 8 Diversion*
- *Direct and indirect wastewater system savings based on a comparison between the City's September 2011 Draft Wastewater Master Plan and the reduced wastewater facility sizing and pumping required as a resulted of the projects included in this Recycled Water Study (see Appendix H).*
- *Totals are in 2011 dollars (ENR Los Angeles Index value of 10,051.30, June 2011) and are based on a net present value analysis using a detailed financial model.*
- *Financial model sensitivity analysis generally produced cost ranging +/- $200/AF of the values shown. Favorable conditions could result in lower costs than shown.*

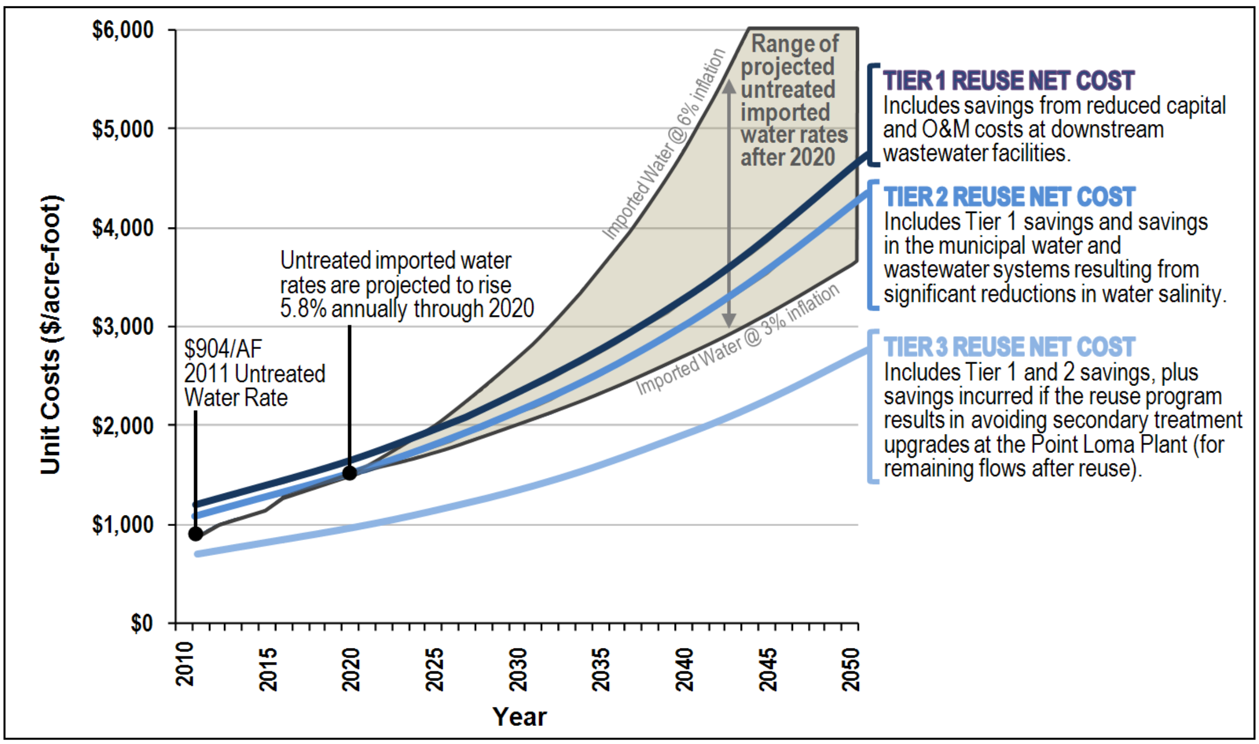
Key Study Conclusion

The Alternative Net Costs represent the costs that should be compared to other water sources – particularly imported untreated water. The average costs of the Alternatives above are:

- Cost assuming direct wastewater savings = $1,200/AF
- Cost assuming above plus salt credit = $1,100/AF
- Cost assuming above plus indirect wastewater savings = $700/AF

These costs compare well to the 2011 untreated water cost of $904 per acre foot, and are more economical than most other new water supply concepts being proposed.

The Study Alternative's Net Costs were extrapolated based on a 3.5-percent inflation rate and compared to projected imported untreated water rate as shown in the figure below. The 2011 SDCWA municipal and industrial untreated water rate for the City was $904 per acre foot. The existing rate was inflated through 2020 based on the "low-rate" scenario values provided by the SDCWA in April 2011 (which averages to a 5.8-percent annual increase). Beyond 2020, the untreated water cost projections were bracketed based on various inflation scenarios ranging from 3 to 6 percent (shown as the shaded area). These scenarios compare well to the Net Costs of the Study's Alternatives (shown as solid lines). The Study's Net Costs shown are the average of all the Study Alternatives and an average of the Favorable and Unfavorable scenario (i.e., the lower cost B1/B2 Alternatives and the favorable scenario would lower the reuse costs further). As shown, the average Tier 1 and Tier 2 cost curves have Net Costs lower than most untreated imported water rate scenarios. If the Tier 3 savings are attributed to the projects in this Study, the program would have significantly lower Net Costs than all untreated imported water rate scenarios. An additional consideration is the long-term effects that other local water projects and reduced demands are causing to MWD/SDCWA rates. As purchases decline, rates must increase to cover fixed costs. This is likely to cause imported water costs to inflate faster than locally controlled projects. Overall, the conclusion of this analysis supports the water reuse program proposed in this Study.



Comparison of the Study's Unit Costs for New Water to the Cost of Imported Untreated Water

The Integrated Reuse Alternative Net Costs compare well to projected untreated imported water rates. Untreated water rates are projected to rise 5.8 percent through 2020 and there remain many uncertainties regarding future costs associated with the Bay-Delta fix and imported water.

What Were the Other Considerations for Each Alternative?

The Integrated Reuse Alternatives were evaluated during the Fine Screening Session and subsequent Stakeholder Status Update Meetings. Each Integrated Reuse Alternative provides common and distinct benefits, as summarized below.

Integrated Reuse Alternative Comparative Summary					
Alternative	Institutional Complexity	Technical Complexity	Number of Treatment Plants	Number of Wastewater Diversions	Key Infrastructure Siting and Complexity Considerations
A1	Med	High (Morena Diversion/Split Split Plant Harbor Drive-Camino del Rio)	4 North City, South Bay, Harbor Drive (WRP) w/ Camino del Rio (AWPF)	2	• Smallest area requirement at the Harbor Drive site • Challenging siting at Camino del Rio site • Challenging siting and operation of the Morena Wastewater Diversion Pump Station • Most pumping of all alternatives due to Morena Diversion • Increased costs due to added brine line
A2	Med	Med/High (Morena Diversion)	3 North City, South Bay Harbor Drive	2	• Reduced Harbor Drive Plant siting needs compared to the "B" alternatives • Challenging siting and operation of the Morena Wastewater Diversion Pump Station
B1	Med	Med/High (split Plant Harbor Drive-Camino del Rio)	4 North City, South Bay, Harbor Drive (WRP) w/ Camino del Rio (AWPF)	1	• Reduced Harbor Drive Plant siting needs compared to B2 • Minimal wastewater pumping • Challenging siting at the Camino del Rio site • Reduced ability to phase • Increased costs due to added brine line
B2	Med	Med	3 North City, South Bay, Harbor Drive	1	• Largest area requirement at the Harbor Drive site • Least cost option • Minimal wastewater and tertiary water pumping • Reduced ability to phase
B3	High (Harbor Drive site & Mission Gorge site)	High (4th Water Reclamation Plant/ Advance Water Purification Facility at Mission Gorge)	4 North City, South Bay, Harbor Drive, Mission Gorge	1	• Multiple agency collaboration could drive further economy of scale benefits • Allows for additional phasing opportunities • Closest plant to San Vicente Reservoir reduces overall pumping • Mission Gorge site requires interagency agreements and administration costs • Mission Gorge Plant is relatively small due to limited tributary wastewater flows. It does not have an economy of scale benefit and reduces some economy of scale benefit at the Harbor Drive Plant • Larger upstream treatment at Mission Gorge Plant impacts downstream water quality at Harbor Drive Plant • Reduced flows/concentrated waste downstream of Mission Gorge Plant may create maintenance issues

Notes:

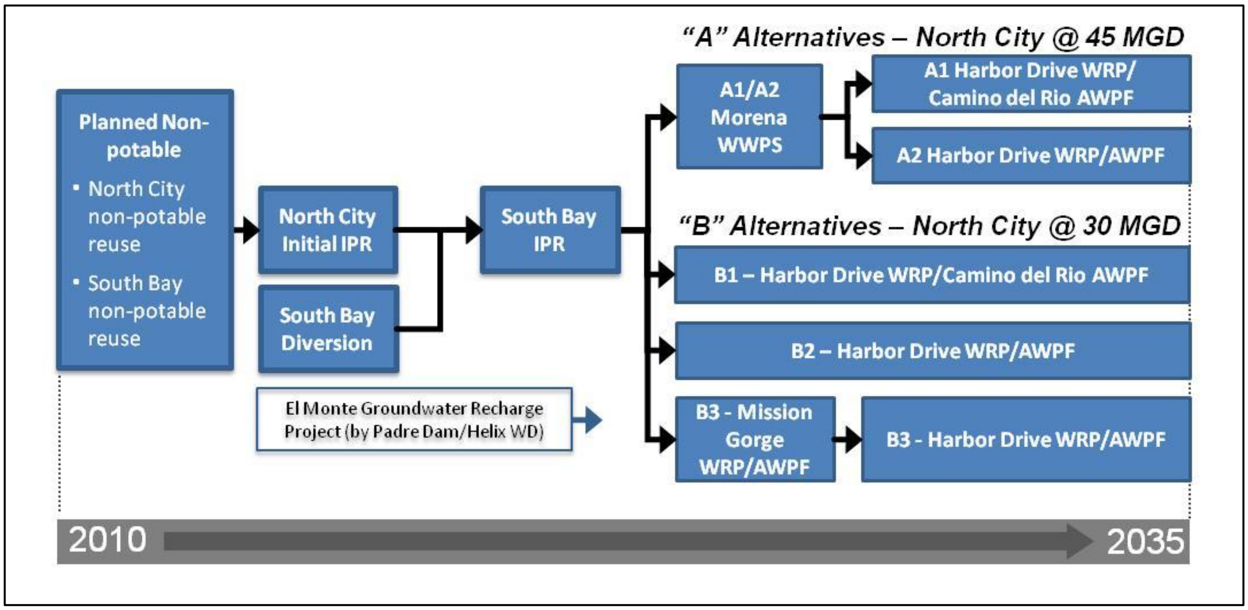
- *Alternative A1 and B1 include a split Harbor Drive Plant at the Harbor Drive site and Camino del Rio site. Although these facilities work together, they were considered separate treatment plant sites in the table above.*
- *Wastewater Diversions can include the Morena diversion to the North City Plant and the Spring Valley No. 8 Diversion to the South Bay Plant. These diversions require wastewater pump stations.*
- *South Bay facilities not included above since common to all Alternatives.*

Why is Adaptability Important?

The implementation of this reuse plan will need to be adaptable to anticipated and unanticipated needs. Adaptability may be triggered based on financial constraints, changes in regulatory requirements, institutional coordination issues, favorable or unfavorable political and community support, and technical issues. The project implementation proposed below provides a number of key actions to help implement this reuse program and maximize adaptability to changing conditions.

How Will the Projects be Implemented?

Implementing the Integrated Reuse Alternatives involves a step-by-step process as shown in the figure below. Although part of the implementation process includes common elements regardless of the alternative, it is important to note that the latter steps are affected by these earlier phase projects. Therefore, implementation considerations are important even during the first phase projects.



Recycled Water Study Project Implementation Summary

The implementation plan summarizes the basic roadmap to complete the reuse plan.

What are Specific Implementation Steps Needed Directly Following this Study?

Achieving the benefits identified in this Study requires an investment. Some of these investments have already been started, such as the Water Purification Demonstration Project now operating at the North City Plant. To proceed to the next steps in this study, additional investments will be needed to plan and develop the program to a level of detail that can be designed, permitted and constructed. These investments are referred to as program implementation steps. The following pages organize and summarize these key implementation steps into an Implementation Checklist.

IMPLEMENTATION CHECKLIST: REGULATORY, INSTITUTIONAL, POLICY & FINANCE

General

- ☐ Develop timeline for implementation steps outlined below.

Water Purification Demonstration Project/Permitting. The Water Purification Demonstration Project (Demonstration Project) and the San Vicente flow modeling are key steps of the public involvement and regulatory permitting processes to confirm the health and safety of the new water supply.

- ☐ Obtain Advanced Water Purification Facility water quality and San Vicente limnology model final results.
- ☐ Provide on-going public involvement and community outreach.
- ☐ Coordinate with CDPH and the Regional Water Quality Control Board on processes and permitting (whether through uniform criteria being developed by CDPH or project specific criteria).
- ☐ Promote advocacy by Stakeholder groups with CDPH and the Regional Water Quality Control Board.

Mayor and City Council. Support from the Mayor and City Council is essential to implement such an important program. While the reuse program appears to offer substantial cost savings to ratepayers (compared to upgrading the Point Loma Plant for the full-scale flows), support from policymakers to advance the program will be needed.

- ☐ Obtain Independent Rates Oversight Committee support.
- ☐ Obtain Natural Resources and Culture Committee approval.
- ☐ Obtain stakeholder advocacy support of the Study by the Metro JPA, Independent Rates Oversight Committee, environmental groups, and other interested parties.
- ☐ Obtain City Council approval.
- ☐ Coordinate implementation with broader water policy issues and programs.

Metro JPA Approval. As partners in the Metro System, support from the Metro JPA is also essential to implement such an important program. Support from JPA policymakers is needed to advance the program.

- ☐ Finalize the cost sharing framework, as summarized below. This includes policy and legal issues, costs and consensus.
- ☐ Promote stakeholder advocacy in support of the Study by the City, Independent Rates Oversight Committee, environmental groups, and other interested parties.
- ☐ Obtain Policymaker support and accept the Study and the reuse program.

Financials/Policy. Fiscal responsibility is important for all parties. For Water and Wastewater ratepayers, there is an important choice required regarding whether to fund this water reuse plan or potentially fund full-scale improvements at the Point Loma Plant.

- ☐ Complete discussions on cost share framework concepts and agreements, clarify City and Participating Agency costs, and clarify sources for offset such as the salt credit.
- ☐ Provide comparative financial analyses with other alternative water sources (if desired).
- ☐ Determine/develop policy on local resource program funding from SDCWA/MWD.
- ☐ Determine SDCWA policy on regional supply benefits, interest in joint participation, and potential rate impacts/savings.
- ☐ Seek out and apply for grants.
- ☐ Develop rate impacts and a detailed financing plan.
- ☐ Provide funding and staff to move forward with the program implementation, including the activities needed for near-term and long-term projects.
- ☐ Develop policy on SBx7-7 stemming from new locally produced water supply.

IMPLEMENTATION CHECKLIST: PERMITTING & TECHNICAL

Permitting. Implementing the reuse plan will require addressing key permitting activities:

- ☐ Point Loma Permitting. Continue permitting coordination amongst Stakeholders as part of the Point Loma Plant 301(h) Modified Permit process. These discussions are assumed to be related to the cost sharing discussions outlined above.
- ☐ Project Permitting. Identify, evaluate and obtain permits needed to complete the reuse projects.

Technical/Other. Implementing the reuse plan will require technical evaluations and engineering:

- ☐ Reuse Program/wastewater planning process coordination. On-going coordination between the proposed reuse program and wastewater planning efforts to refine facilities and costs in support of the cost sharing discussions and Point Loma permitting process.
- ☐ North City treatment. Determine the North City treatment approach (existing filters, feed source, recovery rates, improvements to the treatment processes upstream of the filters, the fate of the electrodialysis reversal units, and other technical design parameters).
- ☐ Non-potable reuse demands and wastewater flow confirmation. Continue to evaluate non-potable reuse demands and use trends; and wastewater flow generation. These totals will be important to finalize the size of indirect potable reuse projects.
- ☐ New facility siting. Develop detailed siting studies for new pump stations and treatment plants, including evaluation and confirmation of availability of the Harbor Drive and Camino del Rio sites.
- ☐ Wastewater treatment pilot testing. Test treatment strategies and high rate systems to develop area-specific design values.
- ☐ New conveyance facility alignments. Perform alignment studies for new conveyance facilities.
- ☐ SV8 Diversion to South Bay. Update the SV8 Pump Station Predesign and Sweetwater River crossing. Coordinate efforts between the Recycled Water Study needs and the September 2011 Draft Wastewater Master Plan (or any updates) needs.
- ☐ South Bay Plant. Continue discussion and coordination on South Bay Plant issues, particularly sizing and timing needed for reuse based on recent revisions to the September 2011 Draft Wastewater Master Plan. Key coordination issues include South Bay timing (both from reuse and wastewater perspectives), and the biosolids approach strategy. This includes evaluating/determining whether biosolids will be treated at the South Bay Plant at a dedicated facility instead of continuing to send it to the Point Loma Plant and the MBC for treatment. These coordination items will aid in determining cost responsibilities as outlined in the financial implementation steps above.
- ☐ South Bay indirect potable reuse delivery. Perform detailed evaluation of the South Bay Plant expansion including pump station and delivery pipeline to Otay Lakes.
- ☐ Otay Lakes operation. Perform an Otay Lakes operational evaluation in relation to local runoff and indirect potable reuse operation to confirm flow rates and optimal project sizing. Develop a hydraulic model similar to those developed for the San Vicente Reservoir to determine seasonal hydraulic patterns within the Otay Lakes system.
- ☐ Joint Project Evaluation. Identify opportunities of joint projects, such as brine pipelines or indirect potable reuse delivery pipelines coordinated with other regional projects.

IMPLEMENTATION CHECKLIST: PERMITTING & TECHNICAL (Continued)

- ☐ Mission Gorge Plant Evaluations. Coordinate further discussion and evaluation on the merits of a joint plant with Padre Dam Municipal Water District in the Mission Gorge area (conceptualized in Alternative B3). Evaluate possible additional savings at the East Mission Gorge Pump Station and additional avoided facility savings in downstream facilities.
- ☐ Groundwater updates. Complete groundwater studies including evaluation of the San Diego Formation and San Diego River system for possible inclusion into future master planning efforts. Update the status of other County groundwater studies including San Pasqual and Padre Dam Municipal Water District's studies.
- ☐ Waste stream recovery. Evaluate waste stream efficiency and recovery analysis to evaluate ways to further minimize waste streams and explore beneficial uses.
- ☐ San Vicente regulatory limits and operational coordination. Perform San Vicente analysis to evaluate maximum potential indirect potable reuse. If it is limited, determine options such as further evaluation of the San Diego formation or integration with other reservoirs. Coordinate reuse operational activities with other San Vicente operations after the dam raise is complete.
- ☐ Regulatory update on minimum reservoir capacities. Check assumptions on smaller sized reservoirs (Lakes Murray, Miramar and Jennings) once indirect potable reuse reservoir augmentation regulations are finalized.
- ☐ SDCWA Coordination. Coordinate with SDCWA on their Master Plan (currently underway), broader water policy support at the state level, and possible regional collaboration involving funding.
- ☐ Peak Wet Weather Flow strategies. Continue to evaluate fail-safe disposal strategies under wet weather conditions, including equalization, live stream discharge, and CEPT-secondary effluent blending at the Point Loma Plant.
- ☐ Santee Basin Aquifer Project. Continue to evaluate this project which is currently under study by the Bureau of Reclamation for Padre Dam Municipal Water District. Preliminary planning numbers put the capacity of the first site considered to be between 1.5 mgd and 3 mgd of groundwater recharge capacity.
- ☐ Helix Water District IPR Project. Continue to evaluate this project where Helix Water District is considering an option to send advanced treated recycled water to Lake Jennings Reservoir as part of a reservoir augmentation IPR project.

Study Results and Conclusions

The overarching goal of the Recycled Water Study (Study) was to evaluate ways to increase water reuse as a means of providing safe, reliable water supplies; to reduce ocean discharges; and to offload the Point Loma Plant. Over the course of the Study, representatives from the Study area's water and wastewater agencies, environmental groups, a representative from the Independent Rates Oversight Committee and independent technical reviewers participated in developing the water reuse program outlined below. These Stakeholders provided valuable opinions and diverse viewpoints that added value to the process and the alternatives developed. Overall, the Integrated Reuse Alternatives presented achieve the Study's goals, provide a bold vision for future water reuse, and provide savings to ratepayers. While water reuse has been evolving in San Diego over the past few decades, the region's master plans have helped guide decision makers with a focus on making good investments, while still being flexible to adapt to future changes. This Study endeavors to continue this tradition and be looked upon as a milestone that helped provide long-term water sustainability to the San Diego region.

What are the Primary Study Results?

Alternatives. Five Integrated Reuse Alternatives were developed based on an extensive, interactive Stakeholder process. Each Alternative includes 83 mgd of new indirect potable reuse and 3 mgd of new non-potable recycled (in addition to 4 mgd of already planned non-potable reuse).

Costs. The 2011 Net Cost results for the Alternatives in this Study represent the costs that should be compared to other water sources – particularly imported untreated water. The average Net Costs are:

- Net Cost assuming direct wastewater savings = $1,200/AF
- Net Cost assuming above plus salt credit = $1,100/AF
- Net Cost assuming above plus indirect wastewater savings = $700/AF

What are the Primary Study Conclusions?

Achieves Favorable Water Costs. The reuse costs above are comparable to 2011 untreated imported water delivery costs of $904/AF, and are projected to be more economical than future water costs. Imported water costs have risen substantially in the past decade and this trend is projected to continue into the foreseeable future. Therefore, this new water supply will provide safe, affordable water for existing and future generations of San Diegans.

Provides Reliability and Local Control. The new reuse supply reduces the region's reliance on imported water and increases local water supply reliability. Local reuse is considered an uninterruptable water source – an important trait since our imported water supply crosses great distances and major earthquake faults.

Enhances Sustainability. The reuse solutions are more sustainable and environmentally friendly. They reduce importing water from Northern California and the Colorado River, lowering energy usage and our overall carbon footprint.

Improves Water Quality. The reuse solutions produce additional water quality benefits such as significant regional salinity reductions. Ratepayers will see reduced salinity in the water –appliances, water heaters and fixtures will last longer. In addition, ocean discharges are reduced resulting in ocean water quality benefits.

Empowers Long-term Cost Control. The solutions increase the City and Participating Agencies' ability to control long-term water and wastewater costs by reducing liability for pending issues such as the California Bay-Delta fix and costly wastewater treatment upgrades.

Supported by Stakeholders. The solutions are supported by rate oversight and environmental group Stakeholder representatives.

Where Can I Find More Information on Water Reuse in the City?

Website. The Public Utilities Department maintains useful information on the City's website. See below for more information.

Recycled Water Home Page. The City's Recycled Water homepage includes extensive information on water reuse, rules and regulations, information on the existing system, and frequently asked questions. The website address is: http://www.sandiego.gov/water/recycled/

Water Reuse Homepage. The Water Reuse homepage includes links to the 2005 Water Reuse Study, the Water Purification Demonstration Project, and the Full Scale Reservoir Augmentation Page. The website address is: http://www.sandiego.gov/water/waterreuse/

General Information. If you are interested in learning more about recycled water, the City's Public Utilities Department can be contacted at (619) 533-7572 or e-mail at water@sandiego.gov.

Community Presentations. Recycled water professionals are available to speak to your community group, organization, special interest club or service organization. They are qualified to deliver their expertise, answer your recycled water questions, and will customize a presentation to meet the needs of your group. To schedule a speaker, simply call our Speakers Bureau Hotline at (619) 533-6638 at least two weeks prior to your program date. Or, you may e-mail requests to waterspeakers@sandiego.gov.

Who Can I Contact for More Information on this Study?

The project team consisted of City staff from the Public Utilities Department, and a consulting team from Brown and Caldwell, Black & Veatch, and CDM.

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LIST OF ACRONYMS AND ABBREVIATIONS

AADF (10-year)	Annual Average Daily Flow with a 10-year storm event
AF	acre-feet
AFY	acre-feet per year
AWPF	Advanced Water Purification Facilities
BOD	biochemical oxygen demand
CDPH	California Department of Public Health
CEC	chemicals of emerging concern
CEPT	Chemically Enhanced Primary Treatment
Chapman Plant	Ralph W. Chapman Water Recycling Facility
City	City of San Diego
EPA	Environmental Protection Agency
HARRF	Hale Avenue Resource Recovery Facility
IPR	Indirect Potable Reuse
IROC	Independent Rates Oversight Committee
LRP	Local Resource Program
MBC	Metropolitan Biosolids Center
MBR	membrane bioreactor
MER	mass emission rate
Metro JPA	Metropolitan Wastewater Joint Power Authority
Metro System	Metropolitan Sewerage System
mgd	million gallons per day
Metro Service Area	Metropolitan Sewerage System Service Area
MWD	Metropolitan Water District of Southern California
MWWD	City of San Diego Public Utilities Metropolitan Wastewater Department
North City Plant	North City Water Reclamation Plant
NPDES	National Pollutant Discharge Elimination System
NWRI	National Water Research Institute
O&M	operations and maintenance
PA	Participating Agency
Padre Dam	Padre Dam Municipal Water District
Point Loma Plant	Point Loma Wastewater Treatment Plant
PS	Pump Station
PS1	Pump Station No. 1
PS2	Pump Station No. 2
PS64	Pump Station 64
SANDAG	San Diego Association of Governments
SB 918	Senate Bill 918
SDCWA	San Diego County Water Authority
South Bay Plant	South Bay Water Reclamation Plant
Study	Recycled Water Study
SV8	Spring Valley 8
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Board
TDS	total dissolved solids
TSS	total suspended solids
U.S.	United States
USBR	Unitied States Bureau of Reclamation
UWMP	Urban Water Management Plan
WRP	Water Reclamation Plant
WTP	Water Treatment Plant
WWMP	Wastewater Master Plan

1. STUDY OVERVIEW

In August 2009, the City of San Diego (City), along with key stakeholders, initiated the Recycled Water Study (Study). This Study summarizes the technical evaluations performed, stakeholder participation, and the integrated reuse alternatives developed. This document is intended to serve as a guidance document to help inform policy leaders about the important decisions ahead regarding water reuse and our water and wastewater infrastructure.

1.1 Study Background

On June 16, 2010, the San Diego Regional Water Quality Control Board and United States (U.S.) Environmental Protection Agency (EPA) adopted Order No. R9-2009-0001 (National Pollutant Discharge Elimination System (NPDES) Permit No. CA0107409) allowing the City to continue to operate the Point Loma Wastewater Treatment Plant (Point Loma Plant) as a chemically enhanced primary treatment (CEPT) facility. The Permit, which became effective on August 1, 2010, allows the City to continue operating the Point Loma Plant in this fashion for five years until July 31, 2015, when the permit must be renewed. During the 2008 to 2010 permit modification process the San Diego Coastkeeper and Surfrider Foundation entered into a Cooperative Agreement (see Appendix A) with the City to conduct a Recycled Water Study. In accordance with the Cooperative Agreement, the environmental community did not oppose the U.S. EPA's decision to grant the modification. The City's responsibility per the Cooperative Agreement is to execute this Study, which is also consistent with the City's long-term goals and objectives.

This Study, based on the Cooperative Agreement, focuses on the Metropolitan Sewerage System (Metro System) which serves the City of San Diego and the Metropolitan Wastewater Joint Power Authority (Metro JPA), as shown on Figure 1-1. The area served by the Metro System is referred to as the Metro Service Area.

1.2 Study Objective and Approach

The Cooperative Agreement sets forth the primary Study goal of maximizing reuse in the Metro Service Area in order to minimize flows to the Point Loma Wastewater Treatment Plant (Point Loma Plant). To achieve this goal, the Study develops and presents Integrated Reuse Alternatives that the public and policy makers can review and select from to guide the future of the Metropolitan Sewer System's service area reuse program. The central focus of the alternatives is non-potable and indirect potable reuse opportunities. Non-potable reuse is simply defined as recycled water generally used for irrigation and industry – not for drinking water. Indirect potable reuse is simply defined as the blending of advanced treated recycled water into a surface water reservoir or groundwater basin that could be used for drinking (potable) water after further treatment. The opportunities were evaluated to meet City, Participating Agency and project Stakeholder reuse goals through a 2035 planning horizon. The integrated reuse alternatives and the overall plan were based on two fundamental principles: 1) providing detailed non-potable recycled water and indirect potable reuse opportunities and 2) relating the opportunities to avoided cost benefits and water quality improvements. These considerations are described further in Chapter 3, Study Process and Evaluation Approach.

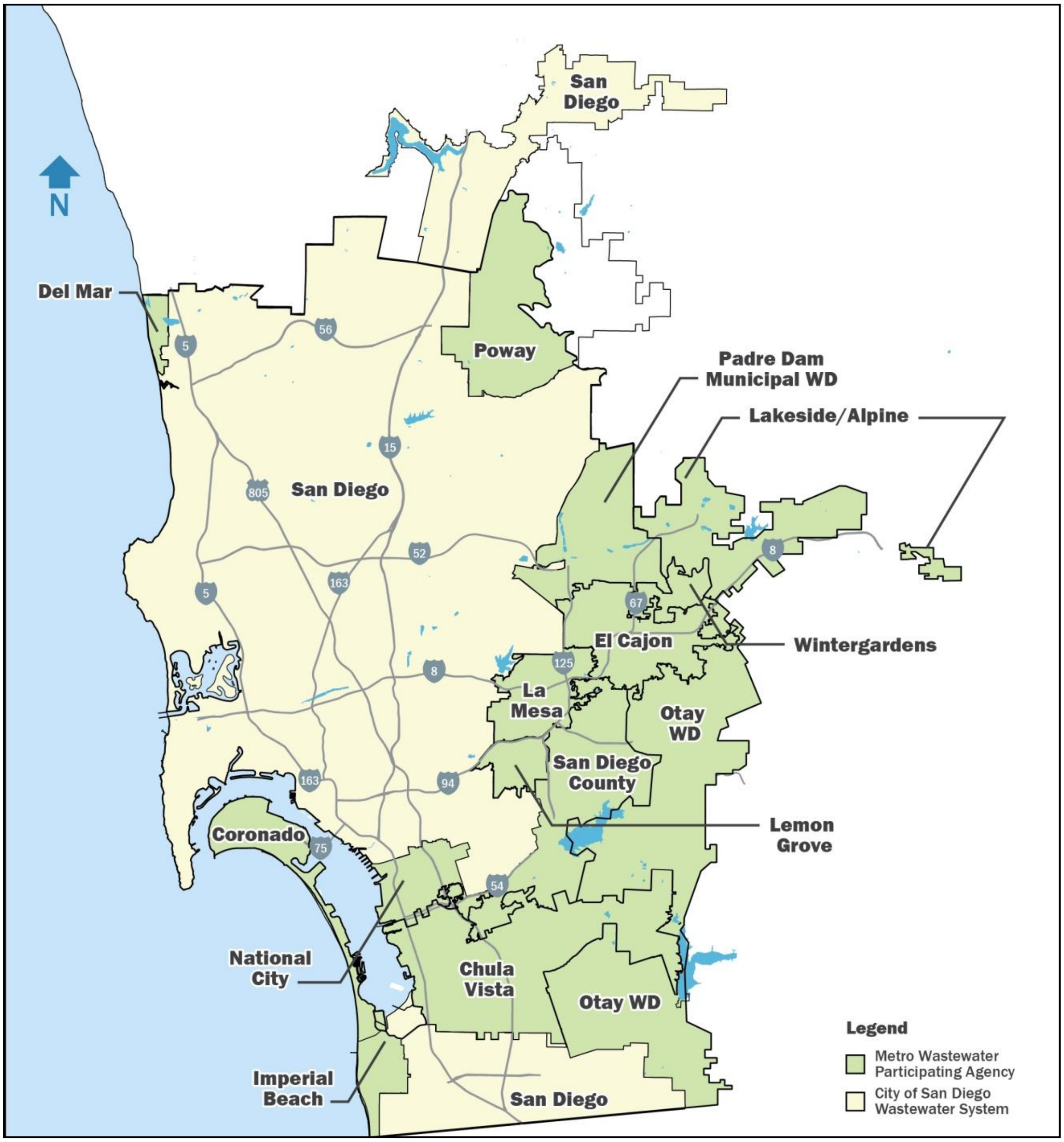


Figure 1-1. Metropolitan Sewerage System Service Area/Metro JPA Members

Note: The San Diego County Sanitation District has recently consolidated and includes Winter Gardens, Lakeside, Alpine and Spring Valley (San Diego County) areas shown above.

1.3 Study Stakeholders

The Stakeholders for this Study are comprised of the San Diego Coastkeeper, the San Diego Chapter of the Surfrider Foundation, and the Participating Agencies of the Metro JPA, who have capacity rights in the Metro System pursuant to the provisions of the 1998 *Regional Wastewater Disposal Agreement Between the City of San Diego and the Participating Agencies in the Metro System.* San Diego County Water Authority (SDCWA), the agency that has primary responsibility for water supply planning efforts, and Independent Rates Oversight Committee (IROC), are also Study Stakeholders. SDCWA representatives provide regular updates on SDCWA activities related to the Study.

PROJECT STAKEHOLDERS

Environmental Groups
- San Diego Coastkeeper
- Surfrider Foundation, San Diego Chapter

Oversight Groups
- Independent Rates Oversight Committee (IROC)

Regional Water Supplies
- San Diego County Water Authority

Metro JPA Members
- City of Chula Vista
- City of Coronado
- City of Del Mar
- City of El Cajon
- City of Imperial Beach
- City of La Mesa
- City of National City
- City of Poway
- Lemon Grove Sanitation District
- Otay Water District
- Padre Dam Municipal Water District
- San Diego County Sanitation District
  - Alpine Sanitation District
  - Lakeside Sanitation District
  - Spring Valley Sanitation District
  - Winter Gardens Sewer Maintenance District)

1.4 Study Process Overview

The Study includes a number of technical evaluations and coordination steps to identify and evaluate reuse alternatives within the City as well as areas served by the Participating Agencies. Throughout the Study, regular Stakeholder Status Update Meetings were held to present progress and to receive input and feedback on the activities. Eight technical memoranda (TM) were developed to document information. Figure 1-2 summarizes these activities, which have comprised this Study.

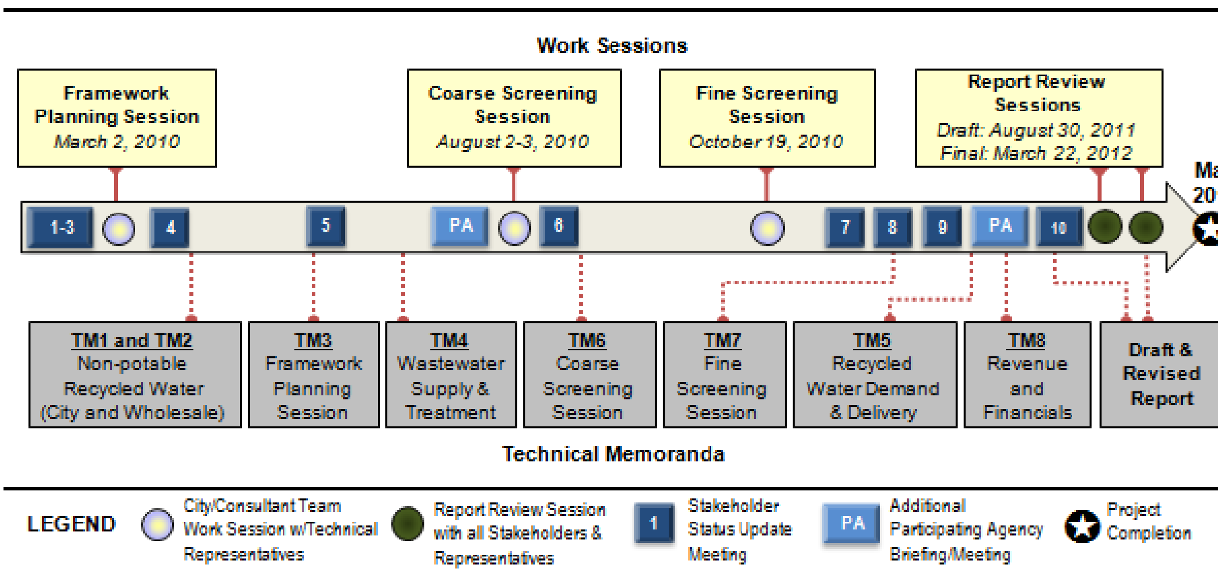


Figure 1-2. Study Process for the Recycled Water Study

1.5 Technical Memoranda Overview

The title and a brief description of each technical memorandum are provided below.

No. 1: Non-potable Reuse Market Assessment. Non-residential market assessments within the City limits are examined, including irrigation customers as well as cooling towers, car washes, and laundromats. Discussions on potential demands offered by individual Participating Agencies are included.

No. 2: Regional Non-potable Reuse Recycled Water Demand. Non-residential market demands within the Participating Agencies of the Metro System are assessed but limited to information received from them on questionnaires distributed by the Study Team.

No. 3: Framework Planning. A summary of the Framework Planning Session held to align the City, the consultant team, and Stakeholders on key project issues, processes, and future steps is provided.

No. 4: Wastewater Supply and Treatment. Discussion of projected recycled water supplies within the Metro System service area and examination of various treatment technologies is compiled.

No. 5: Recycled Water Demand and Delivery. An evaluation of the projected recycled water demand, the various options for delivery of recycled water, and the integrated reuse alternatives is presented.

No. 6: Coarse Screening. The Coarse Screening Session where project components were narrowed down is summarized.

No. 7: Fine Screening. The Fine Screening Session where final solutions and steps needed to move ahead were discussed is summarized.

No. 8: Financial Analysis of Recycled Water Project Alternatives. A cost evaluation of the proposed project components is presented.

1.6 Important Terminology Used in this Report

The following key terms used in this Study are defined in this introductory section due to their frequent use and their importance in understanding the concepts involved. The definitions for these terms are intended for audiences who may or may not be familiar with water reuse. Other definitions, including legislative definitions, can be found in the California Water Code. A more comprehensive glossary is included at the back of this Study.

Wastewater: Wastewater is generally used to describe sewage that comes from homes, industry or businesses. Wastewater is collected and treated at wastewater treatment plants. In San Diego, some wastewater is currently reclaimed as non-potable recycled water; however, the majority is treated and discharged to the ocean. Wastewater is needed for water reuse. Wastewater does not include stormwater in San Diego. Stormwater is collected in separate systems and typically not treated before discharge to streams and the ocean.

Water Reuse: Water reuse is a broad term used to describe the process of converting wastewater to a valuable water resource through treatment processes. Water reuse includes non-potable recycled water development and indirect potable reuse involving integration with drinking water supplies.

Non-potable Recycled Water: Synonymous with Non-potable Reclaimed Water, State of California Title 22 Water, and tertiary treated water. Non-potable recycled water is a form of water reuse that includes primary, secondary and tertiary treatment to produce water suitable for a variety of applications, most notably for landscaping irrigation and industrial uses. Further treatment is required for integration with drinking water systems – see indirect potable reuse.

Purified, Advanced Purified, or Advanced Treated Water: Purified, advanced purified, or advanced treated water undergoes advanced treatment processes to convert non-potable recycled water to a highly purified water quality, suitable for augmentation to an untreated drinking water source. Advanced purified water is currently used for indirect potable reuse projects.

Indirect Potable Reuse: Indirect potable reuse is the planned use of advanced purified water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system, or the planned placement of recycled water into a surface water reservoir used as a source of domestic drinking water supply.

Direct Potable Reuse: The planned introduction of advanced purified water either directly into a public water system, or into an untreated water supply, immediately upstream of a water treatment plant.

Uninterruptible Water Supply: Indirect potable reuse water is considered uninterruptible because it is not influenced by drought, water rights, or other supply interruptions such as the decision to decrease Southern California water supply because of endangered species in the California Bay-Delta.

Untreated Water (sometimes referred to as Raw Water): Water that is collected and stored in local surface water reservoirs and groundwater basins prior to treatment at a potable (drinking) water treatment plant. Untreated water examples include Colorado River water, water from the California Bay-Delta, and runoff from local rainfall.

Potable or Drinking Water: Potable water is water that meets the EPA's Safe Water Drinking Act and California Water Code requirements. Residents and businesses receive potable water at their water meter connection, and its use is unrestricted.

2. WATER REUSE NEED AND RELATED ACTIVITIES

This is an important time for water and wastewater ratepayers in the San Diego area. The decisions to invest in water reuse programs or to fund large-scale wastewater system upgrades will affect the rates, reliability, and regional assets for decades. The fundamental focus of this Study was to develop water reuse alternatives – and then compare the alternatives with other options based on the water supply benefits created and the costs saved by avoiding other water and wastewater systems improvements (reference Chapter 8). The most relevant avoided cost involves the wastewater system and, in particular, the potential need to upgrade the Point Loma Plant to secondary treatment standards. This chapter outlines the considerations related to these issues and summarizes related reports and other activities pertinent to the reuse alternatives developed in this Study.

2.1 Water Supply and Water Reuse as a Local Supply Source

Water is important to the health, safety, and quality of life of people living in the San Diego region. The region has historically received a majority of its water supply from imported sources including the State Water Project (i.e. the Bay-Delta via the California Aqueduct) and the Colorado River Aqueduct. The Metropolitan Water District of Southern California (MWD) is responsible for managing the wholesale delivery of this water throughout Southern California. In San Diego, SDCWA is responsible for managing the distribution of imported water from the MWD and from the Imperial Irrigation Transfer Agreement to approximately 3.1 million residents (San Diego Association of Governments [SANDAG Series 12, 2010]). Currently, 80 percent of the San Diego region's water supply is imported. Local supplies and conservation account for the remaining 20 percent of the total supply.

The region's reliance on imported water makes the reliability of San Diego's water supply vulnerable to impacts from shortages and susceptible to price increases. In 2008, water supplied from the State Water Project was restricted to protect endangered fish species in the Bay-Delta. Drought conditions in Southern California further impacted water supply availability. With the region's population projected to increase to 3.9 million people in 2030 (SANDAG Series 12; 2030 Growth Forecast Update), demands will increase and strain these limited water supplies.

To address these dynamic water supply conditions, the San Diego region has been diversifying its supply portfolio to reduce reliance on imported water. Over the past two decades, this diversified portfolio approach has led to increases in local water supplies. Local water supplies include opportunities through increased water reuse, the recharge and recovery of groundwater, and the desalination of seawater (such as the Pendleton, Carlsbad and Rosarito concepts being evaluated). The City and surrounding communities have also committed to aggressive water conservation and water efficiency programs. The Recycled Water Study, as summarized in this Study, focuses on the Metro Service Area's water reuse potential and its ability to provide it's residents with a sustainable, high-quality, local water supply.

2.2 Metro System Overview

The Metro System (described further in Chapter 3) is an important asset to the San Diego region. The last adopted Wastewater Master Plan was completed in 2003. The Wastewater Master Plan is currently being updated and a draft was prepared and distributed in September 2011. The Metro JPA will vote to adopt the revised plan. The focus of the wastewater planning efforts has been maintaining or lowering the total suspended solids discharged to the ocean per the 2010 NPDES permit (CA0107409). As part of the permit conditions, the Point Loma Plant is limited to 15,000 metric tons per year for discharges through December 31, 2013 (see Appendix B for wastewater mass emission details and Appendix C, Section C.1.1, for further details on the permit). From January 1, 2014, however, the permit requires that the annual mass emission for total suspended solids be 13,598 metric tons or lower. Additional details on the permit and wastewater regulations are located in Appendix C.

The September 2011 Draft Wastewater Master Plan assumed that the Point Loma Plant would continue to operate as a CEPT plant and a series of large-scale projects would be built to divert solids and high flows away from it to prevent potential overflows during peak wet weather events. The diversion included redirecting the flow of wastewater from Point Loma to South Bay, adding a wastewater treatment plant in the Mission Valley area, expanding the North City Plant, and constructing a Point Loma Parallel Outfall to allow flows to bypass the Point Loma Plant and flow directly to the Point Loma Ocean Outfall. Although the September 2011 Draft Wastewater Master Plan would have expanded the Metro System's capacity to produce recycled water at new or expanded existing plants, it was not the primary objective. More importantly, the prospect of indirect potable reuse was not included in the September 2011 Draft Wastewater Master Plan. The cost of the September 2011 Draft Wastewater Master Plan improvements could be reduced by implementing water reuse projects to offload flows from the Point Loma Plant. In later chapters, the financial considerations associated with the reuse alternatives developed under the Recycled Water Study are compared to those included in the September 2011 Draft Wastewater Master Plan.

2.3 Key Studies and Activities

Several studies and activities provide an important basis for the work performed in this Study. The following summarizes these studies and activities and their relevance to this Report.

2.3.1 2005 Water Reuse Study

The City has long recognized the importance of developing a local water supply and has conducted several studies in an effort to create a system that provides that supply. In 2005, the City completed the Water Reuse Study which included a 35-member American Assembly panel comprised of a cross section of San Diego stakeholders. Public viewpoints were solicited through community meetings, focus groups, and telephone/online surveys. The Study included an evaluation of six strategies integrating non-potable reuse and indirect potable reuse opportunities for the North, Central, and South Service Areas. Option NC-3 was preferred by the Stakeholders, which included infilling non-potable demands served by the North City Water Reclamation Plant (North City Plant), followed by an indirect potable reuse project utilizing San Vicente Reservoir. For the South Bay, SB-1 (a non-potable approach serving a majority of non-potable water to the Otay Water District [Otay]) and SB-3 (an indirect potable reuse project utilizing Lower Otay Reservoir) were supported. This study was completed in conjunction with the *City of San Diego Recycled Water Master Plan Update 2005* (additional details on this study are included below).

The concluding American Assembly statement included:

> *"The Assembly unanimously agrees that current technology and scientific studies support the safe implementation of non-potable and indirect potable use projects. The Assembly considers advanced treated (purified) water to be superior in quality to other sources (e.g., Colorado River, State Project Water)."*
>
> *"The Assembly believes that properly designed and operated advanced water treatment processes, coupled with a diligent and publicly accessible water quality monitoring program, produce water of exceptional quality that is protective of public health."*
>
> *"The Assembly believes that the costs of the strategies are affordable and equitable, and considers the strategies to be a necessary investment in our future."*

2.3.2 Water Purification Demonstration Project

The Water Purification Demonstration Project is the second phase of a process evaluating ways for the City to increase its use of recycled water (Figure 2-1). The first phase was the City's Water Reuse Study that identified reservoir augmentation as the preferred option for developing recycled water sources.

The Water Purification Demonstration Project will determine if reservoir augmentation is a feasible option for San Diego. The project will evaluate each step of reservoir augmentation, including:

- Using advanced water purification technology on highly treated wastewater.
- Sending the purified water to a reservoir to blend with existing water supplies.
- Treating the blended water again to be distributed as drinking water.

Figure 2-1. Water Purification Demonstration Project

The City's Water Purification Demonstration Project will demonstrate how one million gallons a day can be purified using technology that is able to produce one of the most pristine sources of water available anywhere.

2005 Independent Technical Panel Members

Chair: Richard Bull, Ph.D.
Joseph A. Cotruvo, Ph.D.
James Crook, Ph.D., P.E.
Richard Gersberg, Ph.D.
Christine L. Moe, Ph.D.
James E.T. Moncur, Ph.D.
Derek Patel, M.D.
Joan B. Rose, Ph.D.
Chair: George Tchobanoglous, Ph.D., P.E., Professor
Michael P. Wehner
Fred Zuckerman

Current Water Purification Demonstration Project Independent Technical Panel Members

Chair: George Tchobanoglous, Ph.D., P.E.
Michael A. Anderson, Ph.D.
Richard J. Bull, Ph.D.
Joseph A. Cotruvo, Ph.D.
James Crook, Ph.D., P.E.
Richard Gersberg, Ph.D.
Sunny Jiang, Ph.D.
Audrey D. Levine, Ph.D., P.E., DEE
David R. Schubert, Ph.D.
Michael P. Wehner

The Water Purification Demonstration Project is underway and will conclude in early 2013. During this time, the Advanced Water Purification Facility will operate at the North City Plant for approximately one year and will produce 1 million gallons per day (mgd) of purified water. Concurrently, a study of the San Vicente Reservoir is being conducted to test the key functions of reservoir augmentation and to determine the viability of a full-scale project. No purified water will be sent to the reservoir during the demonstration phase.

2.3.3 Independent Technical Panels

The City has engaged independent advisory technical review panels in 2005 (for the Water Reuse Study) and 2009 to present (for the Water Purification Demonstration Project). The City partnered with the National Water Research Institute to conduct the independent advisory panels. The panels focused on the health, safety, and viability of indirect potable reuse in the region. The 2005 panel agreed that indirect potable reuse/reservoir augmentation strategies presented the region with a unique opportunity to maximize the use of available capacity of the City's recycled water plants and provide safe new water supplies. The 2009 panel is ongoing in support of the Water Purification Demonstration Project, with preliminary findings supporting the project approach.

2.3.4 2010 Recycled Water Master Plan Update

San Diego Municipal Code (Chapter 6, Article 4, Division 8) requires the City to prepare and adopt a Recycled Water Master Plan to define, encourage, and develop the use of recycled water within its boundaries. The Recycled Water Master Plan must be updated every five years. The last update was completed in 2005 (Recycled Water Master Plan Update 2005), necessitating the 2010 Recycled Water Master Plan Update (2010 Update). The purpose of the 2010 Update is to evaluate opportunities to maximize non-potable reuse if indirect potable reuse projects are not pursued (Figure 2-2). It describes the existing non-potable system and near-term expansions (through 2015), and identifies potential long-term non-potable reuse expansion concepts. Implementation of future non-potable reuse concepts beyond already planned expansions through 2015 relies on the results of the Demonstration Project and the viability of pursuing indirect potable reuse in San Diego.

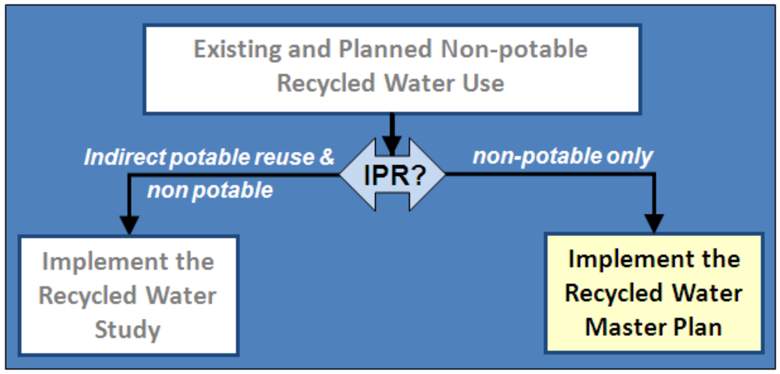


Figure 2-2. Recycled Water Master Plan Relationship to the Recycled Water Study

The Recycled Water Master Plan provides additional non-potable recycled water opportunities if indirect potable reuse is ultimately not pursued.

2.4 Other Studies and Information

The City and project Stakeholders have conducted numerous studies that provide information relevant to the development of this Study. The following is a listing of some of the studies either used in the technical analysis for this Study, or discussed in the Stakeholder meetings.

- **2015 Projections.** Non-potable Reuse Demand Forecast through year 2015.
- **2010 Water Facilities Master Plan.** Prioritized Water Facility Needs, 20-year Capital Improvement Project (CIP). The facility needs are determined based on operational and condition deficiencies.
- **2003 Metropolitan Wastewater Plan.** Wastewater Facility Needs. The Plan provides guidance for establishing a CIP program that is tied to flow projections and current permit conditions. The Plan also includes a list of projects that are driven by a condition assessment program that is currently conducted by the San Diego Public Utilities Department.
- **San Pasqual Conjunctive Study.** This study evaluates the ability of the San Pasqual Groundwater Basin to store water and withdraw at a later time.
- **Tijuana Basin Aquifer.** This study examines the feasibility of using the Tijuana Valley Alluvial Aquifer as a potential aquifer storage and recovery system to seasonally store recycled water.
- **Pilot Wells.** The pilot production well investigation evaluates the potential of ground water basins within the City's jurisdiction for water supply production potential for each basin for a new local water supply source.

- **2010 Urban Water Management Plan (UWMP).** In accordance with the California Urban Water Management Planning Act, all California agencies providing water to more than 3,000 customers or more than 3,000 acre-feet per year (AFY) of water are required to update their UWMP every five years and submit them to the Department of Water Resources. The UWMP looks at the City's historic and current water use projections and compares water supplies with demands over the next 20 years. The plan identifies the imported and local water supplies that will meet future demands including groundwater recovery and water recycling, as well as City's current and planned conservation measures. This helps to ensure that the City can provide a reliable supply of high-quality water to meet current and future demand. The Recycled Water Study used the same demand forecast as the UWMP. The UWMP may be accessed at the following web address: http://www.sandiego.gov/water/pdf/uwmp2010.pdf
- **Recycled Water Master Plan Update 2005.** The 2005 Recycled Water Master Plan was completed in parallel with the 2005 Water Reuse Study. This was the City's five-year update of their Recycled Water Master Plan to fulfill the requirements of San Diego Municipal Code. The study identified potential recycled water customers in both the northern and southern portions of the City, as well as potential new opportunities in the central portion of the City and in San Pasqual. The master plan included a market assessment and presented concepts to expand the City's recycled water distribution system. The 2005 Recycled Water Master Plan may be accessed at the following web address: http://www.sandiego.gov/water/pdf/050927waterreuse.pdf
- **Recycled Water Study Participating Agency Options.** This document was prepared by the Metro JPA Technical Advisory Committee (TAC) and provided to the City as draft on July 21, 2010. The document presented additional options to be considered as part of the Study. Options and ideas are presented to expand recycled water in the northern, eastern, and southern areas. The City provided a response letter to the Metro JPA TAC on August 17, 2010 to discuss how these options have been addressed or will be addressed in the Study. The Metro JPA TAC provided an updated version of these options in March 2011, retitled as *Regional Opportunities to Reduce Flows at Point Loma Plant* and again in September 2011, retitled as *Flow Reductions to Point Loma Wastewater Treatment Plant: Options Offered by the Participating Agencies.* This document is included in Appendix I.

3. STUDY PROCESS AND EVALUATION APPROACH

3.1 Process

The Study was a two year, participatory process. The process included sequential steps to evaluate technical elements, present findings to the stakeholder group, refine the technical work based on stakeholder input, and present the findings in this Report. The key elements of the Study process are summarized in this chapter including the work sessions, the stakeholder integration, the approach to the technical work, and the criteria used on the evaluation process.

3.2 Work Session Summary

Five work sessions were held and attended by the City's project team, the consultant team, and the Stakeholder's independent technical advisor. The Participating Agencies sent representatives to the Coarse Screening Session, Fine Screening Session, and the Study Review Session. The work sessions were conducted at key milestones in the Study process. The format of the sessions included presentations on initial findings and on technical approaches. Group feedback was solicited throughout the presentations and through interactive group activities in which team members were asked to evaluate specific Study elements.

Framework Planning Session. The Framework Planning Session was the first session and was held to align the City, the consultant team and the Stakeholder group on key project issues and the evaluation process. The Framework Planning Session established the road map for the technical process and is summarized in Figure 3-1. The Framework Planning Session also confirmed the core criteria to be used for the water reuse alternatives developed.

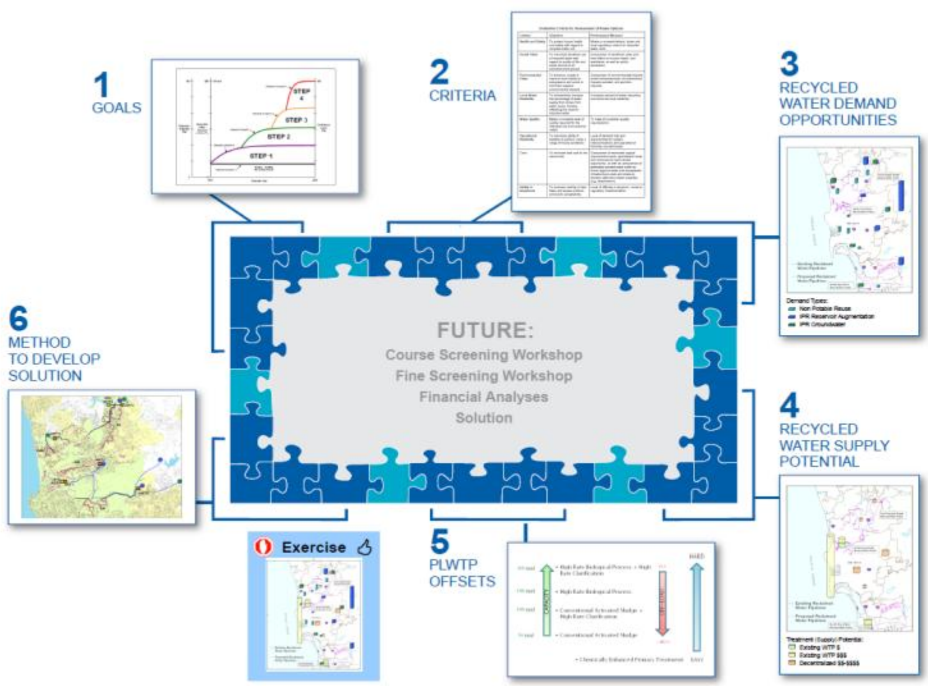


Figure 3-1. Framework Planning Session

The Framework Planning Session outlined the approach to complete the study.

Coarse Screening Session. The two-day Coarse Screening Session focused on the Area Concepts described in Chapter 8. Non-potable and indirect potable reuse opportunities throughout the region were evaluated. Participants were grouped in teams and tasked with developing water reuse alternatives to meet the Study objectives. The groups could also eliminate alternatives and recommend new alternatives.

Fine Screening Session. The Fine Screening Session was a one-day work session that focused on refining the Area Concepts (discussed at the Coarse Screening Session) into the final Integrated Reuse Alternatives (described in Chapter 9). The focus of the Fine Screening Session was for the participants to develop an understanding of the alternatives, to evaluate relative costs, to work as teams to assess whether the alternatives developed met the criteria developed in the Framework Planning Session, and to develop concept project implementation plans.

Work Sessions. *The Coarse Screening and Fine Screening Sessions included presentations, team exercises and facilitated discussions. The sessions leveraged the group's creativity and diverse perspectives to improve the quality of the alternatives presented in the Study.*

Study Review Session. The Study Review Session was a one-day work session held to discuss and refine the Study. Comments to the Study were solicited prior to the meeting and reviewed during the session.

3.3 Stakeholder Status Update Meetings

The Study included 10 Stakeholder Status Update Meetings scheduled throughout the Study process and aligned with important Study milestones. These meetings were attended by the City's team, the consultant team, and representatives from the Participating Agencies, San Diego Coastkeeper, the Surfrider Foundation, San Diego Chapter, the SDCWA, and the IROC. The update meetings lasted from two to three hours and were held at the City's Metro Operations Center 2 in Kearny Mesa, San Diego.

The Stakeholder Status Update Meetings played a vital role in the Study, providing Stakeholders the opportunity to participate and comment on Study efforts. Each Stakeholder played an important role and provided a diverse viewpoint on the future of water recycling in the region. The Stakeholders asked critical questions and provided alternative concepts that added value to the alternatives discussion. When a new concept or approach was proposed, the project team tested the new ideas against the Study goals and objectives (described further below). If the concepts met these goals and objectives, the alternative was considered further in the Study.

3.4 Adaptive Model

To fully evaluate the range of ideas put forward during the work sessions and update meetings, an adaptive model was developed. The adaptive model is a series of spreadsheets, summarized in Figure 3-2, which integrated key technical information and calculations to provide sizing and costs for different water reuse alternatives. The model also summarized sequencing, capital, and operational costs (energy, chemicals, labor) and available flows. It is important to note that the adaptive model is a tool designed to quickly ascertain the impact of changing conditions on the overall planned system and the associated costs.

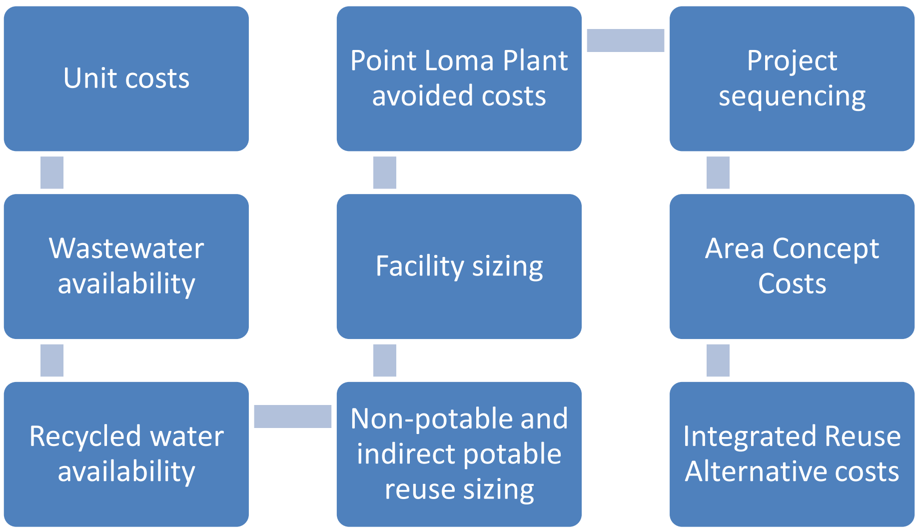


Figure 3-2. Adaptive Model

The adaptive model played an important role during the working sessions in highlighting the project sequencing options and capital and operational and maintenance costs.

3.4.1 Guidelines for what Opportunities were Considered

Achieving the goals for this Study required developing non-potable recycled water and indirect potable reuse opportunities. Multiple methods and project approaches are available to achieve this. The following guidelines were developed to provide the level of detail needed for an opportunity to be considered in this Study. These guidelines were applied to projects developed by the Study Team and opportunities provided by participants at the Stakeholder update meetings and the Coarse and Fine Screening Sessions.

1. **Provide Detailed Opportunities.** Projects (especially the early phase projects) should have enough technical information to determine if they are feasible and safe and provide a valuable local water resource. Projects should be developed based on a consistent approach and be defined to the point that comparative costs and benefits can be developed.

2. **Relate opportunities to water supply benefits, avoided cost savings, and water quality improvements.** The opportunities should address the water and wastewater system benefits created from water reuse projects, particularly through avoided costs savings at the Point Loma Plant. This includes the environmental community's goal of reducing ocean discharges by creating new high quality water reuse opportunities. The plan should also meet the City's and Participating Agencies' goal of managing Metro System costs and their impacts to ratepayers.

A process was developed to meet the key considerations above. Each alternative considered in this process received extensive technical evaluation, stakeholder scrutiny, and refinement. Key components of the process included:

Provide thorough technical evaluations:

- Account for capital and operation and maintenance costs, including an evaluation of pumping needs.
- Balance opportunities and constraints, particularly in relation to the dynamic regulatory permitting environment.
- Apply non-cost criteria to determine other benefits or considerations important in decision making.

Provide larger-scale projects that are more cost effective (i.e. they provide economies of scale):

- Maximize the City's and Participating Agencies' investments in existing infrastructure.
- Identify water and wastewater cost savings by avoiding or deferring system improvements. Focus opportunities to divert wastewater where larger quantities are available.
- Prioritize projects that provide the most water benefit at the least cost (noting that other non-cost criteria must be addressed).

Develop solutions that promote diverse stakeholder goals:

- Recognize the environmental groups' desire to reduce discharges to the ocean from the Point Loma Plant.
- Recognize the City and Participating Agencies' desire to maximize investments through new water reuse opportunities, while minimizing ratepayer impacts from wastewater system costs and upgrades at the Point Loma Plant.

3.5 Criteria Used to Assess Water Reuse Alternatives

One of the preliminary tasks of the Study was to determine the appropriate criteria to use in evaluating potential water reuse alternatives. During the Framework Planning Session, the 2005 Water Reuse Study criteria were presented and compared to the criteria being used in the City's current master planning process. It was determined that the 2005 criteria are applicable to this Study and would be used since they were previously vetted by an in-depth stakeholder process and are directly applicable to water reuse decision making. Each alternative was evaluated on a pass-fail basis against the qualitative criteria and then screened and prioritized based on the quantitative criteria (such as cost). Eight criteria categories were identified for application to the integrated reuse solutions. Table 3-1 summarizes the criteria.

Table 3-1. Evaluation Criteria		
No.	Criteria	Objective
1	Health and Safety	To protect human health and safety with regard to recycled water use and wastewater
2	Social Value	To maximize beneficial use of recycled water with regard to quality of life and equal service to all socioeconomic groups
3	Environmental Value	To enhance, create, or improve local habitat or ecosystems and avoid or minimize negative environmental impacts
4	Local Water Reliability	To substantially increase the percentage of water supply that comes from water reuse, thereby offsetting the need for imported water
5	Water Quality	To meet or exceed level of quality required for the intended use and customer needs
6	Operational Reliability	To maximize ability of facilities to perform under a range of future conditions
7	Cost	To minimize total cost to the community
8	Ability to Implement	To evaluate viability or fatal flaws and assess political and public acceptability

4. KEY FACILITIES, WATER DEMANDS, AND WASTEWATER FLOWS

The reuse alternatives developed in this Study required evaluating certain elements of the region's water, wastewater, and recycled water infrastructure and their related demands and flows. Early in the Study, this information was developed as the foundation for preparing the integrated reuse alternatives presented later in this Report. The following summarizes the key tasks, with additional background provided in the remaining sections of this Chapter.

- **Potable (Drinking) Water Demands.** Determine the projected quantity of water to be produced at water treatment plants to meet the demands within the service area and evaluate ways to integrate reuse alternatives into the picture.
- **Potable (Drinking) Water System Infrastructure.** Identify conveyance facilities (pipelines and pump stations) that may play a role in non-potable recycled water projects or indirect potable reuse projects and identify drinking water treatment plant locations that may play a role in an indirect potable reuse project.
- **Non-potable Recycled Water Facilities.** Assess the existing infrastructure, opportunities for improvements, and/or additions to the existing recycled water system, including treatment and distribution infrastructure, to meet future needs.
- **Non-potable Recycled Water Demands.** Determine the remaining amount of tertiary treated water available for further treatment and recycling after existing and planned non-potable recycled water demands have been met.
- **Wastewater Facilities.** Identify planned facilities upgrades (primarily but not limited to the Point Loma Plant) that could be avoided by expanding reuse throughout the region.
- **Wastewater Flows.** Estimate how much wastewater is available nearby for producing recycled water, and summarize the locations where this resource is located.

4.1 Potable Water System and Demands

The San Diego region has infrastructure that conveys water from various supply sources to storage and treatment facilities. Water conveyance infrastructure relevant to the reuse alternatives developed in this Study, including local reservoirs, groundwater basins, SDCWA aqueduct supply pipelines and key supply pipelines, is shown on Figure 4-1. The City's three potable (drinking) water plants (Alvarado, Miramar, and Otay) were evaluated early in this Study related to their long term demands and their ability to integrate with indirect potable reuse projects.

Figure 4-1. Regional Water Infrastructure Related to the Reuse Alternatives in the Study

4.2 Recycled Water System and Demands

The following summarizes the City's existing recycled water system and two additional reclamation plants that impact flows at the Point Loma Plant. The City's 2010 Recycled Water Master Plan Update includes additional details on the City's existing non-potable recycled water system.

4.2.1 Water Reclamation Plants

The City of San Diego operates two water reclamation plants as part of the Metro System. The North City Water Reclamation Plant (North City Plant) and the South Bay Water Reclamation Plant (South Bay Plant) produce non-potable recycled water for irrigation and industrial uses and divert flows away from the Point Loma Plant. Two additional reclamation plants (each separately owned and operated by one of Participating Agencies and separate from the Metro System) also offload flows before reaching the Metro System. The conveyance of non-potable recycled water from the reclamation plants to customers (via pumps, piping and reservoirs) is coordinated by individual water purveyors and is not part of the Metro System.

4.2.1.1 North City Water Reclamation Plant

The North City Plant was commissioned in 1997. It treats wastewater generated in portions of the northern San Diego region, which includes the cities of Del Mar and Poway, and the City's Mira Mesa, Rancho Penasquitos, Scripps Ranch, and Rancho Bernardo communities. The North City Plant treatment processes are summarized on Figure 4-2. After undergoing tertiary treatment and disinfection, the non-potable recycled water is distributed to surrounding communities for irrigation and industrial uses. Solids removed during the treatment process are pumped approximately five miles to the Metropolitan Biosolids Center for treatment. Wastewater in excess of the non-potable recycled water demands is treated to secondary level and diverted to the Metro System into the Rose Canyon Trunk Sewer and ultimately flows to the Point Loma Plant. The current North City Plant design capacity is 30 mgd (based on an annual average daily inflow rate); however, it was master planned for expansion to 45 mgd.

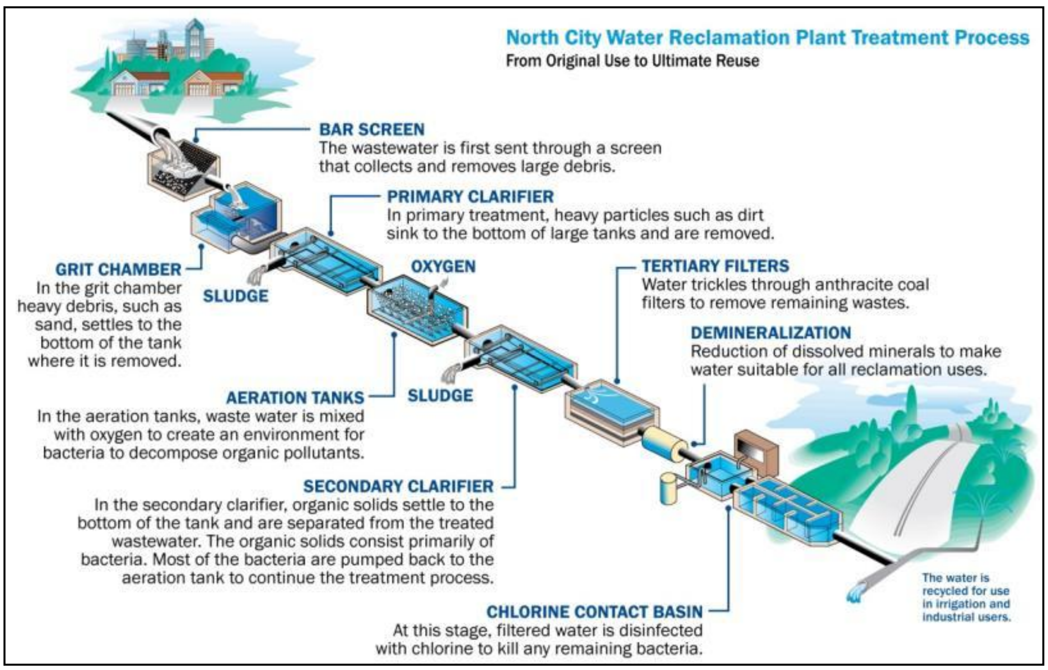
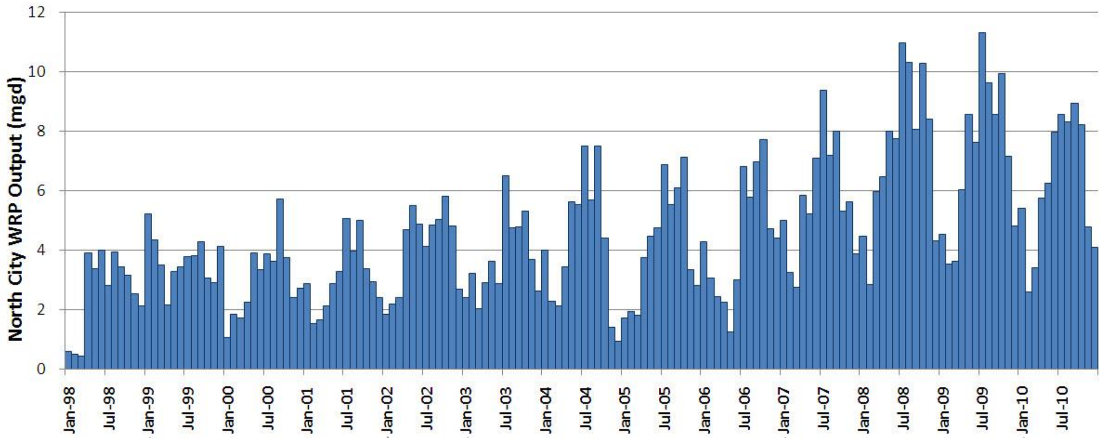


Figure 4-2. North City Water Reclamation Plant Treatment Process Schematic

Historical non-potable recycled water demands served by the North City Plant are shown in Figure 4-3. Three trends can be seen in the North City Plant output. From 1998 to 2004, demands remained fairly constant as the system was expanded. Steadily increasing demands occurred from 2004 through 2008 as the first phase of the 2000 Beneficial Reuse Study improvements were implemented and the City added new infill customers. From 2009 through 2010, a downward trend in demands persisted, even though new users were added to the system. The reduction is attributed to conservation, water efficiency, and the economic downturn.



Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Average Annual	3.7 mgd	3.0 mgd	3.1 mgd	4.1 mgd	3.7 mgd	4.2 mgd	4.2 mgd	4.4 mgd	5.7 mgd	7.3 mgd	7.1 mgd	6.2 mgd
Minimum Month	2.2 mgd	1.1 mgd	1.5 mgd	1.9 mgd	2.0 mgd	0.9 mgd	1.7 mgd	1.3 mgd	2.8 mgd	2.8 mgd	3.5 mgd	2.6 mgd
Maximum Month	5.2 mgd	5.7 mgd	5.1 mgd	5.8 mgd	6.5 mgd	7.5 mgd	7.1 mgd	7.7 mgd	9.4 mgd	11.0 mgd	11.3 mgd	8.9 mgd

09-10 average used for existing

Figure 4-3. North City Water Reclamation Plant Non-potable Recycled Water Output

North City Plant output increased from 2002 through 2008. Lower demands in 2009 and 2010 occurred even though new customers were connected to the system. Conservation, water efficiency, and the poor economic climate were factors that affected usage. Future usage may continue to be affected by these conditions, or new influencers (such as changes to the recycled water rate).

4.2.1.2 South Bay Plant

The South Bay Plant was commissioned in 2002. The plant serves areas close to the South Bay Plant and the Otay Water District (Otay). The facility has a capacity to treat up 15 mgd (based on an annual average daily inflow rate) and is located in the Tijuana River Valley near the international border. The treatment processes are shown on Figure 4-4. The tertiary facilities, which allow production of non-potable recycled water, were certified in 2004. Normal operations began in 2006 after the International Boundary and Water Commission Plant became operational as the first major customer. Tertiary treated water is distributed to surrounding areas for non-potable recycled water uses. Wastewater in excess of the non-potable reuse demands is treated to secondary level and discharged to the ocean via the 3.5-mile-long South Bay Ocean Outfall. Solids removed at the South Bay Plant are returned to the collection system for transport to the Point Loma Plant for treatment.

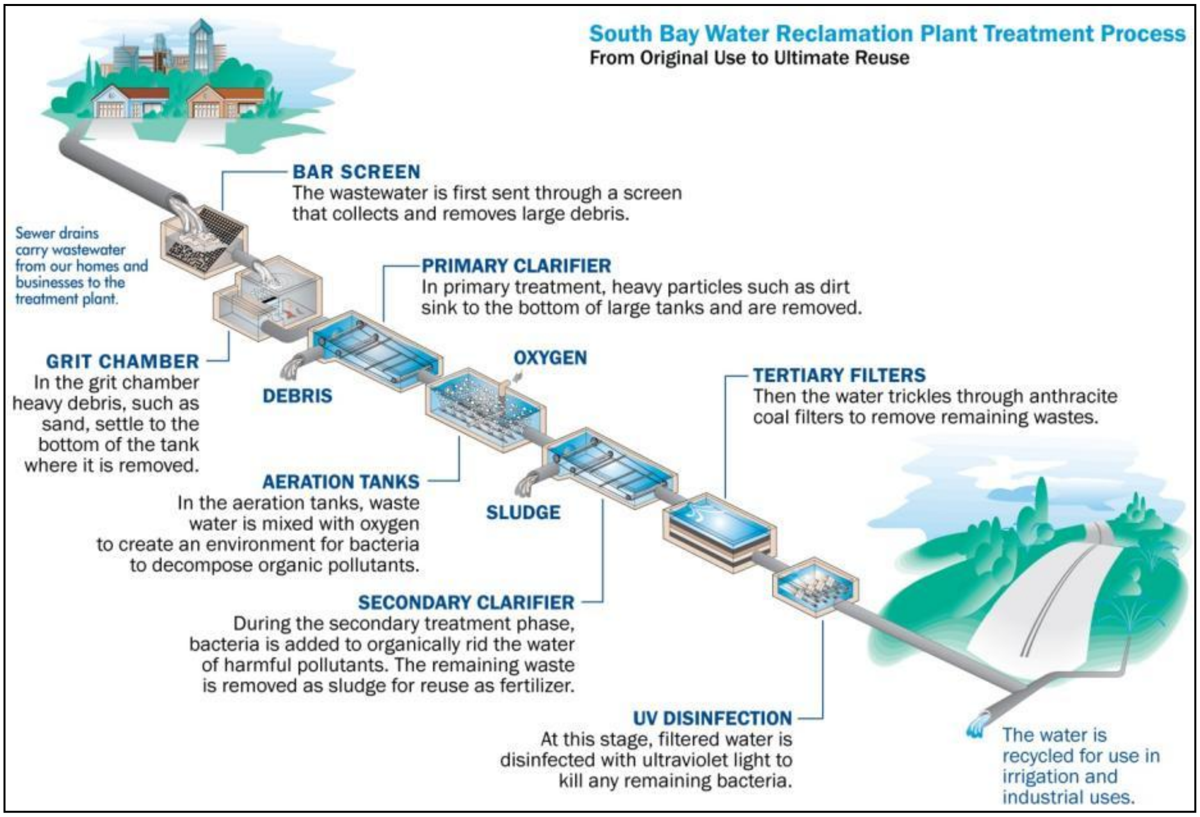


Figure 4-4. South Bay Plant Treatment Process Schematic

Historical non-potable recycled water demands served by the South Bay Plant are shown on Figure 4-5. Similar to the North City Plant, the South Bay Plant has experienced lower demands for the past two years. A majority of the South Bay demands are served to Otay through a wholesale agreement with the City. Otay has developed an extensive non-potable recycled water system, which is supplied from both the South Bay Plant and Otay's Ralph W. Chapman Recycled Water Facility (Chapman Plant).

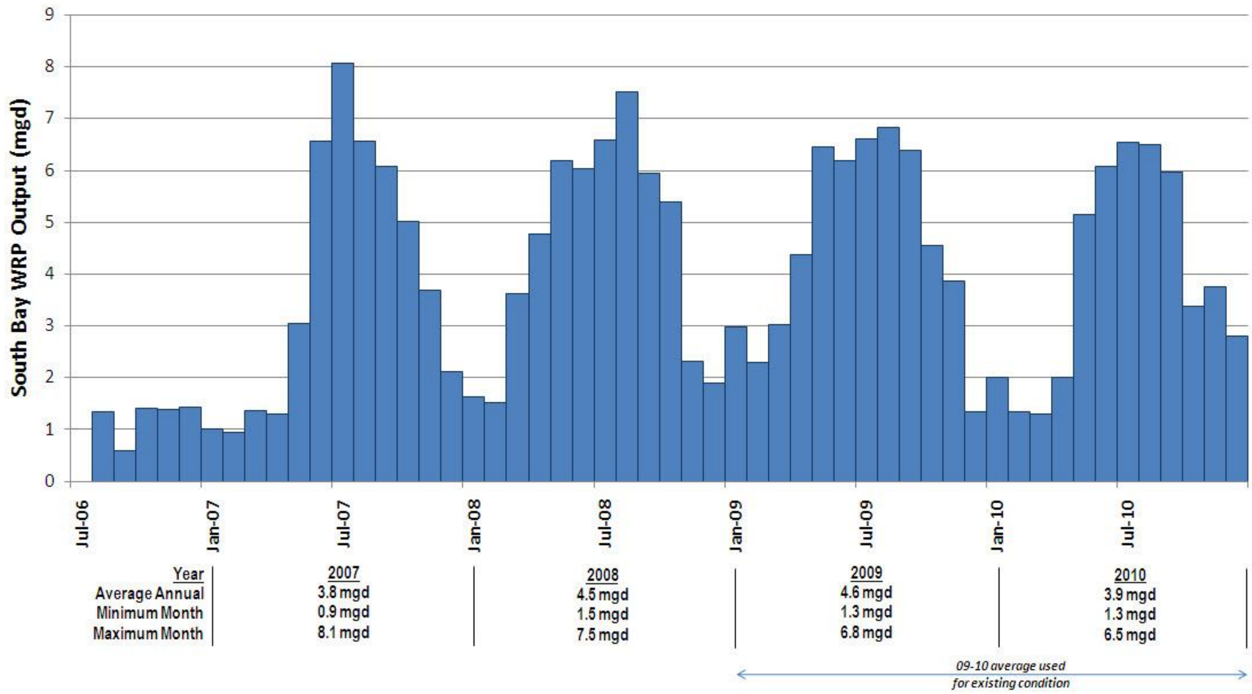


Figure 4-5. South Bay Plant Non-potable Recycled Water Output

Similar to the North City Plant, the South Bay Plant has had decreases in plant output due to reduced demands. Demands in South Bay are projected to increase as new customers are brought online, particularly in Otay's service area.

4.2.1.3 Padre Dam Water Recycling Facility

The Padre Dam Municipal Water District (Padre Dam) has been a leader in water reuse – from its innovative Santee Lakes to a non-potable system encompassing the 2.0 mgd Padre Dam Water Reclamation Facility. The Padre Dam Water Recycling Facility is located in Santee. Wastewater from the City of Santee, portions of the City of El Cajon, and the unincorporated community of Lakeside is diverted to the treatment facility to allow reuse (in lieu of flowing to the Metro System and the Point Loma Plant).

The Padre Dam Water Recycling Facility serves non-potable recycled water demands in Santee through a dedicated distribution system. In 2010 this system delivered 739 AF to landscape irrigation and 15 AF for construction purposes (Table 20 of the 2010 Urban Water Management Plan for Padre Dam). Also in 2010, 1,120 AF of treated water not used for irrigation is discharged to the Santee Lakes, a series of seven constructed lakes owned and operated by Padre Dam. Water enters the first lake and flows by gravity through each lake until it eventually reaches Sycamore Creek, a tributary of the San Diego River. Sycamore Creek flows through decorative ponds within the Carlton Oaks Country Club golf course for approximately one mile before entering the San Diego River. Wastes are sent back to the Metro System for treatment downstream at the Point Loma Plant.

Padre Dam, in conjunction with the Helix Water District, is also evaluating the ability to expand the plant as part of an indirect potable reuse project in El Monte Valley. The 5 mgd El Monte Groundwater Recharge Project would provide a valuable new water source for the region. Its flows and timing were considered in this Study. Padre Dam is also working with the Bureau of Reclamation to evaluate the potential for groundwater recharge in the Santee basin. The elements of this evaluation were not considered in this Study.

4.2.1.4 Ralph W. Chapman Water Recycling Facility

Otay has emphasized the importance of recycled water in San Diego and has one of the largest distribution systems in the region. In 1980, Otay began operation of the Chapman Plant. This facility is located near Rancho San Diego and produces approximately 1.1 mgd of recycled water. Waste from the treatment process is discharged to the sewer for treatment at Point Loma Plant. Recycled water is used for irrigation in Eastlake, Otay Ranch, Rancho Del Rey, and other areas of Chula Vista. Otay has also considered expanding this plant ultimately to 3.9 mgd.

4.2.2 Recycled Water Conveyance System

The City operates a non-potable recycled water system comprised of two service areas – the Northern Service Area and the Southern Service Area. The Northern Service Area is supplied with recycled water from the North City Plant. As of 2010, the Northern Service Area consists of 83 miles of pipeline within San Diego, distributing recycled water to retail customers in the City and two wholesale customers: the City of Poway and the Olivenhain Municipal Water District. Figure 4-6 displays the recycled water conveyance system, which includes 526 retail water meters as of fiscal year 2011. Approximately 99 percent of the retail and wholesale customers use the water for irrigation, while the remaining customers use the water for cooling towers, construction, ornamental fountains and toilet/urinal flushing. The Southern Service Area is supplied non-potable recycled water by the South Bay Plant. The conveyance system is relatively simple and includes 3.12 miles of pipeline that distributes recycled water to the City's retail customers and Otay, a wholesale customer.

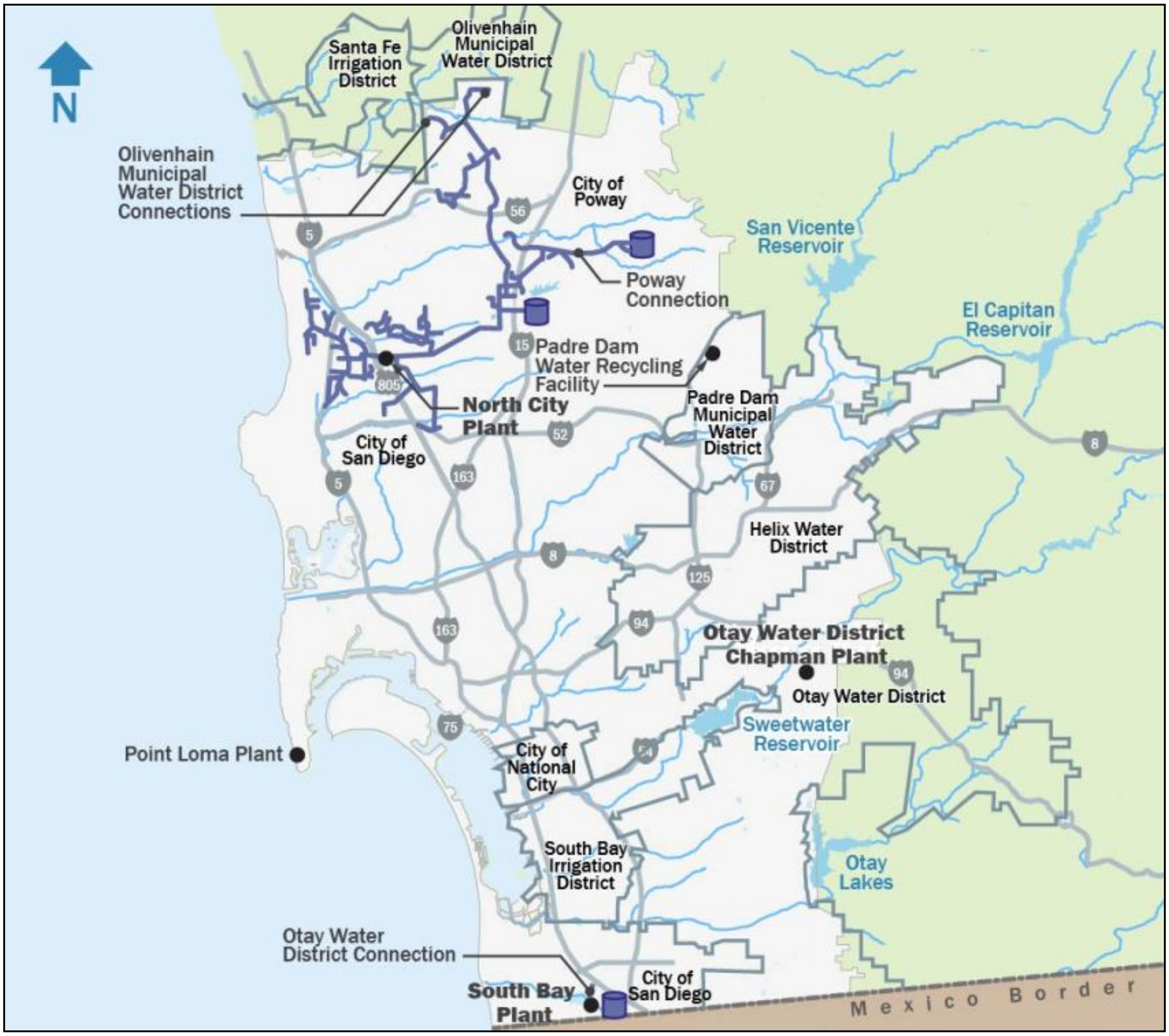


Figure 4-6. Non-potable Recycled Water Conveyance System

Shown above is the City's non-potable recycled water system. Also shown are the recycled water treatment plants in the Metro Service Area. Both Padre Dam and Otay operate their own non-potable recycled water distribution systems.

4.3 Wastewater System

The Metro System is the largest wastewater system in San Diego County. The system is managed by the City and Participating Agencies and serves a 450-square-mile area that includes incorporated areas of the City and 15 cities and districts. The Metro System includes conveyance facilities (pipelines and pump stations), wastewater treatment plants, two ocean outfalls, water reclamation plants, and a regional biosolids processing facility. Figure 4-7 presents a schematic of the Metro System showing the major facilities. The two largest pump stations in the Metro System are Pump Station No. 1 (PS1), located at the City of San Diego and National City border on Harbor Drive, and Pump Station No. 2 (PS2), located along Harbor Drive and adjacent to the San Diego International Airport. PS1 collects wastewater from the southern portion of the Metro System service area and pumps it northward to PS2 via the South Metro Interceptor. PS2 pumps wastewater collected from the Metro System to the Point Loma Plant via two 87-inch force mains and a

96-inch West Point Loma Interceptor. PS1 and PS2 are key locations related to wastewater flows, as described further below.

Current plans to maintain and improve the Metro System include a series of projects requiring significant capital investments in the coming years. In addition, the ability to maintain the Point Loma Plant without secondary treatment facilities continues to be debated and may not be allowed in the future, which would add further costs. Therefore, it is important to determine whether any of these expensive wastewater system upgrades could be avoided through new reuse approaches. The region's ratepayers can often times be better served by investing in sustainable water reuse systems as opposed to wastewater disposal systems.

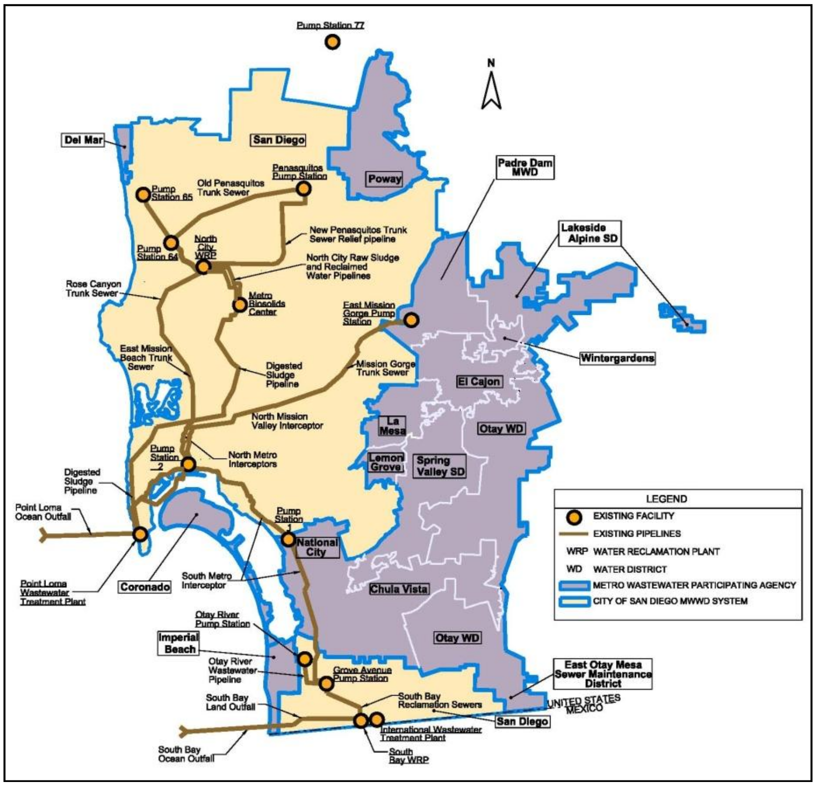


Figure 4-7. Metropolitan Sewerage System

4.3.1 Point Loma Plant

The Point Loma Plant is a chemically enhanced primary treatment facility located on the south and westerly coastline of the Point Loma Peninsula. It has a rated capacity of 240 mgd based on annual average daily flows and a peak wet weather capacity of 432 mgd. The plant is bounded by the Pacific Ocean to the west, the United States Navy Base to the north, Cabrillo National Monument to the south, and Fort Rosecrans National Cemetery to the east. Furthermore, a steep hillside runs adjacent to the plant's east perimeter. The Point Loma Plant processes are summarized in Figure 4-8 and include eight anaerobic digesters that stabilize the primary solids before pumping 17 miles to the Metropolitan Biosolids Center. Treated wastewater is discharged from the plant to the Pacific Ocean via the 4.5-mile-long Point Loma Ocean Outfall.

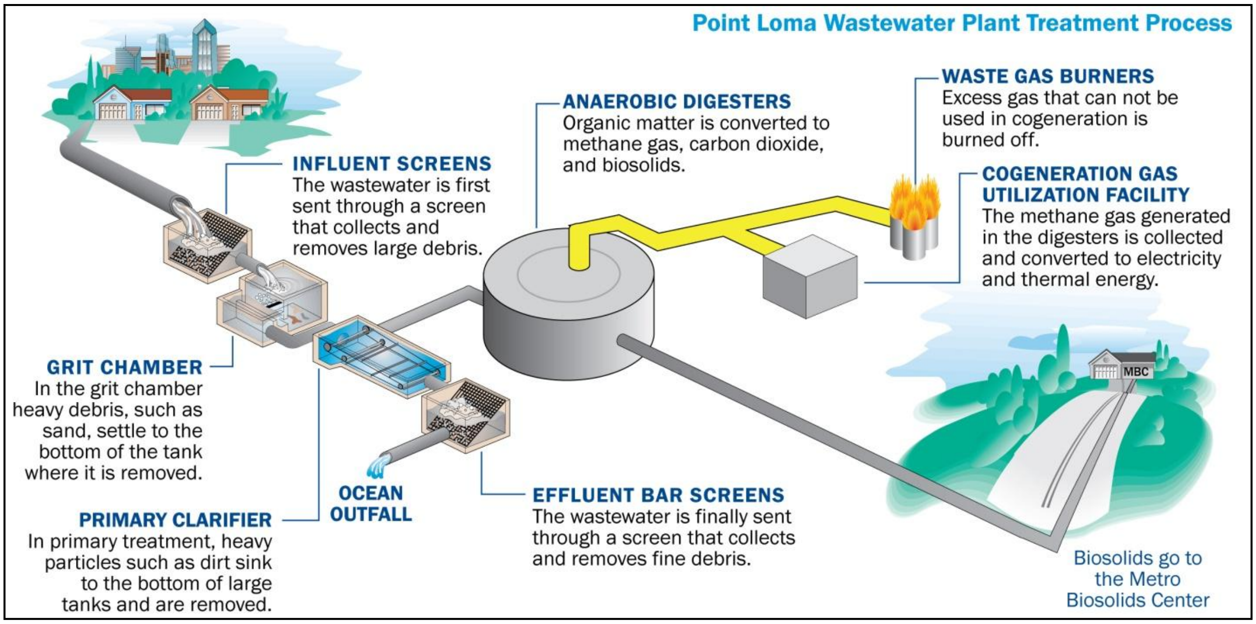


Figure 4-8. Point Loma Plant Process Schematic

4.3.2 Metropolitan Biosolids Center

The Metropolitan Biosolids Center (referred to as MBC) is a Metro System biosolids treatment facility located adjacent to the Miramar Landfill. MBC receives waste from the Point Loma Plant and the North City Plant. Wastes from the North City Plant are pumped to MBC, where it is thickened and digested. A separate pipeline conveys digested biosolids from the Point Loma Plant to MBC. Water from the mixture of digested biosolids from the North City Plant and the Point Loma Plant are removed using a centrifuge. The dewatered biosolids are then hauled away for land application or landfill cover. The MBC was commissioned in 1998 and is currently sized to treat 179 dry tons per day (a dry ton is 2000 pounds of sludge that is devoid of water).

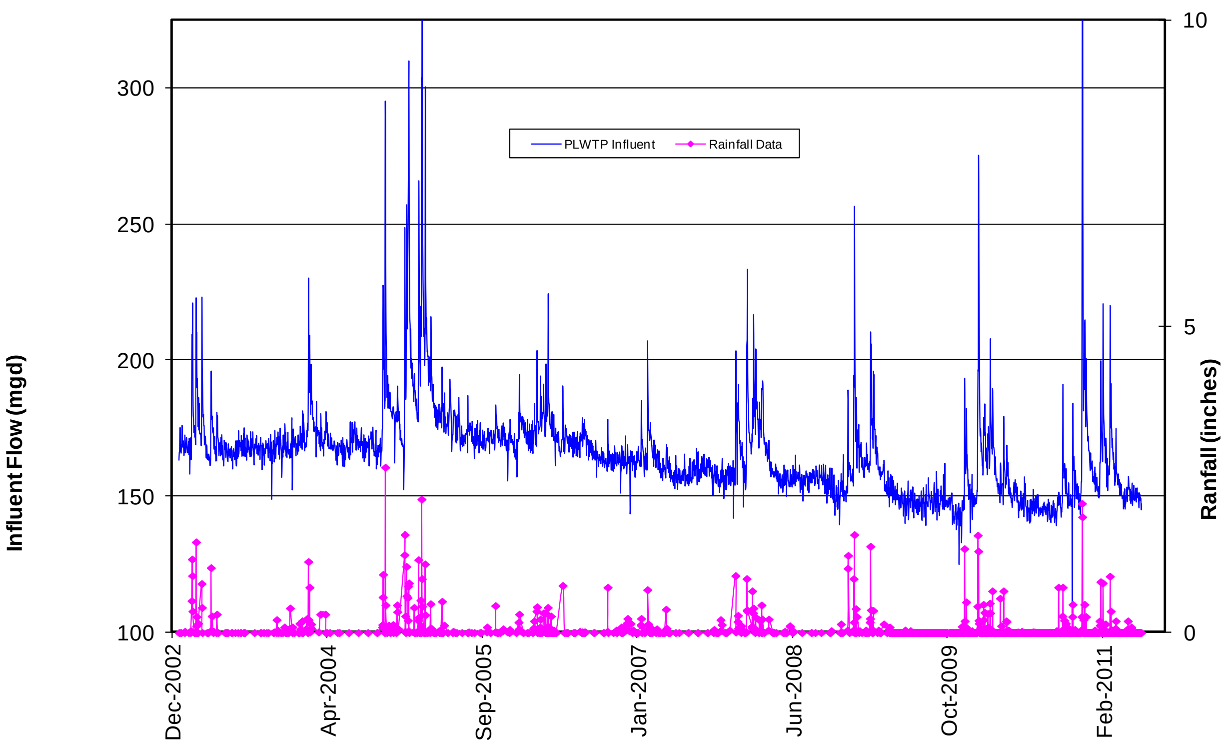
4.4 Wastewater Flows

The City monitors influent and effluent flow from all of their treatment plants as required per NPDES permits and to aid in the operation of plant processes. In addition, flows are monitored at locations where Participating Agencies connect to the Metro System to facilitate the City's billing. Historic flow data can be used to help detect long-term trends and the effects of large-scale events (e.g., storms, recessions, growth due to construction, etc.). The data also helps project future flows that may identify potential capacity shortfalls. Below is a summary of historic flows at the City's treatment facilities.

4.4.1 Point Loma Plant Influent Flows

Point Loma Plant flows from January 2003 through June 2011 are shown on Figure 4-9. The Point Loma Plant consistently received about 170 mgd of annual average daily flows from 2003 to 2004. In 2005, a significant above-average rainfall season triggered higher flow rates of rainfall-dependent inflows and infiltration and groundwater infiltration in the sewer system. During this time, a 185-mgd annual average daily flow was recorded at the Point Loma Plant. The flow gradually receded to the 2003/04 levels of 170 mgd in

2006. Then, over the next four and a half years, flows steadily decreased to approximately 145 mgd by August of 2009. In this timeframe, the North City Plant and the South Bay Plant increased non-potable recycled water production, which reduced flows to the Point Loma Plant. The North City Plant increased recycled water production from 3.5 mgd to 4.5 mgd, while the South Bay Plant increased recycled water production from 4.6 mgd to 8.6 mgd. In addition, decreased rainfall from April 2006 to August 2009 lowered the groundwater table, thus reducing flows attributed to groundwater infiltration. The drought and higher water rates also spurred significant water conservation and water efficiency measures. The combination of these factors contributed to the decreased flow observed at the Point Loma Plant between August 2006 and August 2009. In 2010, the average influent flow increased to 156 mgd due to above average rainfall events.



Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Average Annual	169.7 mgd	173.9 mgd	183.0 mgd	170.0 mgd	161.4 mgd	161.7 mgd	152.8 mgd	156.2 mgd	159.3 mgd
Minimum Month	165.5 mgd	166.8 mgd	169.3 mgd	162.4 mgd	156.5 mgd	150.5 mgd	142.5 mgd	143.9 mgd	149.4 mgd
Maximum Month	181.4 mgd	187.0 mgd	187.0 mgd	179.9 mgd	169.8 mgd	181.3 mgd	175.9 mgd	181.5 mgd	168.7 mgd

Figure 4-9. Point Loma Plant Daily Average Influent Flow and Rainfall Data for 2003 to 2011

Note: 2011 flows include values from January through June only.

4.4.2 Wastewater Flow Scenarios and Application in this Study

The following wastewater flow scenarios were used in this Study. A projected dry weather flow was used to estimate the wastewater availability for producing the recycled water on a typical dry year. A projected 10-year return event wet weather flow scenario was used to size the Point Loma and South Bay facilities based on the City's September 2011 Draft Wastewater Master Plan. The following summarizes these conditions.

Dry Weather Flow (DWF). The DWF condition used is based on 2035 wastewater flow projections and represents the amount of wastewater generated over one year without any consideration of the wet weather component (infiltration and inflow). This flow condition was used to size recycling facilities that are upstream of the Point Loma Wastewater Treatment Plant and that have no outfall.

Wet Weather Flows. The Metro System is designed to handle wet weather events based on criteria developed by the City and approved by the Metro JPA members. The September 2011 Draft Wastewater Master Plan includes a series of projects to handle the wet weather condition based on flows through 2050. Two 2050 flow conditions were used to provide a direct comparison between the Wastewater Master Plan and this Study, strictly for the purposes of determining direct and indirect wastewater system savings generated by the reuse projects in this Study (see Chapter 8). The flow conditions are described as follows:

- **10-year Return Annual Average Daily Flow (AADF).** The 10-year return AADF condition used in this Study is based on 2050 wastewater flow projections and represents the amount of wastewater generated over one year and contains a wet weather component based on a 10-year return period.
- **10-year Return Peak Wet Weather Flow (PWWF).** The 10-year return PWWF condition used in this Study is based on 2050 wastewater flow projections and is determined by applying a peaking factor to the 10-year return AADF to obtain the peak daily flow occurring during the 10-year return event (i.e., AADF is the annual average flow including the wet weather return period and PWWF is the peak daily flow during the return event). This flow condition applies to the strategy and design of the Point Loma and South Bay Plants to handle a peak wet weather event.

Table 4-2 below summarizes Metro System flows for different conditions, and which condition was used for sizing and capacity analyses.

Table 4-2. Wastewater Flows and Application to this Study

Location	2035 Dry Weather Flows: Basis for Sizing Reuse Projects	2050 Point Loma and South Bay Sizing	
		Annual Average Daily Flow w/10-year Return Event	Peak Wet Weather Flow w/10-year Return Event
South Bay Plant	44 mgd	65 mgd	151 mgd
North City Plant	29 to 45 mgd	N/A	N/A
Harbor Drive	55 mgd to 72 mgd	N/A	N/A
Mission Gorge	0 mgd to 9 mgd	N/A	N/A
Point Loma Plant	79 mgd	143 mgd	320 mgd

Notes:

- *2050 Flows shown are based on the reuse projects included in this Study and were compared to the City's September 2011 Draft Wastewater Master Plan 2050 flows (see Chapter 8 and Appendix H).*
- *SV8 Diversion will be sized for a 47 mgd AADF and a 133 mgd PWWF in coordination with City's September 2011 Draft Wastewater Master Plan.*
- *Grove Avenue Pump Station (GAPS) will convey 18 mgd during annual average daily demands and peak wet weather events. Remaining flows enter the South Metro Interceptor and can be diverted back to the South Bay Plant via the planned SV8 Diversion.*
- *North City, Harbor Drive and Mission Gorge ranges dependent upon which Alternative is selected (see Chapter 8).*
- *28 MG storage assumed to equalize PWWF to the Point Loma Plant.*
- *2035 Point Loma Plant DWF assumes 9 mgd of non-potable recycled water is produced at the North City Plant and 3 mgd is produced at the Padre Dam Plant.*
- *5 mgd of IPR from the El Monte Groundwater Recharge or other equivalent project included.*
- *68 mgd of IPR delivered to the San Vicente Reservoir included.*

4.4.3 North City Plant Influent Flows

The North City Plant receives influent directly from the Penasquitos Pump Station (PS) and a portion of the flow in the New Rose Canyon Trunk Sewer, which conveys the Pump Station 64 (PS64) discharge. Currently, 7 mgd is diverted from the Penasquitos Pump Station, and approximately 10 mgd is diverted from the new Rose Canyon Trunk Sewer. The resulting influent flow at the North City Plant is approximately 17 mgd. All flows are treated to secondary levels. A portion of the flows (only the amount needed for the non-potable recycled water system) are treated to tertiary levels. Excess secondary treated flows not used in the non-potable recycled water system are returned to the Metro System. North City influent flows are anticipated to reach 28.8 mgd in 2035.

4.4.4 South Bay Plant Influent Flows

In 2002, the South Bay Plant began treating approximately 4.6 mgd of wastewater from the South Bay area, conveyed to the plant via the Grove Avenue Pump Station. In the summer of 2006, the plant began increasing the amount of wastewater treated by approximately 4 mgd to a total of 8.6 mgd. The increase was needed to meet the increased recycled water demand from Otay, which had just completed an extension of their recycled water distribution system. Dry Weather Flows to the South Bay Plant are projected to be 12.9 mgd by 2035 and 15 mgd (reaching the existing Plant capacity) by 2050 (unless a new diversion is constructed to divert wastewater from the Point Loma Plant to the South Bay Plant). The Study included evaluating new wastewater diversions to the South Bay Plant at the Study's 2035 planning horizon. The City and Otay are also separately discussing interim diversions to meet peak summer day demands.

4.4.5 Wastewater Flows and Losses through Treatment Processes

Each year the City prepares a Flow and Strength Report that reviews historic wastewater flows and prepares projections to support the Public Utilities Department's financial planning. These projections are important to this Study since the quantity, location, and quality of the available wastewater are key considerations in developing reuse alternatives. Updated projections for flow and load calculations were developed using San Diego Association of Governments (SANDAG) population forecast. This information was compiled with additional data and technical analysis to provide flow projections as summarized on Figure 4-10.

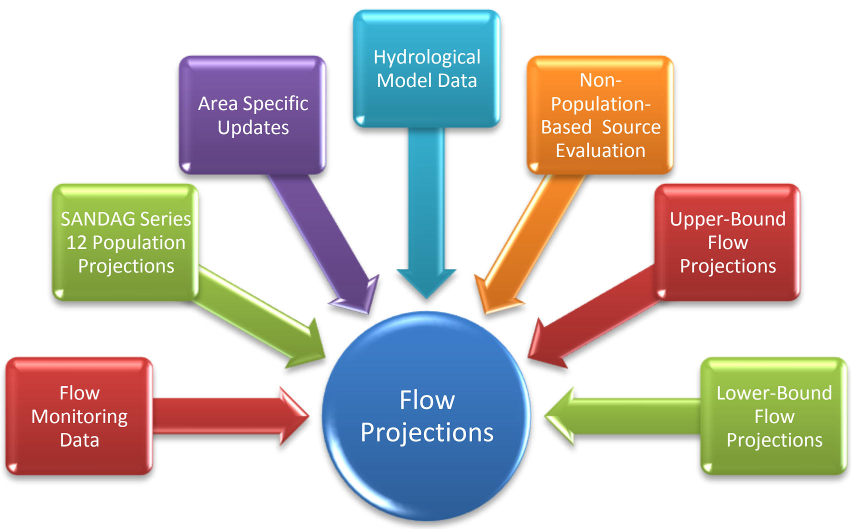


Figure 4-10. Elements that Make Up the Flow Projections

Table 4-3 summarizes the wastewater available at existing and 2035 conditions at various locations in the Metro System. These totals were important in evaluating how much wastewater could be diverted to existing water reclamation plants and whether new treatment plants could be located at these locations where the wastewater was available. Figures 4-11 and 4-12 illustrate the relative locations of the major sewer lines indicated in Table 4-3.

Table 4-3. Projected Dry Weather Flows at Specified Locations in the Metro System

Site No.	Sewer Line	Dry Weather Flows (mgd)						
		2010	2015	2020	2025	2030	2035	
N1	Pump Station 64 Force Main	18.0	18.1	18.2	19.2	19.6	20.1	**Tributary to the North City Plant** (N1–N2)
N2	Penasquitos Pump Station Force Main	7.8	8.1	8.5	8.6	8.6	8.7	
N3	Miramar	1.0	1.0	1.0	1.0	1.1	1.1	**Morena Diversion** (N3–N7)
N4	UCSD	3.4	3.6	3.7	3.8	3.8	3.8	
N5	San Clemente Canyon/Rose Canyon Old	1.0	1.0	1.0	1.0	1.1	1.1	
N6	Balboa	1.0	1.0	1.0	1.1	1.1	1.2	
N7	Second La Jolla/Pacific Beach	5.7	5.9	6.1	6.3	6.5	6.8	
N8	Tecolote Canyon	3.1	3.1	3.1	3.1	3.1	3.2	
N9	East Mission Gorge	14.8	15.7	16.6	17.6	18.4	19.4	
N10	North Mission Valley	32.3	33.3	34.4	35.8	37.1	38.6	
N11	South Mission Valley	3.6	3.6	3.6	3.6	3.8	3.9	
N12	Ocean Beach	3.9	4.0	4.2	4.3	4.4	4.6	
N13	East Point Loma	2.0	2.1	2.1	2.1	2.2	2.2	
	North Metro Interceptor (to PS2)	**82.8**	**86.3**	**89.9**	**93.3**	**96.0**	**99.2**	
S1	Grove Avenue Pump Station (Existing)	8.2	9.7	11.3	12.0	12.4	12.9	**Tributary to the South Bay Plant** (S1)
S2	Imperial Beach	0.9	0.9	0.9	0.9	0.9	0.9	**Spring Valley 8 Diversion** (S2–S7)
S3	Palm City	2.5	2.6	2.7	2.7	2.8	2.9	
S4	Salt Creek Trunk Sewer CV14	3.2	3.7	4.3	5.1	5.6	6.2	
S5	Chula Vista CV2	4.5	4.8	4.8	4.9	5.0	5.0	
S6	Chula Vista CV3	2.0	2.0	2.0	2.0	2.1	2.1	
S7	Spring Valley Trunk Sewer SV8	12.5	13.1	13.8	14.0	14.0	14.0	
S8	National City NC2	0.4	0.5	0.5	0.5	0.5	0.6	
S9	National City NC3A	2.9	3.1	3.3	3.7	4.2	4.6	
S10	National City NC5	0.9	1.0	1.0	1.1	1.2	1.3	
S11	Harbor Drive Trunk Sewer	21.4	24.8	28.3	29.5	30.4	31.6	
S12	Downtown/Coronado SD7A	6.0	7.6	9.2	9.8	10.1	10.6	
	South Metro Interceptor (to PS2)	**74.4**	**80.1**	**85.8**	**89.6**	**92.2**	**95.7**	
	Metro System Total	**157.8**	**167.1**	**176.4**	**183.6**	**188.8**	**195.6**	

Notes:

- *Flows at key locations in the Metro System are provided. See Figure 4-11 and 4-12 for locations. A flow of approximately 0.7 mgd from the Point Loma area joins Point Loma Plant influent downstream of Pump Station 2. Flows are based on mid-point unit generation rates and SANDAG Series 12 data. 2015 values interpolated using 2010 and 2020 values. Grove Avenue PS 2010 flow based on South Bay Plant influent from Jan 2009 to June 2009. Flows are user generated flows and do not account for upstream diversions.*
- *Dry weather flows do not include wet weather related return events. The flows above were used for sizing the recycled water projects as these flows are considered the typical operating condition.*

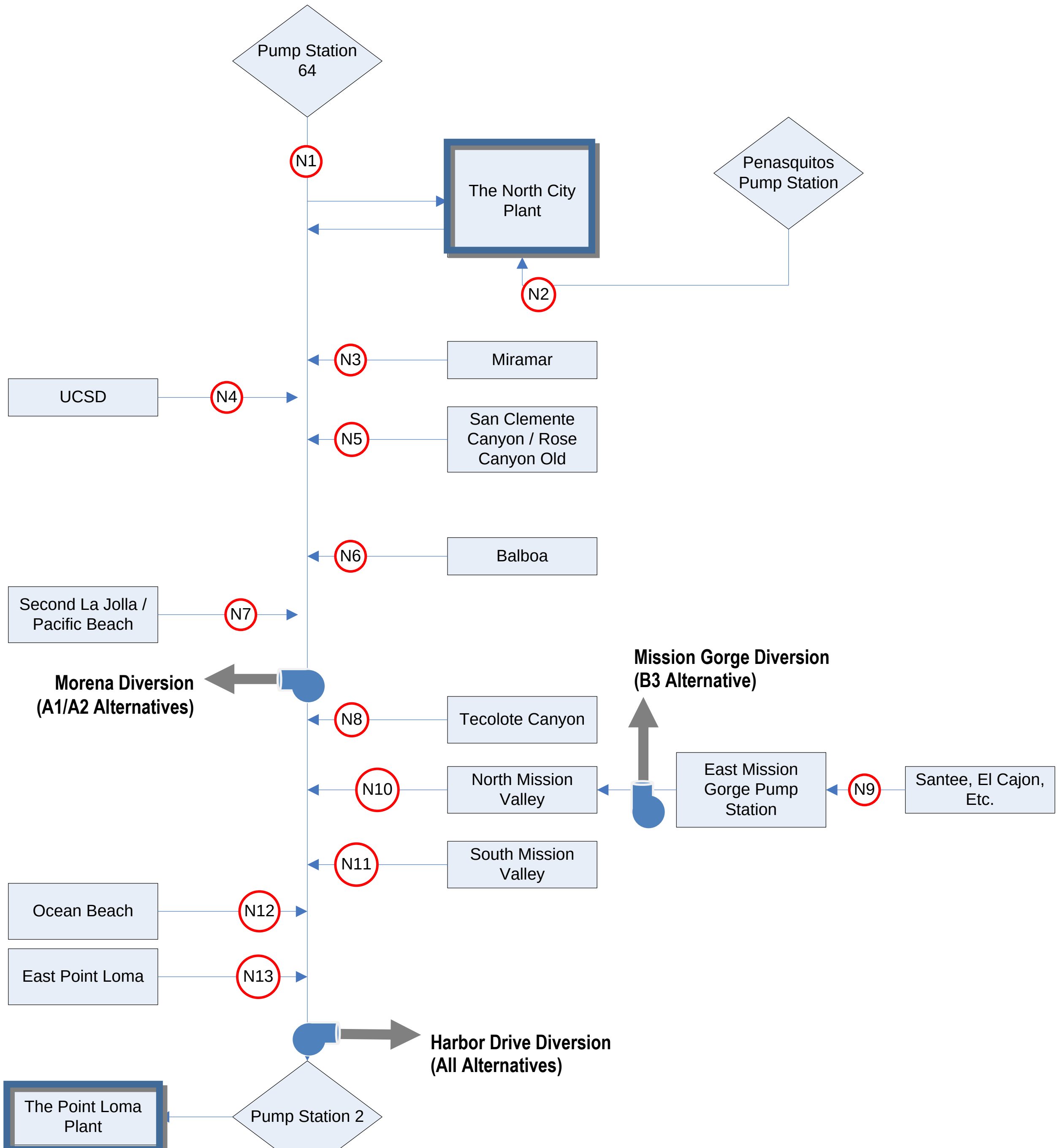


Figure 4-11. Schematic of the Metro System's North Area Trunk Sewers

The Diversions shown are included in the Study's Alternatives, as described in Chapters 7 and 8.

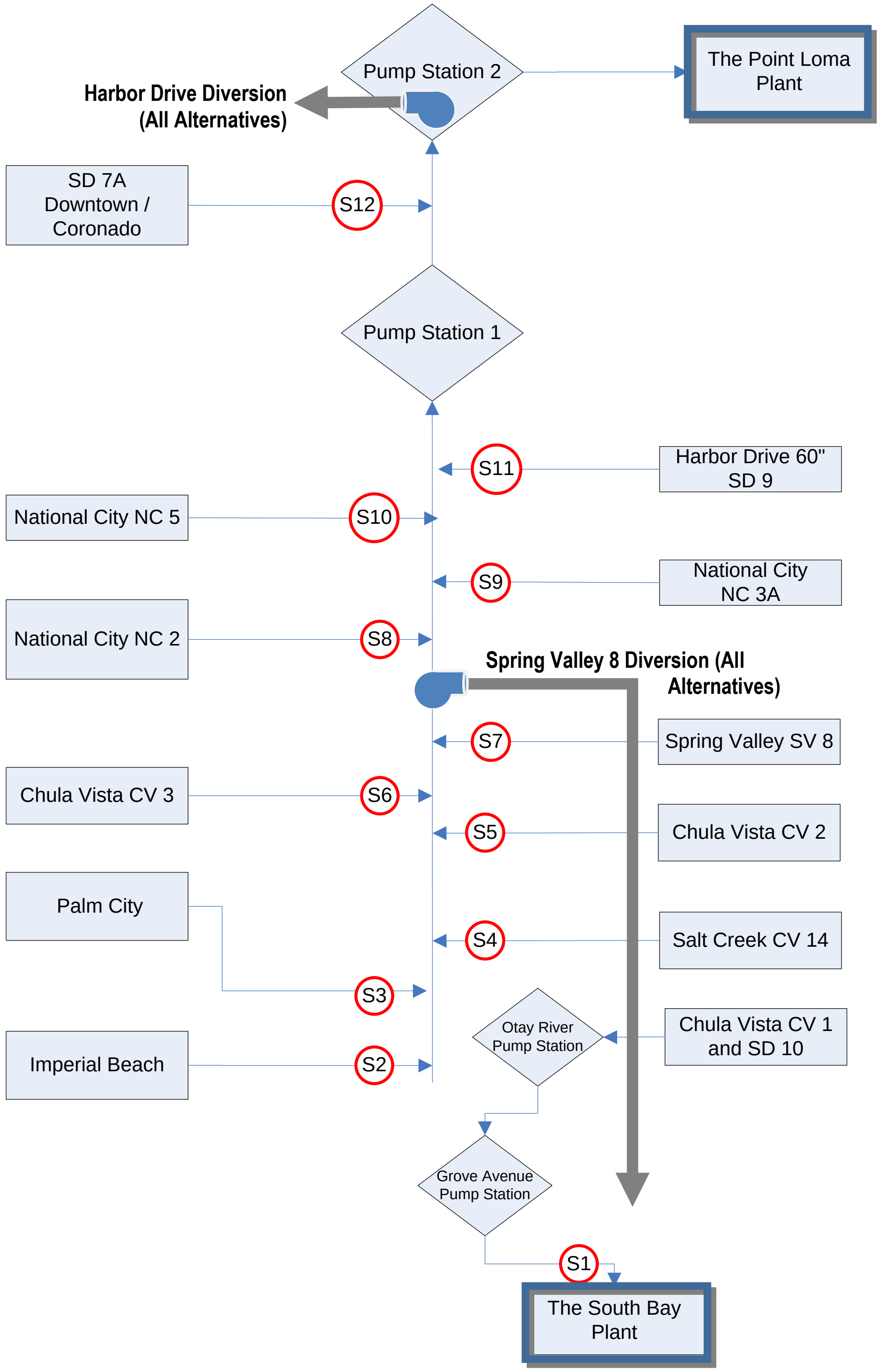


Figure 4-12. Schematic of the Metro System's South Area Trunk Sewers

The Diversions shown are included in the Study's Alternatives, as described in Chapters 7 and 8.

4.4.6 Water Losses from Treatment Process

Losses occur as water is cleaned and treated. The amount of water lost as wastes varies depending on the specific processes used. Losses are important in water reuse, since the available wastewater must be treated through multiple processes to convert it to tertiary water for non-potable recycled water projects and then further treated for indirect potable reuse projects. Each treatment step removes part of the waste stream as shown in Figure 4-13, reducing the amount of water available. If there is not enough wastewater tributary to a treatment plant for water reuse projects, then the flows must be supplemented by diverting (usually through pumping) from another location. The adaptive model summarized in Chapter 3 accounted for the changing water volumes as water was treated to higher water quality levels.

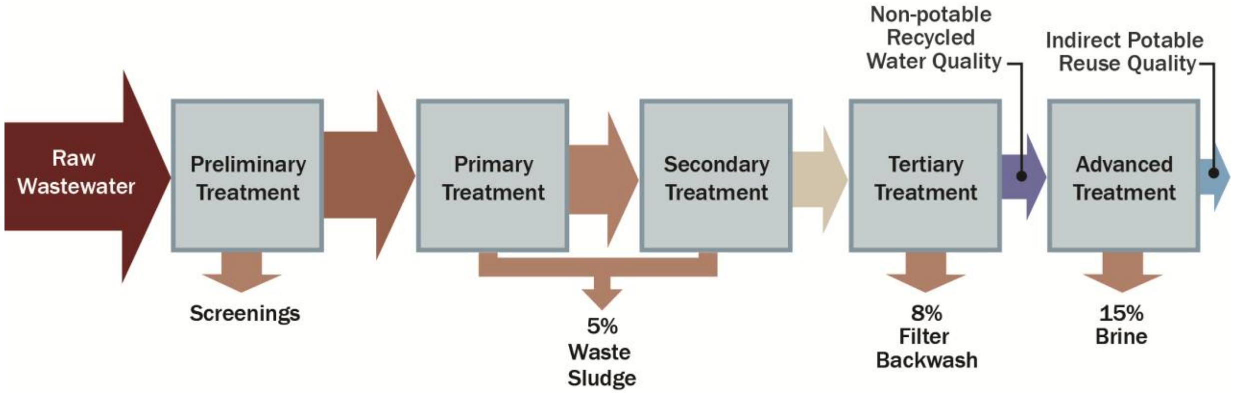


Figure 4-13. Typical Water Losses in Water Reclamation and Advanced Water Purification Treatment Processes

5. NON-POTABLE RECYCLED WATER OPPORTUNITIES

The Study included evaluating two primary approaches to water reuse. The first was to increase non-potable recycled water use through expansion of the existing system or development of new systems. The second was to develop new indirect potable reuse projects using reservoir augmentation or groundwater recharge. This chapter describes the technical basis and foundation for developing non-potable recycled water opportunities. The opportunities outlined in this chapter were considered for incorporation into the Area Concepts described in Chapter 7 and then developed further into the Integrated Reuse Alternatives described in Chapter 8.

5.1 Non-potable Recycled Water Opportunities Summary

Non-potable recycled water opportunities were determined by calculating existing demands and estimating future demand potential. Delivering water to new customers requires expanding the existing non-potable reuse system by using the existing reclamation plants, or creating new systems through building new satellite plants near the location where the demands exist. Areas throughout the City were considered using a market assessment process (a study to estimate potential customer demands). Wholesale opportunities were also assessed through the use of agency surveys. The following section summarizes the non-potable recycled water opportunities considered.

5.2 Baseline Non-potable Recycled Water Demands

The North City and South Bay Plants currently serve non-potable recycled water to customers within the City, and to the wholesale customers Otay, City of Poway, and Olivenhain Municipal Water District through wholesale connections. Existing demand commitments to these customers is important since these demands need to be accounted for and subtracted from the total water available in order to determine how much water remains for the new opportunities investigated in this Study. These existing demands were referred to as the baseline demand condition. During the Study, the baseline demands were expanded to include near-term non-potable recycled water contracts (such as the Otay Water District contract through 2026) and the City's planned projects through 2015.

The following summarizes the baseline demand components:

- **Existing Demands.** Existing demands were quantified by averaging the 2009 and 2010 demand data at the North City Plant and the South Bay Plant. This was deemed appropriate to account for recent demand variability due to drought, water efficiencies, water conservation, and the strained economic climate.
- **North City Demands Planned through 2015.** The increase in the North City demands anticipated by 2015 was based on an active list of projects and planned connections maintained by the Public Utilities Department. Examples of new demands include implementing Phase II of the 2005 Recycled Water Master Plan and infill customers that have agreements with the City to connect to the existing system.

- **South Bay Plant Demands Planned through 2015 (City's retail system).** The changes in the South Bay retail system demand anticipated by 2015 were based on an active list of projects and planned connections maintained by the Public Utilities Department. The South Bay retail system demands are anticipated to decrease due to the reduced demands at the International Boundary and Water Commission Plant.
- **South Bay Demands Planned through 2026 (Otay Water District).** Otay demands included in the baseline totals were based on an agreement between the City and Otay. The totals include increased demands through 2026. The South Bay Plant serves demands in excess of Otay's Chapman Plant.

Table 5-1 summarizes the baseline demand totals. These totals are consistent for each reuse alternative included in the Report. A breakdown of wholesale customer contributions is included in the subsequent section. The non-potable recycled water demands shown were assumed to grow to these values over the period indicated, and remain at the totals shown in perpetuity. New water reuse opportunities (both non-potable and indirect potable reuse) were considered only after these demands were accounted for.

Table 5-1. Baseline Non-potable Recycled Water Annual Demands

Area/Component	Existing Demands 2009/2010		Planned Demands 2010-2015/2026		Total Annual Baseline Demands	
	AFY	MGD	AFY	MGD	AFY	MGD
North City Plant Total	7,463	6.7	2,740	2.4	10,203	9.1
South Bay Plant Total	4,747	4.2	2,001	1.8	6,747	6.0
Total North City Plant & South Bay Plant	**12,210**	**10.9**	**4,741**	**4.2**	**16,950**	**15.1**

Notes:

- *Demands shown are average annual demands. Seasonal demand impacts addressed below.*
- *Existing demands based on an average of calendar year 2009 and 2010 plant data provided by the City.*
- *Planned demands for the system (except Otay Water District) include new demands through 2015 based on the Recycled Water Demand Projections managed by City of San Diego Public Utility Department Recycled Water Program. Planned demands for the Otay Water District include demand projections through 2026 based on contract totals between the City and the Otay Water District. Otay Water District demands shown do not include Chapman Plant supplies totaling 599 AF in 2015 and 992 AF for 2026 and later years based on data provided by the Otay Water District. For planning purposes, 900 AFY was assumed to be available from the Chapman Plant.*

5.3 Future Non-potable Recycled Water Opportunities

Future non-potable recycled water demand opportunities were developed as options to weigh in favor of and against indirect potable reuse approaches. These opportunities were reviewed and discussed during the workshops and Stakeholder meetings. Discussions included different viewpoints on non-potable reuse ranging from: 1) a desire to eliminate non-potable reuse once indirect potable reuse is implemented; to 2) a desire to continue non-potable reuse where appropriate, and to prevent having stranded assets from prior investments. Figure 5-1 summarizes the market assessment process used to refine raw demand data into projected non-potable recycled water demands for different opportunities, locate the demands, layout conceptual systems to determine costs, and then refine the demands based on historical connection rates.

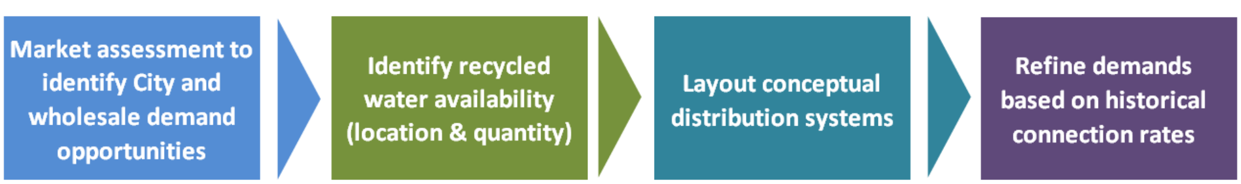


Figure 5-1. Non-potable Recycled Water Opportunity Development

5.3.1 Future Citywide Non-potable Recycled Water Opportunities

Citywide future non-potable recycled water opportunities were compiled based on the market assessment. The market assessment included three key sources of information: 1) the City's potable water customer database to identify irrigation customers, 2) the City's industrial waste dischargers database to identify potential cooling tower customers, and 3) phone surveys conducted by the Study Team with commercial and industrial customers who use large quantities of potable water. Focus areas were broken out based on the demand concentrations to facilitate laying out conceptual distribution systems as shown on Figure 5-2. The focus areas and the demands are summarized in Table 5-2. The focus areas are broken out into two categories—those served by existing plants and those served by new plants.

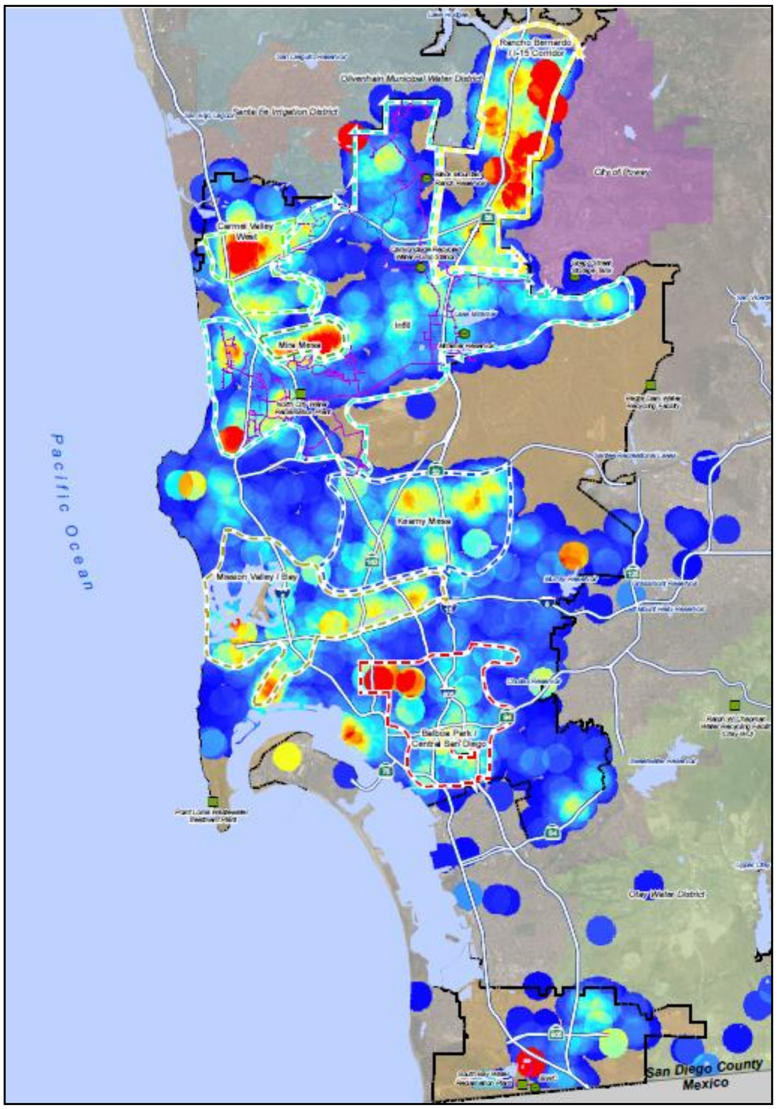


Figure 5-2. Non-potable Recycled Water Opportunity Density Map
A map was prepared to show the concentration of water demands that were candidates for conversion to non-potable recycled water. Red areas represent the highest concentration of potential demands and dark blue areas represent areas with the lowest potential conversion demands.

Table 5-2. Citywide Future Non-potable Recycled Water Opportunities Considered

Focus Area	Annual Demands	
	AFY	mgd
Areas served from existing treatment plants		
Infill	2,693	2.4
Balboa Park/Central San Diego	1,132	1.0
Carmel Valley West	546	0.5
Kearny Mesa	539	0.5
Mira Mesa	294	0.3
Mission Valley/Bay	1,146	1.0
Rancho Bernardo/I-15 Corridor	2,634	2.4
Areas served by new treatment plants		
Balboa Park/Central San Diego	1,108	1.0
Kearny Mesa	615	0.5
Mission Valley/Bay	1,130	1.0
Rancho Bernardo/I-15 Corridor	2,620	2.3

Notes:

- *Annual demands are adjusted based on historical conversion/connection rates. Focus areas served by new plants are not additive to the same Focus Areas listed above under those served by existing plants; rather, they are alternative approaches.*

5.3.2 Future Wholesale Non-potable Recycled Water Opportunities

Non-potable recycled water opportunities were also investigated to serve wholesale customers. The market assessment included surveying 11 agencies for possible service. From the surveys, five agencies were identified for further consideration. The agencies considered and the actions taken are summarized as follows:

- **City of Coronado.** The City of Coronado is served by California American Water, a private water company. The survey for the City of Coronado indicated a potential demand of 460 AFY (0.4 mgd) for the City of Coronado, and 920 AFY (0.8 mgd) for potential Navy demands. These demands were not carried forward in this Study since the Navy is investigating construction of an independent plant to meet both Navy and City of Coronado demands.
- **City of Poway.** The City of Poway indicated that they would have additional demands of 1,100 AFY (1.0 mgd) through a new northern connection through Rancho Bernardo. The northerly connection was conceptualized in the City's 2000 Beneficial Reuse Study, but funding would need to be identified for the significant conveyance system expansion needed for this option. These demands were considered in the Rancho Bernardo/I-15 Corridor Area Concept summarized in Chapter 7. While this option was not included in the Integrated Reuse Alternatives, they were noted as a candidate project for a privately funded water offset project (see Chapter 7).
- **Olivenhain Municipal Water District.** The Olivenhain Municipal Water District survey demands were within the totals the City had identified in the 2015 baseline demand condition (described above). Therefore, no additional demands were carried forward beyond what was already included in the baseline demands.
- **Otay Water District.** Otay provided projected demand increases in addition to the demands included in the baseline demand condition. The demand increases occur between 2026 and 2040, and amounted to an increase reaching 3,363 AFY (3.0 mgd) annually. These demands were considered and advanced in the South Bay Area Concepts summarized in Chapter 7.
- **Santa Fe Irrigation District.** Santa Fe Irrigation District provided a potential demand of 850 AFY (0.8 mgd) to serve an existing distribution system and to expand service to the eastern portion of their service area. Santa Fe Irrigation District was also assessing other supply opportunities during this period. These demands were considered, but not advanced in lieu of other North City/San Vicente alternatives due to limited water availability at the North City Plant and uncertainty regarding this opportunity.

5.3.3 Other Agency Reclamation Plant Considerations

It is important to note that other Participating Agencies have effective non-potable recycled water programs in place. Padre Dam and Otay each treat and distribute recycled water at and from existing facilities (summarized in Chapter 4). These efforts have helped to offload the Metro System, and have provided a reliable water resource to the region. These systems were considered in the Study analysis since their operation affects the amount of wastewater available for treatment at downstream facilities and, in Otay's case, the amount of recycled water needed at the South Bay Plant to meet their demands. The following summarizes these considerations:

- **Padre Dam Water Recycling Facility.** It was assumed that approximately 2,240 AFY (2.0 mgd) of existing non-potable reuse and 1,120 AFY (1.0 mgd) of future non-potable reuse would be produced at the Padre Dam Water Recycling Facility. This does not include the El Monte indirect potable reuse project, which was considered separately as described in the indirect potable reuse project section.
- **Chapman Plant.** Otay meets their non-potable reuse demands from the South Bay Plant and the Chapman Plant. Data provided by Otay projected Chapman Plant recycled water production rate to

vary between 465 to 1162 AFY. These totals were subtracted from the total Otay demands to determine the remaining amounts needed from the South Bay Plant.

5.4 Non-potable Recycled Water Carried Forward in the Study

The amount of non-potable reuse advanced to the Area Concepts (and ultimately the Integrated Reuse Alternatives) was determined through the collaborative Study process. The opportunities were presented and debated throughout the early stages of the Study, with Stakeholder input occurring at the status meetings and as part of the Coarse Screening Session. Opportunities were weighed against the water reuse goals developed to offload the Point Loma Plant, the project criteria, and the benefits derived.

The first limitation with non-potable recycled water demands was identified by comparing the market assessment to the Study goals. The market assessment for both City retail customers and wholesale customers (not including planned and contracted totals) amounted to approximately 23 mgd for North City and 4 mgd for South Bay. This fell well short of the water reuse target in this Study. To further evaluate non-potable recycled water, a comparative analysis was performed on Alternative B2 (described in Chapter 8). The comparative analysis used the B2 Alternative both with and without a non-potable recycled water system expansion to the Rancho Bernardo area using the North City Plant. Rancho Bernardo was selected for this analysis since it included the largest concentration of potential non-potable recycled water demands and was the closest to existing facilities. The analysis concluded that adding the non-potable recycled water element to the B2 Alternative increased the unit cost of the water produced by approximately 8-percent. While non-potable recycled water projects can be beneficial, the analysis did show the cost effectiveness of doing larger scale indirect potable reuse projects that don't require extensive conveyance networks and the separate billing and customer support systems associated with individual recycled water customers. These factors shaped the approach to utilize non-potable options in a modest fashion, with a majority of the new reuse coming from larger indirect potable reuse projects.

While the non-potable recycled water opportunities carried forward could be considered modest, they represent a balanced approach to maximizing existing City and Participating Agency assets. The non-potable recycled water demands carried forward can be summarized as the Baseline Demands plus 3 mgd for expanded service to Otay occurring between 2026 and 2040. Figure 5-3 displays the projected growth in non-potable demands for each agency. Table 5-3 summarizes the non-potable demands carried forward for both the North City the South Bay Plants.

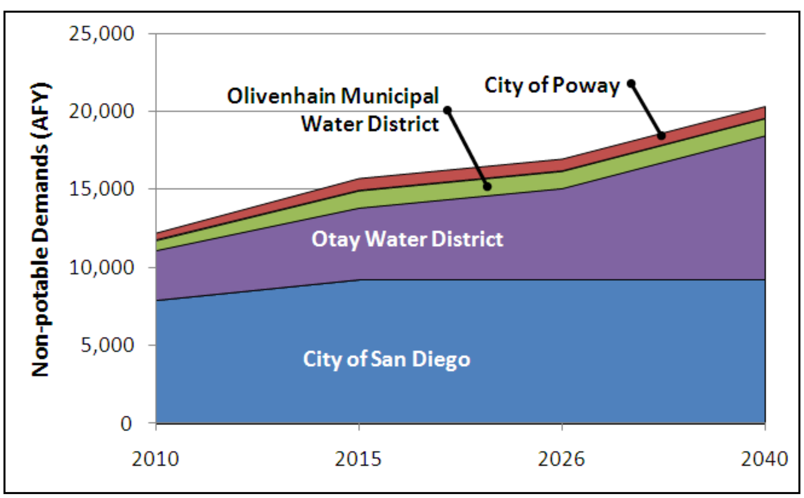


Figure 5-3. Projected Non-potable Recycled Water Demands

Average annual non-potable recycled water demands are projected to rise through 2040 based on the non-potable opportunities targeted for the for the North City and South Bay Plants

Table 5-3. Non-potable Recycled Water Projected Demands										
Agency	Existing		Planned		Planned (OWD)		Future (OWD)		Total	
	2009/2010		2010-2015		2015-2026		2026-2040			
	AFY	mgd	AFY	mgd	AFY	mgd	AFY	mgd	AFY	mgd
North City Plant										
City of San Diego	6,394	5.7	1,959	1.7	0	0.0	0	0.0	8,353	7.4
City of Poway	428	0.4	323	0.3	0	0.0	0	0.0	751	0.7
Olivenhain Municipal Water District	642	0.6	458	0.4	0	0.0	0	0.0	1,100	1.0
Total North City	**7,464**	**6.7**	**2,740**	**2.4**	**0**	**0.0**	**0**	**0.0**	**10,204**	**9.1**
South Bay Plant										
City of San Diego	1,539	1.4	-639	-0.6	0	0.0	0	0.0	900	0.8
Otay Water District	3,209	2.9	1,395	1.2	1243	1.1	3,363	3.0	9,210	8.3
Total South Bay	**4,748**	**4.2**	**756**	**0.7**	**1,243**	**1.1**	**3,363**	**3.0**	**10,110**	**9.0**
North City and South Bay Plants										
Total Combined	**12,212**	**10.9**	**3,496**	**3.1**	**1,243**	**1.1**	**3,363**	**3.0**	**20,314**	**18.1**

Notes:

- *Demands shown are average annual demands. Seasonal demand impacts addressed below.*
- *Existing demands based on an average of calendar year 2009 and 2010 plant data provided by the City.*
- *Planned demands for the system (except Otay Water District) include new demands through 2015 based on the Recycled Water Demand Projections managed by City of San Diego Public Utility Department Recycled Water Program. Planned demands for the Otay Water District include demand projections through 2026 based on contract totals between the City and the Otay Water District. Otay Water District demands shown do not include Chapman Plant supplies totaling 599 AF in 2015 and 992 AF for 2026 and later years based on data provided by the Otay Water District.*
- *Otay Water District Demands between 2026 and 2040 carried forward into the Coarse Screening Session varied by option. The totals shown herein are from Option C2, described in Chapter 8, which included 3.0 mgd of demands. Option C2 was used in all of the Integrated Reuse Alternatives presented in Chapter 8.*

5.4.1 Seasonal Demand Considerations

Non-potable recycled water usage is highly affected by the seasons since a majority of the water serves landscaping. Demands peak in the summertime, with a general rule of thumb being that peak summer day demands will be twice the average annual demands. The seasonal fluctuation is an important constraint for non-potable recycled water systems since serving peaks requires sizing treatment plants and storage facilities large enough to handle the highest demand condition. This generally means that the treatment plant capacity must be two times larger than the average demands, resulting in potentially underutilized capacity at the treatment plants. Optimization through peak management has become a major focus for all infrastructure systems. Examples include off-peak electrical rate incentives to reduce electrical loads during peak usage periods, and freeway carpool programs to lessen the volume of cars during peak commuting hours. For water reuse, agencies with underutilized plants are looking towards indirect potable reuse to optimize unused treatment capacities. Other concepts involve pricing incentives to help lower peak usage.

Seasonal non-potable recycled water demands were developed for the North City Plant (Figure 5-4) and the South Bay Plant (Figure 5-5). The curves represent monthly estimates based on historical monthly peaking factors provided by the City and Otay. It is important to note that peak day demands can exceed these totals in summer months. The seasonal curves include the following:

- Existing demands based on flow records from 2007 through 2010.
- Planned and future demands, including:
  - City of San Diego, City of Poway and Olivenhain Municipal Water District planned demands through 2015.
  - Otay planned demands through 2026 and future demands through 2040 (these totals do not include flows provided by the Chapman Plant).

Also shown is the remaining tertiary water available based on plant capacities and projected wastewater flows through 2035 (see Chapter 4 for wastewater assumptions). The North City Plant uses the existing plant capacity and projected 2035 wastewater flows without additional diversions. The South Bay Plant assumes an additional wastewater diversion using the Spring Valley No. 8 connection. Diversions are described further in Chapter 8. This remaining water can be used to meet peak day demands and serve new indirect potable reuse projects that optimize the remaining treatment plant capacities.

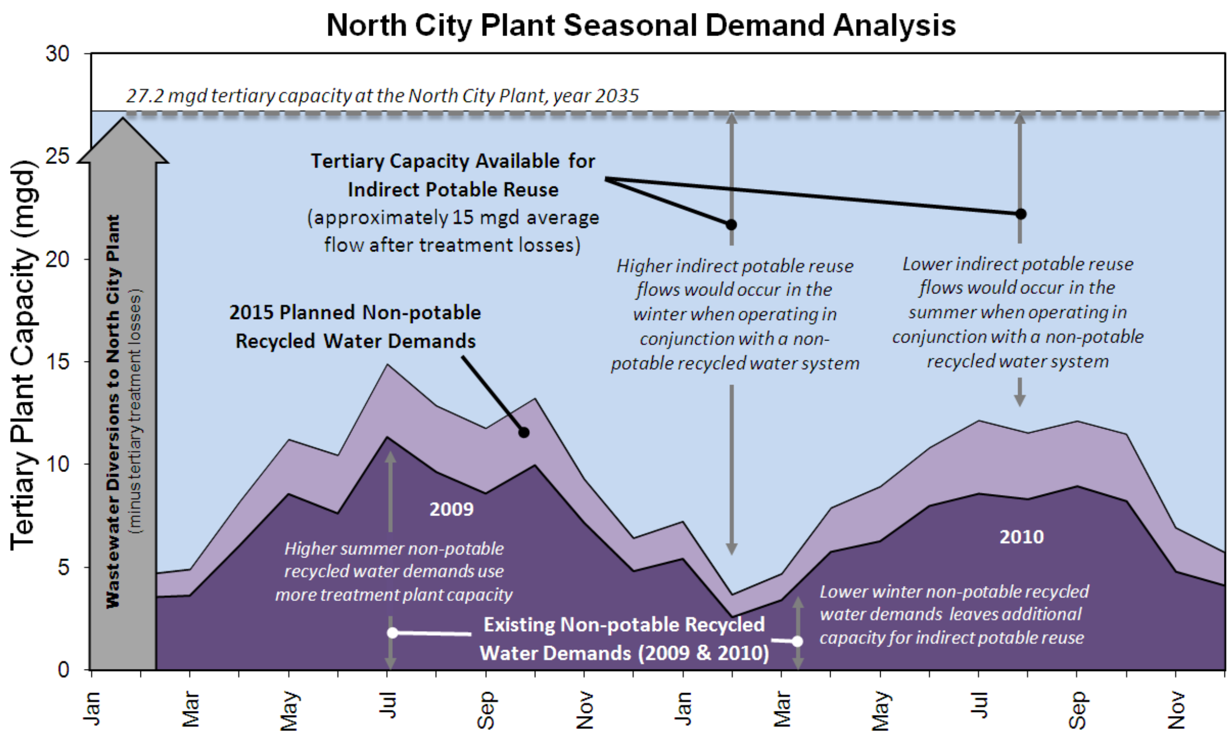


Figure 5-4. Seasonal Demand Analysis at the North City Plant

Non-potable reuse is highly influenced by seasonal peak demands. Higher summer demands affect the ability to utilize the entire plant capacity. The remaining capacity at the North City Plant, after planned non-potable recycled water demand increases through 2015, is allocated to indirect potable reuse.

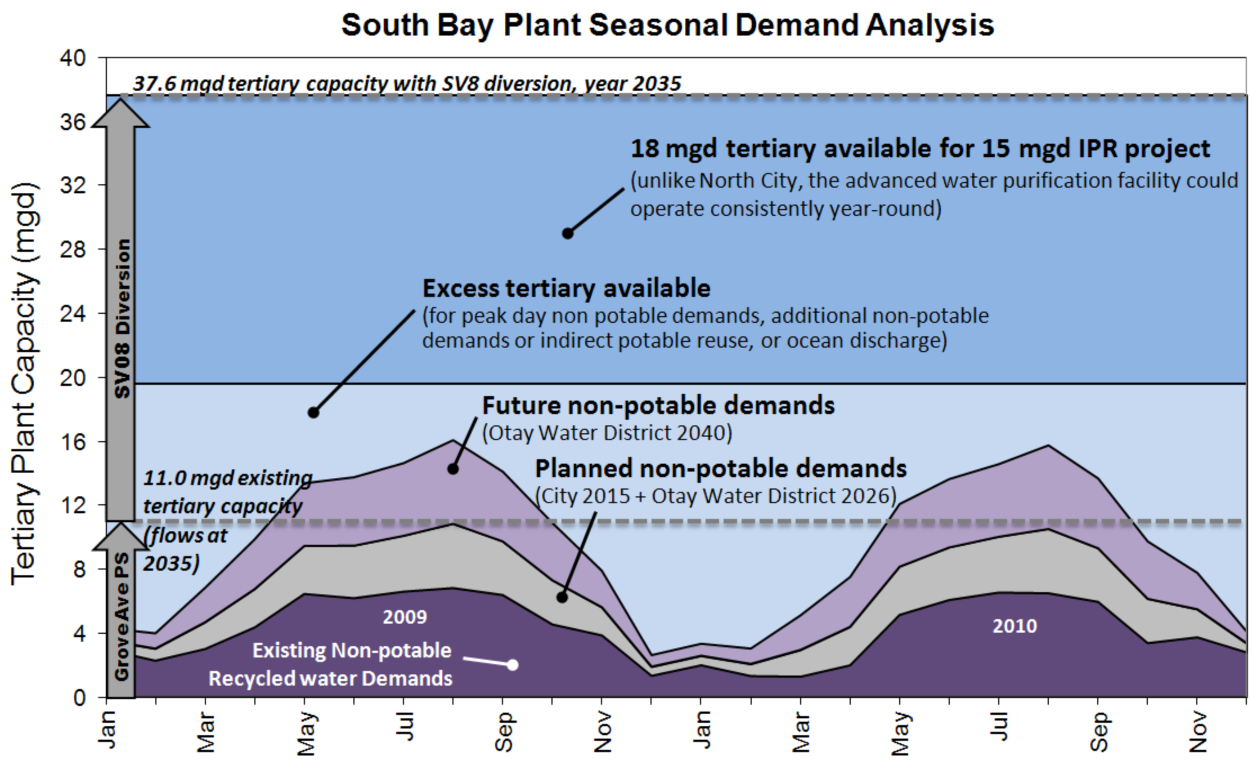


Figure 5-5. Seasonal Demand Analysis at the South Bay Plant

The planned South Bay Plant Spring Valley 8 (SV8) Diversion creates a different situation than the North City Plant. The SV8 Diversion provides enough wastewater to produce treated water to meet non-potable needs and a base loaded Advanced Water Purification Facility/indirect potable reuse project. Excess treated water could be used to meet the difference between peak day demands (peak month demands shown) or additional reuse. The South Bay Plant would be expanded from 15 mgd to approximately 45 mgd (influent capacity). The tertiary capacities shown are lower than influent capacities due to treatment losses. Additional treatment losses occur between the tertiary and advanced purification processes for indirect potable reuse projects.

6. INDIRECT POTABLE REUSE OPPORTUNITIES

The Study evaluated two primary approaches to water reuse. Chapter 5 summarized the non-potable recycled water opportunities. This chapter describes the technical basis and foundation for developing the indirect potable reuse opportunities. In addition, this chapter also includes discussion on the potential for regulatory changes allowing direct potable reuse and how those changes could impact the indirect potable reuse opportunities. The project opportunities outlined in this Chapter were considered for incorporation into the Area Concepts described in Chapter 7 and then developed further into the Integrated Reuse Alternatives described in Chapter 8.

6.1 Indirect Potable Reuse Summary

Indirect potable reuse is the planned addition of purified recycled water to domestic drinking water (potable water) supplies. The term "indirect" refers to the distinction that the purified water is mixed with a natural water source prior to delivery to customers. The purified recycled water meets rigid state and national water quality standards, and is often of higher quality than the natural water (or untreated water) with which it is mixed. The two general categories related to indirect potable reuse are groundwater recharge and reservoir augmentation. Groundwater recharge involves purifying the water using advanced treatment processes and then recharging the water into groundwater basins with injection wells or through surface spreading. Extraction of the water may involve treatment at the well site. Reservoir augmentation involves purifying the water using advanced treatment processes and then adding the water to a surface water reservoir located upstream of a drinking water treatment plant. The water from the reservoir is then further treated at a downstream drinking water plant before being distributed to customers.

Many communities in the United States and throughout the world are currently practicing or are planning indirect potable reuse projects. The largest and most well-known project in the world has been implemented just north of San Diego in Orange County, California. The Orange County Groundwater Replenishment System, which began operation in January 2008, can produce up to 70 mgd of highly purified recycled water that serves the water demands of nearly 600,000 residents. The project is currently being expanded to 100 mgd with an anticipated operational start-up in 2014. This system requires less than half the energy needed to pump imported water from northern California to southern California and less than one third of the energy required for desalination of seawater.

Indirect potable reuse projects also produce water low in total dissolved solids (TDS), which is helping to improve water quality in areas with impacted water supplies—a major issue for southern California due to high salinity of imported water sources. For example, the Groundwater Replenishment System produced water with final product water having a TDS level from 35 to 50 milligrams per liter (mg/L); whereas, water entering San Vicente Reservoir from January 2009 through July 2011 had an average TDS value of approximately 500 mg/L.

Orange County, CA Groundwater Replenishment Facility. *The Groundwater Replenishment facility is just north of San Diego, and is recharging enough purified recycled water into the groundwater supply to serve 600,000 residents – with a superior water quality that is improving the basin.*

The success of the Groundwater Replenishment System and the many benefits of indirect potable reuse have generated a trend towards this approach. In Riverside County, the City of Riverside, the Western Municipal Water District, and the Eastern Municipal Water District are each planning indirect potable reuse projects. Santa Clara Valley Water District in San Jose is planning a 10 mgd indirect potable reuse project with plans to increase the capacity to 40 mgd. The Los Angeles Department of Water and Power is also planning a 13 to 27 mgd indirect potable reuse project *(Los Angeles Department of Water and Power flows based on the LADWP website, 2011; other project data provided by WateReuse California, 2011)*. Likewise, the trend has increased in San Diego County with the proposed El Monte Groundwater Recharge Project (currently on hold, but indirect potable reuse planning ongoing). The City of Escondido is also considering indirect potable reuse project concepts.

Specific to San Diego County, the current Study concluded that indirect potable reuse presented a greater potential to reduce the amount of wastewater reaching the Point Loma Plant by achieving larger scale and less seasonally dependent options compared to non-potable reuse approaches. Non-potable recycled water is driven by seasonal demands and requires the Point Loma Plant to retain treatment and disposal capacity during low demand periods (such as rain events when irrigation demands decline). Non-potable recycled water also requires maintaining a separate distribution system, separate accounting and billing, and separate testing programs, which impacts costs as described in the cost comparison in Section 5.4.

6.2 Indirect Potable Reuse Benefits

The goal of the 2005 Water Reuse Study was to maximize the available capacities at the North City and South Bay Plants, which amounted to approximately 20 mgd. To achieve this, the 2005 Water Reuse Study, and the related American Assembly Stakeholder group, favored indirect potable reuse with limited expansion of non-potable recycled water approaches. In comparison, this current Recycled Water Study expanded the water reuse potential by considering all the available wastewater in the Metro System available for reuse – up to 215 mgd. The increased scale further reinforced the need to look for larger projects with improved economy of scale. Indirect potable reuse projects provided the needed scope and scale for this purpose. Indirect potable reuse and non-potable recycled water opportunities were debated in the Stakeholder meetings, and the following benefits were highlighted related to indirect potable reuse.

- **Indirect potable reuse maximizes unused plant capacities, is generally not seasonally limited, and provides local control.** When coupled with a non-potable recycled water operation, indirect potable reuse can use the remaining water to maximize the overall plant capacity (as shown in Figure 5-4 of the previous chapter). When not influenced by a non-potable recycled water system, indirect potable reuse plants can deliver water consistently year-round since the delivery points (large surface reservoirs or groundwater basins) are large enough to accommodate constant inflows. Therefore, indirect potable reuse can maximize the ratepayer's investments, particularly at the North City Plant, by using the treatment capacity left over after non-potable recycled water demands are met. (Reference Figure 5-4 in the previous chapter for a graphical representation on how indirect potable reuse utilizes the unused capacity at the North City Plant). Indirect potable reuse also provides a locally controlled water source available to supplement or offset imported water supplies.
- **Indirect potable reuse provides large Point Loma Plant offsets.** Indirect potable reuse can provide water reuse opportunities to reduce flows to the Point Loma Plant and ocean discharges and create a new source of water supply. Ratepayer savings increase further when enough flow is diverted to permit simpler, less costly upgrades at the Point Loma Plant (see the Point Loma Plant offset discussion in Chapter 8). Non-potable reuse opportunities identified in the Study cannot achieve the same level of offset at lower costs.
- **Indirect potable reuse water has a superior ability to improve water quality in Southern California.** Salt management is becoming a key water quality consideration for Southern California. The imported water supply, particularly Colorado River water, has high TDS levels. Indirect potable reuse water would reduce salinity levels in the reservoirs, at homes, and in soils. Local indirect

potable reuse projects could produce water with salinity levels 20 times lower than non-potable recycled water and 10 times lower than the drinking water currently delivered to residents, thereby improving reservoir water quality.

- **Few Limitations in Reuse Application.** Indirect potable reuse provides high quality water that is of equal or better quality than untreated imported water. Therefore, this water has virtually unlimited use opportunities. It is a locally developed sustainable water supply that is uninterruptible and is not affected by outside influences such as drought, water rights, and other supply interruptions.
- **Maximizes sustainability.** Indirect potable reuse is a sustainable water practice since it maximizes the use of an underutilized resource at a local level. The practice reduces the energy use and impacts caused by importing water long distances.

6.3 Indirect Potable Reuse Opportunities

Developing indirect potable reuse concepts requires an understanding of the constraints associated with recycled water supply availability, regulatory framework issues, infrastructure capacities, local runoff and water demands. Indirect potable reuse opportunities were categorized into two scenarios based on the supply source they were integrated with: reservoir augmentation using existing surface water reservoirs and groundwater recharge using existing groundwater basins. Of these two approaches, reservoir augmentation to surface water reservoirs offers the greatest opportunity for maximizing water reuse in the San Diego region. San Diego is fairly limited in groundwater capacity and relies more heavily on surface water reservoirs for storing local and imported water supplies. While there are opportunities to implement groundwater recharge projects in the region, the capacity of such projects is relatively small compared to some reservoir augmentation opportunities. Additional details and discussion regarding indirect potable reuse opportunities for both reservoir augmentation and groundwater recharge projects are presented below.

6.3.1 Reservoir Augmentation Opportunities

The region's surface water reservoirs offer opportunities for indirect potable reuse. The region uses surface water reservoirs to store a majority of its untreated water supply, which originates primarily from the Colorado River and the State Water Project. The untreated water is conveyed from these reservoirs to drinking water treatment plants, and then delivered to customers through a distribution system. The following regional reservoirs were initially considered for this study, which are also shown on Figure 6-1:

- Sutherland Reservoir
- El Capitan Reservoir
- Lake Hodges
- Lake Miramar
- Lake Jennings
- Lake Murray
- San Vicente Reservoir

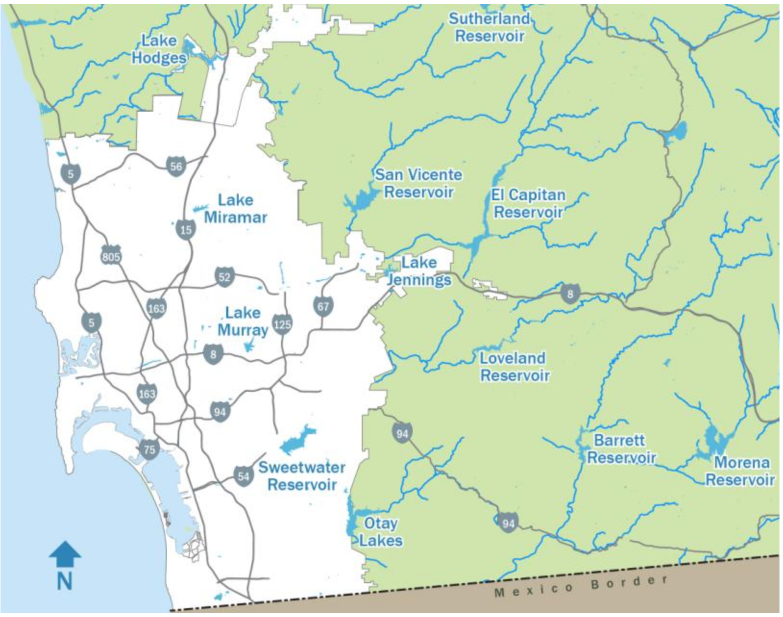


Figure 6-1. Surface Water Reservoirs Considered

- Morena Reservoir
- Barrett Reservoir
- Otay Lakes
- Sweetwater Reservoir

Reservoirs were evaluated and shortlisted based on their size, proximity to infrastructure (which relates to costs), ability to integrate with existing water treatment plants, anticipated characteristics related to regulatory compliance, and institutional complexity. The development of these opportunities and the constraints associated with them were discussed in the Stakeholder review meetings, including a detailed constraints discussion occurring in Status Update Meeting No. 5 held in May 2010.

Table 6-1 summarizes the reservoirs considered and advanced to the Coarse Screening Session. The table also contains the key considerations used in the screening process and discussed at the Stakeholder meetings. The potential project sizing shown was estimated by comparing the candidate reservoirs to the previously planned indirect potable reuse project at San Vicente. San Vicente was used for this purpose since it has been more thoroughly studied and modeled for indirect potable reuse use than any other reservoir in the region. San Vicente Reservoir, Otay Lakes, and Lake Hodges were advanced as candidate indirect potable reuse opportunities.

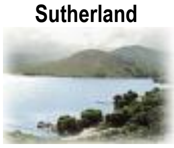
Table 6-1. Surface Water Reservoir Candidates Advanced

Reservoir	Storage Capacity (acre foot)	Indirect Potable Reuse Potential		Key Considerations
		AFY	mgd	
San Vicente (w/ Dam Raise) 	241,312 (89,312 pre-Dam Raise)	100,000	89	Recommended approach from 2005 Water Reuse Study, dam raise increases retention times and potential capacities, ability to distribute throughout the region and to the largest treatment plants.
Lower Otay 	49,849	25,000	22	Previous recommendation from 2005 Water Reuse Study, with proximity to South Bay Plant. Located adjacent to the 33 mgd (2035 capacity) Otay Water Treatment Plant.
Hodges 	30,251	18,000	16	Proximity to Pump Station 77 and available wastewater, City reuse history in San Pasqual area.

Note: Estimated indirect potable reuse project potentials based on adjusting the original San Vicente indirect potable reuse project (20 mgd in a 90,230 AF reservoir for a 2-year retention time) to the other reservoir capacities assuming a one year retention time. The regulatory criteria being developed as part of the Water Purification Demonstration Project will determine the feasible project size.

Table 6-2 summarizes the reservoirs that were considered, but not advanced to the Coarse Screening Session. The table also contains the key considerations used in the screening process and discussed at the Stakeholder meetings. Although Lake Murray and Miramar Lake were considered too small for indirect potable reuse projects at this time, potential project sizes were calculated since they are located at the two largest water treatment plants in the Metro Service Area. In addition, Lake Murray is downstream of the San Vicente Reservoir and may be considered integral with the San Vicente Reservoir opportunity. Lake Miramar could be served from the San Vicente Reservoir by operating the San Diego County Water Authority's new San Vicente Tunnel and San Vicente Pump Station. Lake Jennings could be served by the San Vicente Reservoir, depending on how the Helix Water District manages their supply options.

Table 6-2. Surface Water Reservoir Candidates Not Advanced

Reservoir	Storage Capacity (acre foot)	Indirect Potable Reuse Potential		Key Considerations
		AFY	mgd	
Miramar 	6,682	3,000	3	Too small to meet anticipated regulatory requirements. As the regulatory environment for indirect potable reuse evolves, these requirements may become feasible. Located adjacent to the 215 mgd (2035 capacity) Miramar Water Treatment Plant.
Murray 	4,682	2,000	2	Too small to meet anticipated regulatory requirements. As the regulatory environment for indirect potable reuse evolves, these requirements may become feasible. Located adjacent to the 200 mgd (2035 capacity) Alvarado Treatment Plant.
Jennings 	9,790	-	-	Too small to meet anticipated regulatory requirements; distance from source waters; complex institution issues related to its operation by the Helix Water District and Helix's focus on a groundwater recharge project with the Padre Dam. As the regulatory environment for indirect potable reuse evolves, these requirements may become feasible.
Sweetwater 	28,079	-	-	Small size and institutional issues. Owned by Sweetwater Authority; any indirect potable reuse project would require participation and support from Sweetwater Authority. This includes the Loveland Reservoir.
Sutherland 	29,508	-	-	Distance from key infrastructure resulting in higher costs than other options.
Morena 	50,694	-	-	Distance from key infrastructure resulting in higher costs than other options.
Barrett 	34,806	-	-	Distance from key infrastructure resulting in higher costs than other options.
El Capitan 	112,807	-	-	Distance from key infrastructure resulting in higher costs than other options.

Note: Estimated indirect potable reuse project potentials based on adjusting the original San Vicente indirect potable reuse project (20 mgd in a 90,230 AF reservoir for a 2-year retention time) to the other reservoir capacities assuming a one year retention time (retention times ranging from six months to two years were considered). Sizing was not estimated for screened reservoirs, except Lake Miramar and Lake Murray since they are located adjacent to the two largest drinking water treatment plants in the Metro Service Area.

6.3.2 Groundwater Recharge Opportunities Considered

The region's groundwater basins offer additional opportunities for indirect potable reuse. While San Diego does not possess groundwater basins of the same scale as Los Angeles or northern Orange County, there are potential basins that were considered for indirect potable reuse projects. Groundwater recharge opportunities were conceptualized by locating a new advanced water purification facility. Water treated at this facility would be pumped to the targeted groundwater basin. At the basin, the water would be pumped into injection wells or placed in spreading basins and allowed to percolate into the groundwater aquifer. The method used to add water to the aquifer is dependent upon several factors, including the basin characteristics and geology and the land availability. The advanced treated water blends with native groundwater and is extracted downstream after meeting minimum regulated hydraulic retention times – a minimum amount of time required before extraction to comply with existing groundwater recharge regulations. The groundwater is then extracted using wells, potentially treated at the well (depending on the water quality), and lastly added to the drinking water system.

The following regional groundwater basins were considered for this study and are shown on Figure 6-2:

- El Monte Valley
- San Pasqual
- San Diego Formation
- Mission Valley
- Otay River
- Tijuana
- San Dieguito
- Carmel Valley

Figure 6-2. Groundwater Basins Considered

Evaluations performed during the Study confirmed (similar to the 2005 Water Reuse Study) that groundwater recharge opportunities in San Diego County are more limited than reservoir augmentation due to the size, yields, and characteristics of the local groundwater basins. Of the basins evaluated for groundwater recharge, the San Pasqual Basin was advanced for further consideration. The San Diego Formation was also considered. However, it was determined that limited information was available to develop a detailed alternative comparable to other options. The El Monte Groundwater Recharge Project was also advanced to the Coarse Screening Session.

Table 6-3 summarizes the groundwater basins advanced to the Coarse Screening Session. The table also contains the key considerations used in the screening process and discussed at the Stakeholder meetings. The potential project sizing shown was estimated by comparing the candidate basins to the El Monte Valley basin using a six month hydraulic retention time. The El Monte basin was used for this purpose since it has been more thoroughly studied and modeled for groundwater recharge than any other basin in the region.

Table 6-3. Groundwater Basin Candidates Advanced

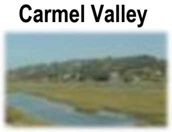
Reservoir	Storage Capacity (acre foot)	Indirect Potable Reuse Potential		Key Considerations
		AFY	mgd	
El Monte Valley (or similar project) 	10,000 to 50,000	5,000	4.5 to 5.0	The El Monte basin was evaluated by the Helix Water District and the Padre Dam Municipal Water District for an indirect potable reuse groundwater augmentation project. This project was coordinated with this Study since wastewater flows for this project affect downstream wastewater availability in the Metro System. Although this project is currently on hold, it or a similar project could further offload the wastewater system and provide valuable new water to the region. The status of this project is anticipated to be tracked as an Implementation Step.
San Pasqual 	58,000 to 73,000	2,900 to 11,600	2.6 to 10.4	The San Pasqual basin has several characteristics suitable for an indirect potable reuse project – proximity to wastewater, a history of reuse, City owned land, and detailed background information. Recharge may also improve degraded groundwater upstream of Lake Hodges, and the shallow portions of the basin may be suitable for meeting regulatory requirements. These benefits are countered by some limitations. The basin has a large tributary area with suitable blending supplies, but not a lot of volume for blending. There are numerous existing potable and agricultural wells in the area that would require meeting certain regulatory provisions. Also, the San Pasqual basin, and more importantly its connectivity to Lake Hodges, is complex from an institutional standpoint. Lake Hodges water can be transported to the Santa Fe Irrigation District, San Dieguito Water District and Olivenhain Municipal Water District and also includes SDCWA operations. While this does not eliminate San Pasqual from consideration, challenging permitting and institutional issues would need to be addressed.

Notes:

- *Basin storage capacity derived from Department of Water Resources Bulletin No. 118 and SDCWA Groundwater Report, dated June 1997.*
- *Reuse potential sizing calculated by comparing the candidate basin to the El Monte Groundwater Recharge Project. El Monte Groundwater Recharge Project data based on recent studies provided by Helix Water District. Potential sizing shown based on a six month retention time, consistent with recent regulatory trends (three month to two year retention times were considered).*

Table 6-4 summarizes the groundwater basins not advanced to the Coarse Screening Session. The table also contains the key considerations used in the screening process and discussed at the Stakeholder meetings. As noted previously, the San Diego Formation was closely considered for advancement to the Coarse Screening Session; however, the lack of information prevented this alternative from being fully developed into a comparable option. The ongoing work between the City and United States Geological Service regarding the San Diego Formation will allow re-visiting this option in future planning efforts. The remaining basins not advanced were eliminated from consideration based on a variety of reasons, including: infrastructure needs leading to higher costs, small size, water quality issues, liquefaction potential, and institutional complexity.

Table 6-4. Groundwater Basin Candidates Not Advanced

Reservoir	Storage Capacity (acre foot)	Indirect Potable Reuse Potential AFY	Indirect Potable Reuse Potential mgd	Key Considerations
San Diego Formation 	40,000 to 90,000 (up to 960,000)	0 to 25,000	0 to 22.3	The San Diego Formation is a large basin with good potential However, additional background information is necessary to develop a project. The City and the United States Geological Survey are currently studying the basin, which will help determine whether this basin would yield beneficial indirect potable reuse projects (which would be considered in future master plans). Other key concerns included seawater intrusion and the heavily developed nature of the overlying coastline near downtown San Diego. The Otay River portion of this basin was also assessed and eliminated from further consideration due to it small size and distance.
Mission Valley 	40,000 to 42,000	0 to 2,000	0 to 1.8	The Mission Valley Basin has certain benefits including simpler institutional issues and an improved ability to get water into and out of the basin. However, it is generally too narrow and too shallow for injection wells. The basin was recently identified as having some connectivity to the San Diego Formation (discussed above). Seawater intrusion, liquefaction potential, localized pollutant plumes, and the highly developed lands overlying the basin were additional considerations. Although the Mission Valley Basin was not considered further for groundwater recharge at this time it should be considered in future studies.
Tijuana 	50,000 to 80,000	0 to 2,000	0 to 1.8	The Tijuana Basin has some shallow areas (approximately 30 percent of the basin) that may be suitable for indirect potable reuse. However, the basin water quality is compromised by sewage and untreated industrial discharges in the upper layer and salt water intrusion when over-pumped. Extracted water from the basin can be poor quality and would likely require additional treatment in excess of normal conditions. In addition, the basin has extensive riparian vegetation, and extraction of groundwater could have a significant environmental impact on this habitat. These factors and less costly reservoir augmentation choices in South Bay eliminated this basin from further consideration.
San Dieguito 	52,000 to 63,000	1,600 to 10,800	1.4 to 9.6	The upper portion of the San Dieguito Basin may be suitable for groundwater recharge using spreading basins and shallow injection wells. This approach was conceptualized in the 2005 Water Reuse Study. The Olivenhain Municipal Water District has also been studying this basin. The basin is in proximity to a portion of the City's existing non-potable recycled water distribution system. However, substantial infrastructure would still be required. In addition, institutional complexity, community group concerns, liquefaction potential, and limited high value land factored into eliminating this basin from further consideration.
Carmel Valley 	-	-	-	The Carmel Valley Basin is relatively small, and seawater and urban influences may prove challenging. Therefore, this basin was not considered further.

Notes:

- *Basin storage capacity derived from Department of Water Resources Bulletin No. 118 and SDCWA Groundwater Report, dated June 1997.*
- *The San Diego Formation total size has been estimated at 960,000 AF (not including the Sweetwater Basins), but 40,000 to 90,000 AF of storage is considered useable at this time. Ongoing efforts to understand the extents and ability to use this basin will help provide a better foundation for future studies.*
- *Reuse potential sizing calculated by comparing the candidate basin to the El Monte Groundwater Recharge Project. El Monte Groundwater Recharge Project data based on recent studies provided by Helix Water District. Potential sizing shown based on a six month retention time, consistent with recent regulatory trends.*

6.4 Direct Potable Reuse Considerations

Direct potable reuse opportunities were conceptualized during this Study, but were not included as proposed options at this time since they are currently not allowed in California. . The concepts considered during the Study included:

- Conveying purified water from an advanced water purification plant facility at the North City Plant to the Miramar Water Treatment Plant.
- Conveying purified water from an advanced water purification plant facility at the South Bay Plant to the Otay Water Treatment Plant.
- Conveying purified water from an advanced water purification plant facility near Harbor Drive to the Alvarado Water Treatment Plant.

Further development of these concepts will likely occur once there is a framework for how the California Department of Public Health (CDPH) will regulate these projects. While California Senate Bill SB-918 (reference Appendix D) included development of a feasibility study for uniform criteria, the timing and scope of actual requirements will remain unclear until 2016 or later. However, there is continued interest and support being generated for direct potable reuse, such as the January 2012, National Water Resource Institute white paper entitled, *"Direct Potable Reuse: Benefits for Public Water Supplies, Agriculture, the Environment, and Energy Conservation"* (also included in Appendix G). This paper summarizes important benefits and considerations, and cites successful projects in New Mexico and Texas.

Even though the future is unclear for direct potable reuse, the concepts were considered in terms of how they would affect the recommended indirect potable reuse projects in this Study. Potential impacts contemplated included additional treatment processes and monitoring at advanced water purification facilities (added costs) and reduced piping and pumping (cost savings) since deliveries could be made more directly to treatment plants and/or the aqueduct system. Additional considerations are listed in the implementation section of this report.

7. AREA CONCEPTS

Area Concepts were constructed to provide detailed, comparable options for discussion at the Coarse Screening Session and Stakeholder meetings. Area Concepts included non-potable recycled water opportunities from Chapter 5 and indirect potable reuse opportunities from Chapter 6. Area Concepts were developed as the first step in preparing the integrated reuse alternatives discussed later in this Report. Figure 7-1 displays the process of developing opportunities into Area Concepts. Area Concepts were refined at the Fine Screening Session, evaluated according to the Study's goals and project criteria, and then compiled into the Integrated Reuse Alternatives presented in Chapter 8.

Opportunities
Non-potable recycled water (Chapter 5)
Indirect potable reuse (Chapter 6)

Area Concepts
(with multiple options - Chapter 7)

Integrated Reuse Alternatives
(Chapter 8)

Figure 7-1. Area Concepts Were Constructed to Provide Detailed, Comparable Options for Discussion at the Coarse Screening Session and Stakeholder meetings

7.1 Area Concept Sub-regions

Area Concepts were organized into three sub-regions within the Metro Service Area, as shown on Figure 7-2. These sub-regions were selected based on: 1) having wastewater available to reclaim in sufficient quantities, 2) being able to expand existing facilities or having land available to build new facilities, and 3) a need for the water produced (non-potable recycled water customers, surface water reservoirs and/or groundwater basins). The three sub-regions included:

- **North City/San Vicente.** The northern portion of the Metro Service Area, which could be served by the North City Plant or a new treatment plant along the Metro System corridor from Mission Valley to Pump Station No. 2 along Harbor Drive.
- **South Bay.** The southern portion of Metro Service Area currently served by the South Bay Plant with the potential to divert additional wastewater from the South Metro Interceptor.
- **Rancho Bernardo/San Pasqual Area.** The northern portion of the Metro Service Area that could be served by a new treatment facility located in Rancho Bernardo adjacent to Pump Station 77.

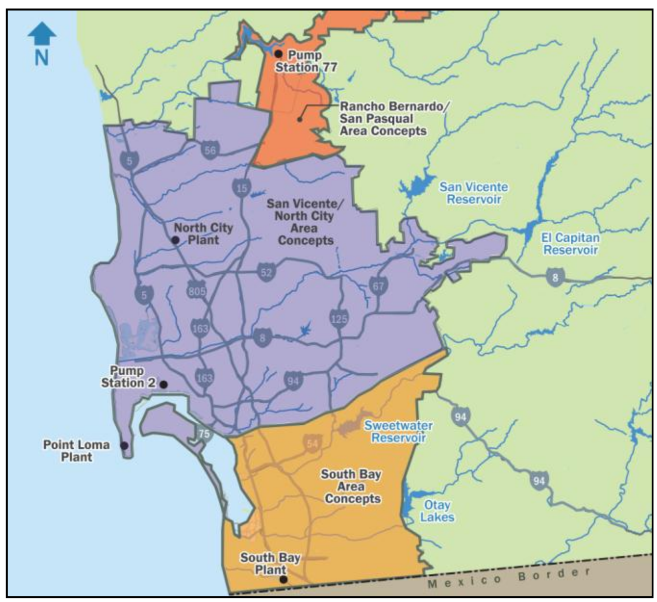


Figure 7-2. Area Concept Sub-regions
Area Concepts were developed for three sub-regions of the Metro System

7.2 Area Concept Background

Area Concept Presentations. *The Coarse Screening and Fine Screening Sessions included analysis of Area Concepts. Teams studied the opportunities, developed projects, and presented their concepts to the participants.*

As noted above, the three Area Concepts involved combining non-potable recycled water opportunities and indirect potable reuse opportunities. Non-potable recycled water opportunities were sized based on the information provided in Chapter 5. Indirect potable reuse opportunities were sized by comparing the available wastewater supplies (summarized in Chapter 4) to the indirect potable reuse capacity potential (summarized in Chapter 6). The Area Concepts were then created by identifying feasible treatment and conveyance facilities. Each Area Concept included three options to provide participants at the Coarse and Fine Screening Sessions the ability to compare the benefits of different approaches within each area. These options were labeled consistently for each Area Concept and were referred to as Option A, Option B, and Option C.

Capital cost and operation and maintenance costs were developed for each option within each area. Other project costs, including engineering, administration, legal, environmental permitting, construction management, land acquisition, and project contingencies, were also included. The infrastructure layouts and the costs were topics of major discussions at the Coarse and Fine Screening sessions and Stakeholder Status Update Meetings.

Pumping was also an important component in developing the Area Concepts. Pumping affected capital and operational costs and was an important sustainability consideration. Pumping is influenced by physical parameters such as the distance pumped and the elevation difference between the sending and receiving locations. The distance and elevation parameters were established by where wastewater was available and the delivery point for the newly created water (either to non-potable recycled water customers or indirect potable reuse projects using a surface water reservoir or groundwater basin). Pumping is also affected by the flow rates needed to serve the opportunities. Flow rates were affected by the type of water being pumped which varied by option. As water is treated to higher degrees, less of it needs to be pumped since a portion has been removed through the process as waste streams. Considering the type of water pumped as a guideline for how projects should be developed, projects that pumped advanced purified water were preferred over projects that pumped wastewater long distances. The following relates flow rates to the type of water pumped:

- **Advanced Water Purification Facility/Indirect Potable Reuse Water.** Most ideal water to pump within the considered options. Indirect potable reuse water requires pumping approximately 15 percent less flow than pumping tertiary treated water and approximately 28 percent less flow than pumping wastewater.
- **Tertiary Treated Water/Non-potable Recycled Water.** Tertiary treated water requires pumping approximately 15 percent more flow than pumping indirect potable reuse water and approximately 13 percent less flow than pumping wastewater.
- **Wastewater.** Most costly and energy intensive (and difficult to pump from an odor control perspective). Wastewater requires pumping approximately 13 percent more flow than pumping tertiary treated water and approximately 28 percent more flow than pumping indirect potable reuse water. This water has the greatest potential impact if spilled, including adverse environmental impacts.

7.3 Initial North City/San Vicente Area Concepts

The North City/San Vicente Area Concepts played an important role in this Study similar to previous efforts. The 2005 Water Reuse Study affirmed that the San Vicente Reservoir was an ideal location to maximize the use of the treated water produced at the North City Plant through indirect potable reuse. Since the 2005 Water Reuse Study, the San Vicente Reservoir Dam Raise Project has begun. The Dam Raise Project will increase the reservoir storage capacity from approximately 89,000 AF to 241,000 AF and is scheduled for completion in 2013 to 2014. The increased reservoir size and operational flexibility to move water throughout the region keeps San Vicente Reservoir the focal point for advancing water reuse in this area.

***San Vicente Dam Raise**. The San Vicente Reservoir expansion (architectural rendering shown above) and its integration with regional facilities make it an ideal candidate for indirect potable reuse.*

The Coarse Screening Session presented three Area Concepts for the North City/San Vicente Area, as shown on Figure 7-3. Option A: Morena included a Morena wastewater diversion which pumped additional wastewater to the North City Plant. Option B: Mission Gorge included a new water reclamation facility and advanced water purification plant to supplement indirect potable reuse water from the North City concept. Option C: Mission Valley was similar to the Morena Options, and included a wastewater diversion that pumped additional flows to the North City Plant. The diversions included in Option A and C allowed increasing the capacity of the North City Plant, while Option B evaluated a plant located closest to the planned delivery source. These options were targeted based on their favorable locations along major trunk sewers in the Metro System, which resulted in greater availability of wastewater for reuse.

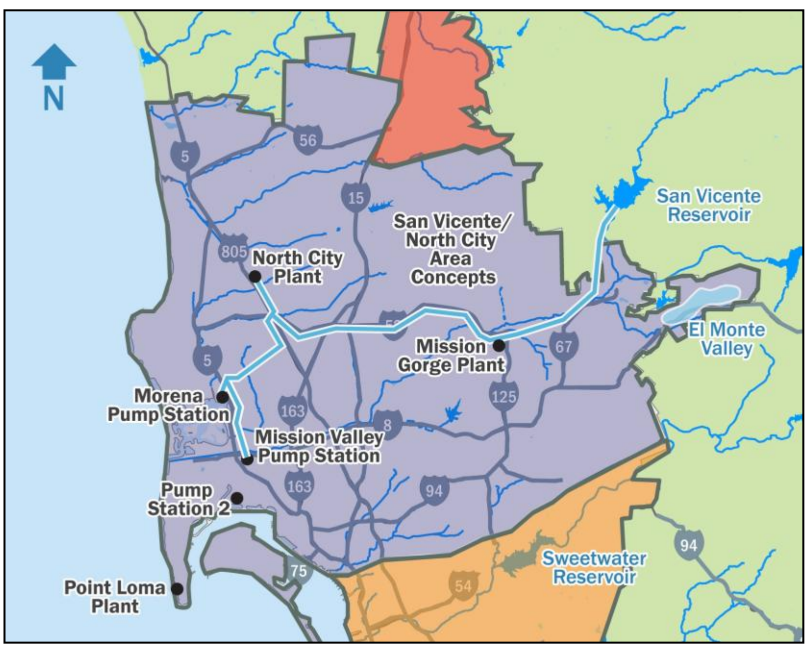


Figure 7-3. Initial North City/San Vicente Area Concepts

Three options were presented at the Coarse Screening Session. The options were later refined to include a new plant closer to Pump Station 2. The El Monte Valley project (by other agencies) was also considered due to its impact on Metro System flows.

The key task for the workshop participants was balancing a variety of considerations for each option. These included: finite existing reclamation capacities and the decision whether to divert new flows to increase capacity; the potential for new treatment plants to increase supplies; the location and capacity of the delivery points for non-potable recycled water (customers) and indirect potable reuse (reservoirs or groundwater basins); costs; environmental benefits; risks; and the ability to implement. The work session participants also considered the effects and timing of the El Monte Groundwater Recharge Project, currently being planned by the Helix Water District and Padre Dam. The El Monte Groundwater Recharge Project is an indirect potable reuse groundwater recharge project that would recharge groundwater supplies in the El Monte Valley in Lakeside, California. This project was considered since it affects the amount of wastewater diverted in the Mission Gorge area just before Padre Dam's Metro System connection. Coarse Screening Session participants agreed that the El Monte Groundwater Recharge Project should be assumed to occur, and it was sequenced with the alternatives developed in the Study.

7.3.1 Coarse Screening Session Conclusions on North City/San Vicente Area Concepts

Coarse Screening Session participants provided valuable input and ideas for the North City/San Vicente Area Concepts. Participants considered numerous permutations of the three core options and discussed the benefits of each. The biggest concern from participants was related to the Mission Valley component (which affected all three options). Pumping larger quantities of wastewater, a long distance to the North City Plant was cited as adding costs and risks. Another concern was that once the master planned capacity of North City was reached at 45 mgd, construction costs increase dramatically since existing facilities would need to be demolished, additional land may be needed, and the construction methods on the new facilities is more expensive due to site constraints. Work session participants suggested modifications to refine the North City/San Vicente Area Concepts for the Fine Screening Session. The revisions provided a new, larger-scale advanced water purification facility located between Mission Valley and Pump Station No. 2 along Harbor Drive.

7.3.2 Modifying the North City/San Vicente Area Concepts

The major refinement stemming from the Coarse Screening Session was changing the Mission Valley diversion that pumped wastewater to the North City Plant into a new advanced water purification facility with water delivered directly to the San Vicente Reservoir. The new plant site was targeted within a corridor, aligned along the North Mission Valley Interceptor in Mission Valley and the North Metro Interceptor ending at Pump Station No. 2 adjacent to the San Diego International Airport. Siting a new large-scale plant is difficult in most locales and even more so in the highly-developed, high-value areas of San Diego, such as this corridor. However, the region's ability to maintain the high quality of life and land values is predicated on having clean, renewable water resources – a need that promotes prudent investments in infrastructure.

7.3.3 Preliminary Siting Evaluation

A preliminary siting assessment was conducted from the east end of the targeted corridor at Qualcomm Stadium to the west end at Pump Station No. 2. At the eastern end of this corridor, the City owns several acres of land at and adjacent to Qualcomm Stadium. A majority of the land in the area is used for stadium activities and parking for trolley passengers. The majority of the remaining City-owned land is located along the San Diego River. The City owns a 17 acre vacant site on the south side of the San Diego River, which is referred to as the Camino Del Rio site. This is the location of the City's former aquaculture recycled water demonstration site that has since been removed. The City has planned for a water reclamation plant at this site for a number of years.

Placing a plant at the west end of the corridor would put its location at a Harbor Drive site located adjacent to the City's Pump Station No. 2 facility. The Harbor Drive site is located at the confluence of the City's two largest interceptor sewers: the North Metro Interceptor and the South Metro Interceptor. At this location, a majority of the wastewater generated by the Metro System collects before being pumped to the Point Loma Plant. The 22 acre site is currently occupied by several agencies (San Diego Fire Rescue Department, San Diego Police Department, San Diego Community College District, and San Diego County Sheriff Department). These agencies have historically indicated their willingness to relocate on the condition that a more suitable site is found.

Since the site is occupied by multiple agencies and recognizing that there are competing uses for this site, the Public Utilities Department engaged in discussions with the San Diego Fire Rescue Department, San Diego Police Department, San Diego Community College District, San Diego County Sheriff Department, San Diego Redevelopment Agency, and the San Diego Real Estate Assets Department. The meetings were conducted to discuss the feasibility of using this site for the purposes described in this Study. The Public Utilities Department initiated the process of determining costs and requirements for relocating the site's current occupants and evaluated alternative sites for the proposed treatment facilities. The siting analysis identified vacant tracks of land with 17 to 23 acres of properly zoned land adjacent to wastewater facilities and available for the proposed facilities. The Harbor Drive site was compared to a site adjacent to wastewater Pump Station No. 1 in National City, Fiesta Island, and Qualcomm Stadium. The siting analysis is included in Appendix E. These other sites proved more expensive and obtrusive than the Harbor Drive site (even without land acquisition costs which were not available for the analysis). Therefore, Harbor Drive was advanced as the targeted site in this Study, along with the existing North City and South Bay Plants and the concept plant at Mission Gorge. Continued siting work is a key implementation step outlined in Chapter 8.

7.3.4 Harbor Drive Site's Strategic Importance

The Harbor Drive site provided substantial benefits and cost savings compared to the locations considered above. The following summarizes the key features unique to this site:

- **Provides Cost Benefits.** The Harbor Drive site provides the following cost benefits:
  - **Facility Cost Savings.** Locating the proposed facilities at the Harbor Drive Site requires the least amount of infrastructure, which reduces capital costs and the operational and maintenance costs related to these additional facilities.
  - **Co-location Savings.** Co-locating the facility adjacent to Pump Station No. 2 and the water quality lab concentrates City staff at a single location and helps increase efficiency and minimize duplicative staffing needs (such as administrative support and security personnel).
  - **Operational Savings.** The ability to efficiently operate year-round (described further below) saves operational costs and maximizes the utilization of the investment.

Related Facilities at the Harbor Drive Site. *The Harbor Drive site already accommodates Pump Station No. 2 (the largest wastewater pump station in San Diego) and the Environmental Monitoring and Technical Services Division facility (shown above), which houses the City's water quality laboratory. Co-locating a new plant at this site saves costs, increases flexibility and reduces risks.*

- **Provides Flexibility.** A majority of the Metro System wastewater flows collect at the Harbor Drive site before being pumped to the Point Loma Plant. This volume of flow, estimated at 105 to 120 mgd (depending on the alternative and amount of reuse completed upstream) provides the following important benefits in regards to operational flexibility:

- **Efficient, Base-loaded Operation**. The amount of wastewater at the proposed Harbor Drive Plant would allow the advanced water purification facility to operate at a consistent flow year-round. Plants with constant output are more efficient to operate saving costs.
- **Ability to Peak During High Demands.** The excess amount of wastewater to treat at Harbor Drive site would allow the plant to treat and produce even higher advanced purified water flows during the summer. Although this is not as efficient as the baseline operation described above, it could provide more water to local drinking water treatment plants when demands are highest. Indirect potable reuse output at the North City, South Bay and Mission Gorge Plants is limited by the amount of wastewater available and the occurrence of peak summer non-potable recycled water demands.
- **Flexibility to Meet Future Needs.** This location, with its converging high flow wastewater pipelines, provides excess wastewater that would allow future expansion of advanced water purification facilities (if desired). This provides flexibility to adapt to direct potable reuse opportunities (pending regulatory changes) and other groundwater opportunities (including the nearby San Diego Formation) that may prove feasible in future planning updates.
- **Maximizes Use of Existing Assets**. The Harbor Drive site allows disposal of brine to the Point Loma Plant by using the existing Pump Station No. 2 facility, which would be adjacent to the plant.

- **Reduces Risk.** The Harbor Drive site minimizes risk through the following benefits:
  - **Consolidation of Odor Control**. The need for odor control is consolidated to an existing impacted site (the Harbor Drive site adjacent to Pump Station No. 2) rather than at two locations (Pump Station No. 2 and an alternative site).
  - **Reduced Wastewater Pumping.** This site limits the risks and added pumping costs associated with conveying wastewater across the City to an alternative plant location and conveying waste streams back to Pump Station No. 2.

7.3.5 Harbor Drive Facility Options to Minimize Site Needs

The revised North City/San Vicente Area Concepts considered ways to limit or reduce the area needed for the Harbor Drive Plant facilities (its footprint) at the Harbor Drive site recognizing that it may be limited and has multiple City uses proposed. Two approaches were considered:

- **Split Plant.** To lessen the footprint needed at the Harbor Drive site, options were developed that located the water reclamation portion of the plant at Harbor Drive to treat wastewater to non-potable tertiary levels and located the advance water purification facility processes to generate indirect potable reuse water at the Camino Del Rio site in Mission Valley. This approach does not receive the same economy of scale cost benefits from having the treatment facilities combined; but, it does limit the siting needs at both sites should future detailed siting studies identify constraints or costly construction impacts. The revised Area Concepts described below that use this approach are labeled as Theme A1 and Theme B1.
- **Consolidated Plant.** The second approach to lessen the facility footprint was to build all the treatment processes at Harbor Drive. The footprint is consolidated by eliminating the redundant facilities needed at two separate locations (such as administration and security elements). Therefore a consolidated approach provides a more efficient approach and lower operational costs compared to split plants. However, construction costs may be higher depending on final needs, sizing, and land availability (which may require more vertical construction methods to fit plant components in a smaller footprint). The revised Area Concepts described below that use this approach are labeled as Theme A2, Theme B2, and Theme B3.

7.4 Revised North City/San Vicente Area Concepts

Due to the emerging importance of the Harbor Drive site and the additional flows available at this site, the North City/San Vicente Area Concepts were revised to increase overall water reuse. A multi-phase approach was used to develop a minimum of 65 mgd of advanced treated water for indirect potable reuse (the reuse target is described further in Chapter 8). These totals are in addition to existing and planned non-potable recycled water flows at the North City Plant. The North City Area Concepts were developed into two major themes to reach this goal, each having sub-themes that differ according to whether the Harbor Drive facility would be split between the Harbor Drive and Camino Del Rio sites, or be consolidated at the Harbor Drive site. Figure 7-4 summarizes the projects and sequential steps of the A and B Themes (Chapter 8 includes additional details on the numbering system used to define these Area Concepts).

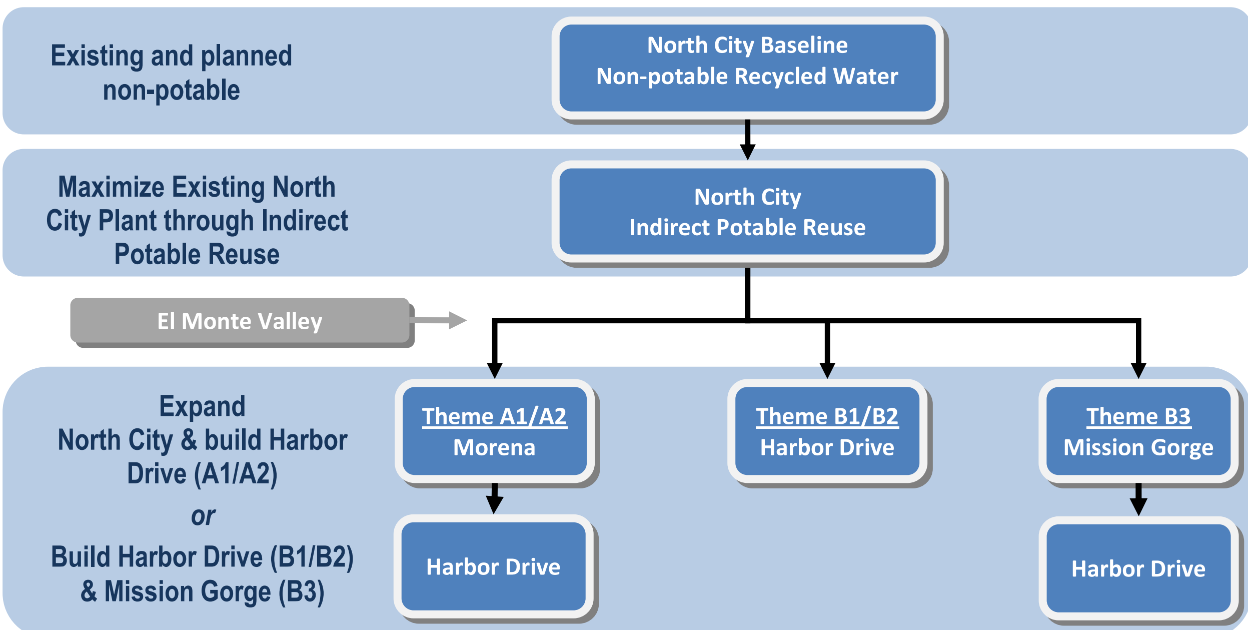


Figure 7-4. Refined North City/San Vicente Area Concepts

The Area Concept themes are summarized as follows. Table 7-1 summarizes the elements included in each Area Concept Theme.

- **North City/San Vicente Theme A – Maximize the North City Plant Master-Planned Capacity of 45 mgd.** The North City Plant was master planned to expand from its existing 30 mgd capacity to 45 mgd. Option A (from the initial Area Concepts summarized above) consists of a diversion at Morena that diverts enough flow to the North City Plant to meet this master-planned treatment capacity of 45 mgd (reference Chapter 4 for inflows into the plant). The diverted flows allow serving existing and planned non-potable recycled water demands amounting to 9.1 mgd, an initial indirect potable reuse project sized at 15.0 mgd, and a second phase indirect potable reuse project sized at 11.9 mgd. The indirect potable reuse projects include water deliveries to the San Vicente Reservoir. The 40.9 mgd remainder of the water reuse target is met by a Harbor Drive Plant and indirect potable reuse project to the San Vicente Reservoir. The Harbor Drive Plant is smaller for the A Themes, since more flows are treated at the North City Plant.

- **North City/San Vicente Theme B – Maximize the North City Plant Existing Capacity of 30 mgd.** The B Themes were developed to take advantage of the strategic importance of the Harbor Drive site including the ability to maximize the economy of scale of a larger, consolidated plant at this location. The B Themes maximize the existing North City Plant capacity of 30 mgd by serving existing and planned non-potable demands of 9.1 mgd and a North City indirect potable reuse project sized at 15mgd (similar to the A Themes). The difference with the B Themes is that no further diversions occur to the North City Plant. The remainder of the water reuse target is met by a 52.8 mgd Harbor Drive Plant and indirect potable reuse project to the San Vicente Reservoir (Theme B2), or a combination of a 46.0 mgd Harbor Drive Plant and a 6.8 mgd Mission Gorge Plant (Theme B3).

Table 7-1. North City/San Vicente Area Concept Summary – Included Elements

Elements in the Area Concept	A1	A2	B1	B2	B3
Add more Existing non-potable recycled water	✓	✓	✓	✓	✓
Planned non-potable recycled water (through 2015)	✓	✓	✓	✓	✓
Maximize the North City Plant to its 45 mgd master planned capacity	✓	✓			
Maximize the North City Plant to its existing 30 mgd capacity			✓	✓	✓
Initial North City indirect potable reuse to San Vicente	✓	✓	✓	✓	✓
North City expansion using the Morena Diversion with indirect potable reuse to San Vicente	✓	✓			
Harbor Drive Plant with indirect potable reuse water deliveries to San Vicente Reservoir	✓	✓	✓	✓	✓
Harbor Drive consolidated Water Reclamation Plant/Advanced Water Purification Facilities (WRP/AWPF)		✓		✓	✓
Harbor Drive WRP/Camino Del Rio AWPF split plant	✓		✓		
Mission Gorge indirect potable reuse to San Vicente					✓

Table 7-2 includes the flows associated with each element and the overall offload at the Point Loma Plant.

Table 7-2. North City/San Vicente Area Concept Summary – 2035 Dry Weather Flows

Theme	Harbor Drive AWPF Location	North City Non-potable Recycled Water (mgd)	Indirect Potable Reuse Water (mgd)			Offloading (mgd)	
			North City	Harbor Drive	Mission Gorge	New Facilities	New & Existing Facilities
A1	Camino Del Rio (Mission Valley)	9.1	26.9	40.9	0	67.8	76.9
A2	Harbor Drive	9.1	26.9	40.9	0	67.8	76.9
B1	Camino Del Rio (Mission Valley)	9.1	15.0	52.8	0	67.8	76.9
B2	Harbor Drive	9.1	15.0	52.8	0	67.8	76.9
B3	Harbor Drive	9.1	15.0	46.0	6.8	67.8	76.9

Notes:

- *Reuse totals shown are average annual values. The Study analysis also accounted for seasonal influences. See Figure 5-4.*
- *Point Loma Plant offloads are for 2035 Dry Weather Conditions and are calculated both with and without North City non-potable recycled water flows. The financial analysis included costs and benefits only for the new facilities identified in this Study. Non-potable reuse offloading is also not included during 2050 wet weather events for estimating direct and indirect wastewater systems savings (see Chapter 8 and Appendix H for further details).*
- *The flows shown are 2035 projections. All proposed plants have startup dates between 2020 and 2035. Startup prior to 2035 will have lower flows initially; however, the interim flows are projected to be 90- to 95-percent of the 2035 flows (reference Table 4-2).*
- *The El Monte Groundwater Recharge Project plans to inject 5 mgd of IPR water into the El Monte Valley groundwater basin. The El Monte project is currently on hold, but Padre Dam and Helix Water District continue to plan for this or a similar indirect potable reuse project. While the flows for this project are not shown in the table above, they were accounted for and coordinated with Reuse Projects in this Study.*

Table 7-3 summarizes the type of water being pumped for each theme. In general, the B Themes had the least pumping requirements since they maximized pumping high quality advanced purified water that already had waste streams removed.

Table 7-3. North City/San Vicente Area Concept Summary – Pumping

Area Concept and Key Differentiator	Type of Water Pumped
A1 Morena Diversion to North City Harbor Drive WRP with AWPF at Camino Del Rio	Wastewater Tertiary Water (for non-potable demands) Advanced Purified Water (for indirect potable reuse)
A2 Morena Pump Diversion to North City	Wastewater Advanced Purified Water (for indirect potable reuse)
B1 Larger Harbor Drive WRP with AWPF at Camino Del Rio	Tertiary Water (for non-potable demands) Advanced Purified Water (for indirect potable reuse)
B2 Larger Harbor Drive WRP/AWPF	Advanced Purified Water (for indirect potable reuse)
B3 Larger Harbor Drive WRP/AWPF Mission Gorge WRP/AWPF	Advanced Purified Water (for indirect potable reuse)

7.4.1 North City/San Vicente Themes A1 and A2

The A Themes were developed to maximize the 45-mgd master-planned treatment capacity potential at the North City Plant. The key aspects of these approaches are summarized below.

Theme A1

Theme A1, displayed in Figure 7-5, includes the following key elements:

- Serves existing non-potable demands.
- Serves planned non-potable demands that increase through 2015.
- Maximizes the master-planned tertiary capacity at North City Plant at 45 mgd.
- Includes a North City Advanced Water Purification Facility to produce indirect potable reuse water and deliver it to the San Vicente Reservoir.
- Includes a North City Water Reclamation Plant/Advanced Water Purification Facility expansion to increase indirect potable reuse flows to the San Vicente Reservoir (via diverted wastewater from the Morena Pump Station).
- Includes a Harbor Drive Water Reclamation Plant (tertiary plant).
- Locates the Harbor Drive Advanced Water Purification Facility at Camino Del Rio (Mission Valley) to reduce space requirements at the Harbor Drive site. This facility would produce indirect potable reuse water for delivery to the San Vicente Reservoir.
- Requires two brine lines to avoid re-circulating high salinity brine discharges.

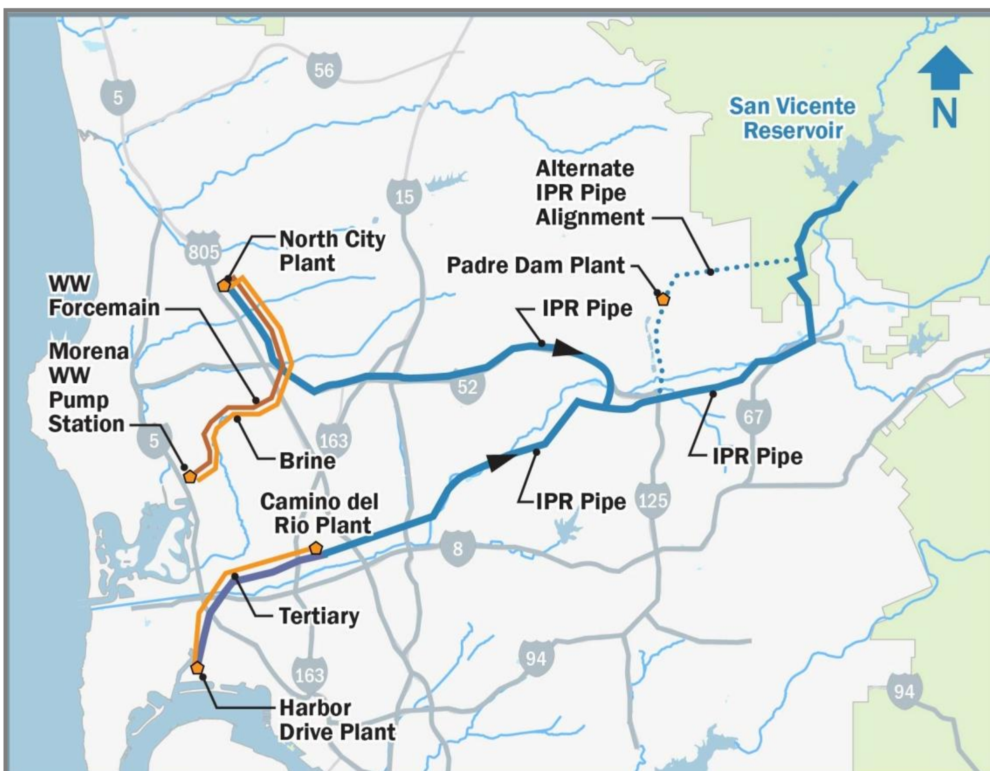


Figure 7-5. Schematic of Theme A1

Theme A2

Theme A2, displayed in Figure 7-6, includes the following key elements:

- Serves existing non-potable demands.
- Serves planned non-potable demands that increase through 2015.
- Maximizes the master-planned tertiary capacity at North City Plant at 45 mgd.
- Includes a North City Advanced Water Purification Facility to produce indirect potable reuse water and deliver it to the San Vicente Reservoir.
- Includes a North City Water Reclamation Plant/Advanced Water Purification Facility expansion to increase indirect potable reuse flows to the San Vicente Reservoir (via diverted wastewater from the Morena Pump Station).
- Includes a Harbor Drive Water Reclamation Plant (tertiary plant) and co-located Advanced Water Purification Facility (indirect potable reuse plant). This facility would produce indirect potable reuse water for delivery to the San Vicente Reservoir.
- Requires a brine lines to avoid re-circulating high salinity brine discharges.

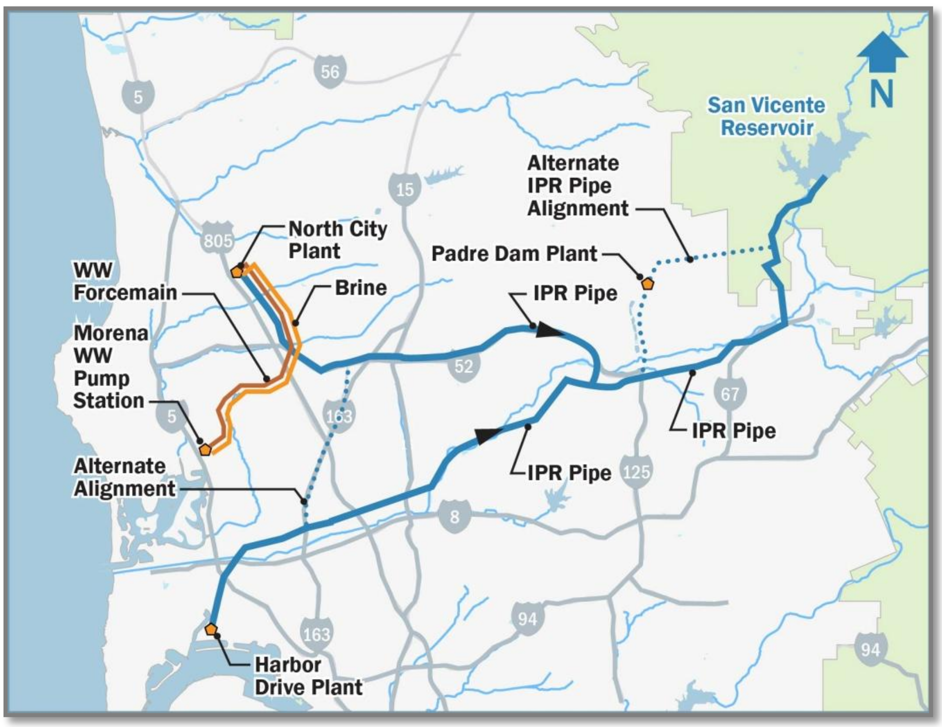


Figure 7-6. Schematic of Theme A2

7.4.2 North City/San Vicente Themes B1, B2 and B3

The B Themes were developed to maximize the existing treatment capacity of 30 mgd at the North City Plant. The key aspects of these approaches are summarized below.

Theme B1

Theme B1, displayed in Figure 7-7, includes the following key elements:

- Serves existing non-potable demands.
- Serves planned non-potable demands that increase through 2015.
- Maximizes the existing tertiary capacity at North City Plant at 30 mgd.
- Includes a North City Advanced Water Purification Facility to produce indirect potable reuse water and deliver it to the San Vicente Reservoir.
- Includes a Harbor Drive Water Reclamation Plant (tertiary plant).
- Locates the Harbor Drive Advanced Water Purification Facility at Camino Del Rio to reduce space requirements at the Harbor Drive site. This facility would produce indirect potable reuse water for delivery to the San Vicente Reservoir.
- Requires a brine lines to avoid re-circulating high salinity brine discharges.

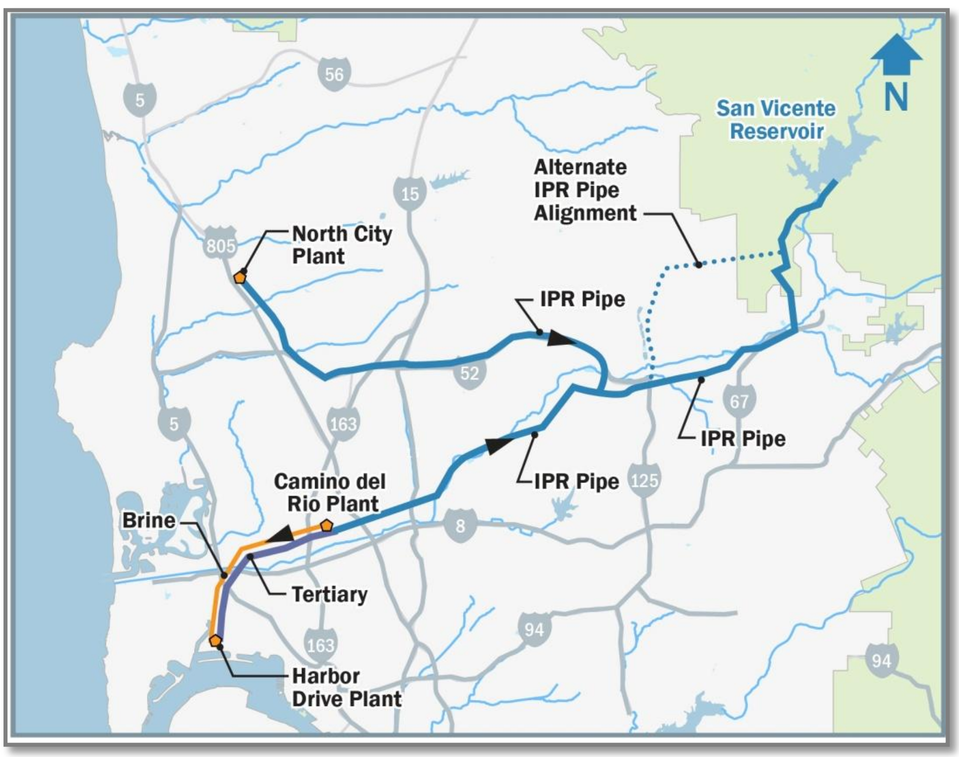


Figure 7-7. Schematic of Theme B1

Theme B2

Theme B2, displayed in Figure 7-8, includes the following key elements:

- Serves existing non-potable demands.
- Serves planned non-potable demands that increase through 2015.
- Maximizes the existing tertiary capacity at North City Plant at 30 mgd.
- Includes a North City Advanced Water Purification Facility to produce indirect potable reuse water and deliver it to the San Vicente Reservoir.
- Includes a Harbor Drive Water Reclamation Plant (tertiary plant) and co-located Advanced Water Purification Facility (indirect potable reuse plant). This facility would produce indirect potable reuse water for delivery to the San Vicente Reservoir.

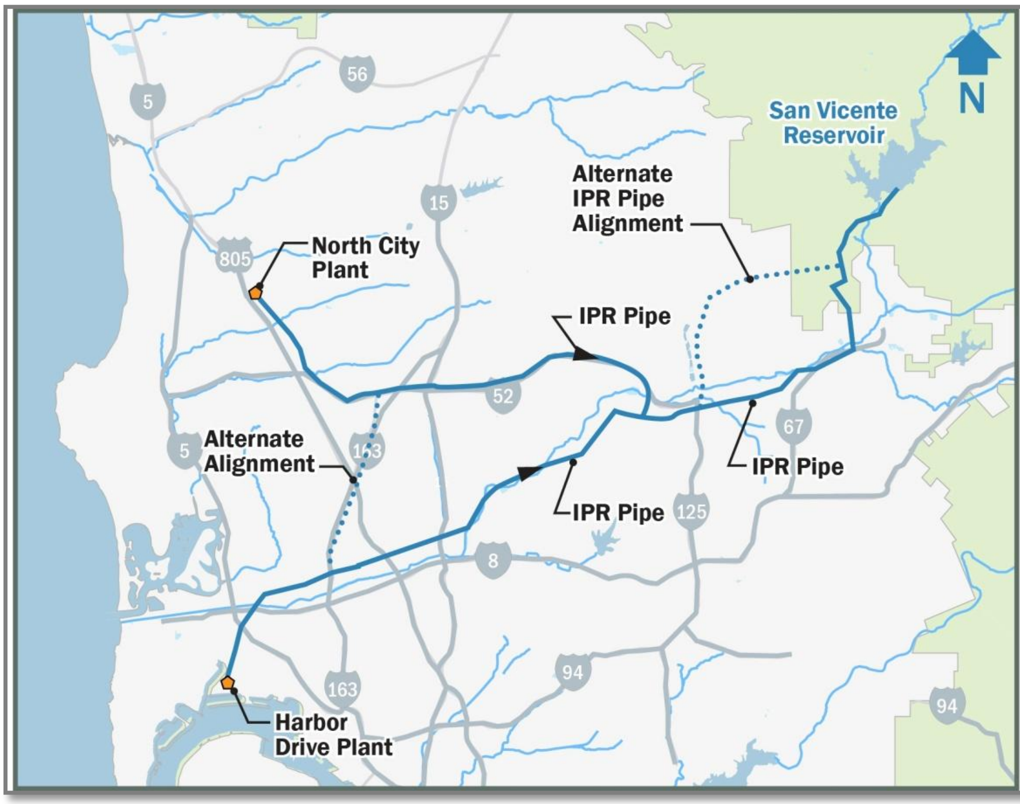


Figure 7-8. Schematic of Theme B2

Theme B3

Theme B3, displayed in Figure 7-9, includes the following key elements:

- Serves existing non-potable demands.
- Serves planned non-potable demands that increase through 2015.
- Maximizes the existing tertiary capacity at North City Plant at 30 mgd.
- Includes a North City Advanced Water Purification Facility to produce indirect potable reuse water and deliver it to the San Vicente Reservoir.
- Includes a Harbor Drive Water Reclamation Plant (tertiary plant) and co-located Advanced Water Purification Facility (indirect potable reuse plant). This facility produces indirect potable reuse water for delivery to the San Vicente Reservoir.
- Includes a Mission Gorge Water Reclamation Plant (tertiary plant) and co-located Advanced Water Purification Facility (indirect potable reuse plant). This facility would produce indirect potable reuse water for delivery to the San Vicente Reservoir.

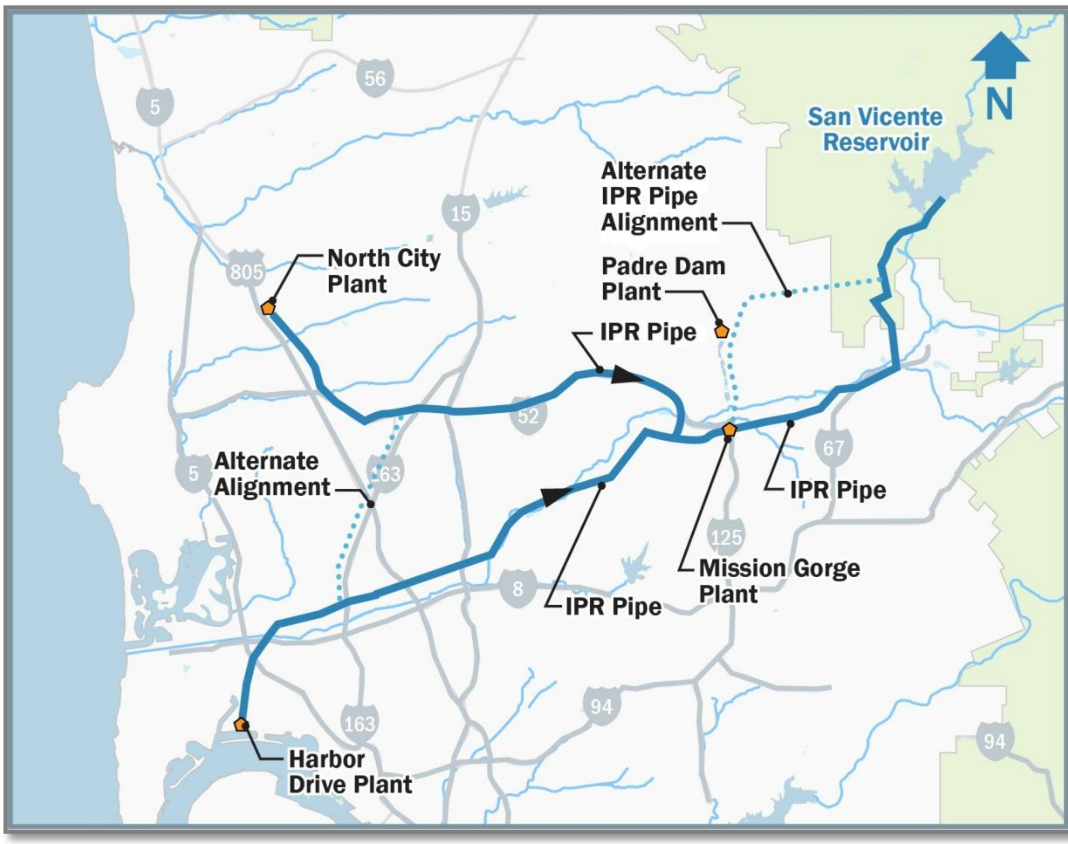


Figure 7-9. Schematic of Theme B3

Note: The Mission Gorge Plant may be co-located with the Padre Dam Plant. A siting study would be required to determine the most appropriate location.

7.5 South Bay Area Concepts

Similar to the original North City/San Vicente Area Concepts, the South Bay Area Concepts also included three options. The alternatives were titled South Bay Option A, Option B and Option C. Each option included baseline non-potable recycled water demands for South Bay (as described in Chapter 5). These baseline non-potable recycled water demands included existing flows at the South Bay Plant, planned flows through 2015 for City retail customers, and 2026 contracted flows with Otay. Each option then provided differing non-potable recycled water and indirect potable reuse approaches. The Options were presented at the Coarse Screening Session and are summarized in Figure 7-10 and Table 7-4. An additional Option, labeled C2 and also shown below, was added based on feedback at the Coarse Screening Session to consider diverting additional wastewater to the South Bay Plant. South Bay Option C2 played an important role in shaping the Integrated Reuse Alternatives as this option was included in all of the final Integrated Reuse Alternatives described in Chapter 8. Figure 7-11 displays the facilities included in this Option.

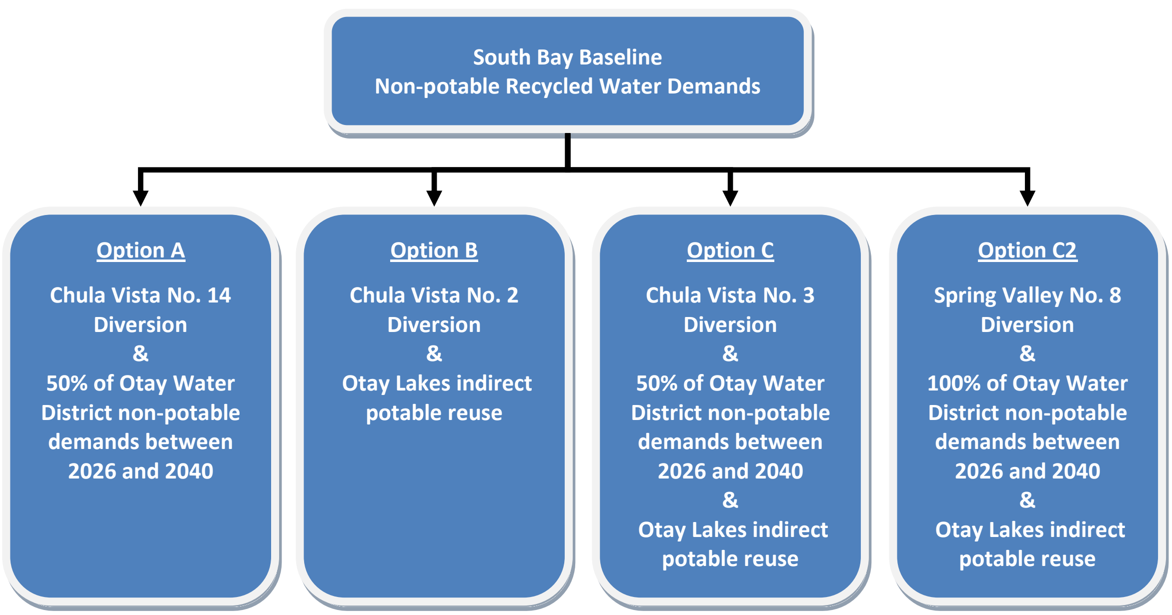


Figure 7-10. Schematic of South Bay Options

Table 7-4 summarizes the elements included in each Area Concept.

Table 7-4. South Bay Area Concepts Summary – Included Elements

Elements in the Area Concept	A	B	C	C2
Existing non-potable recycled water	✓	✓	✓	✓
Planned non-potable recycled water (2015 City/2026 OWD)	✓	✓	✓	✓
Future non-potable recycled water (1.5 mgd for OWD)	✓		✓	
Future non-potable recycled water (3.0 mgd for OWD)				✓
Diversion to South Bay	CV14	CV2	CV3	SV8
South Bay indirect potable reuse to Otay Lakes		✓	✓	✓

Notes: Acronyms used in this table include: OWD = Otay Water District; CV = Chula Vista; SV = Spring Valley.

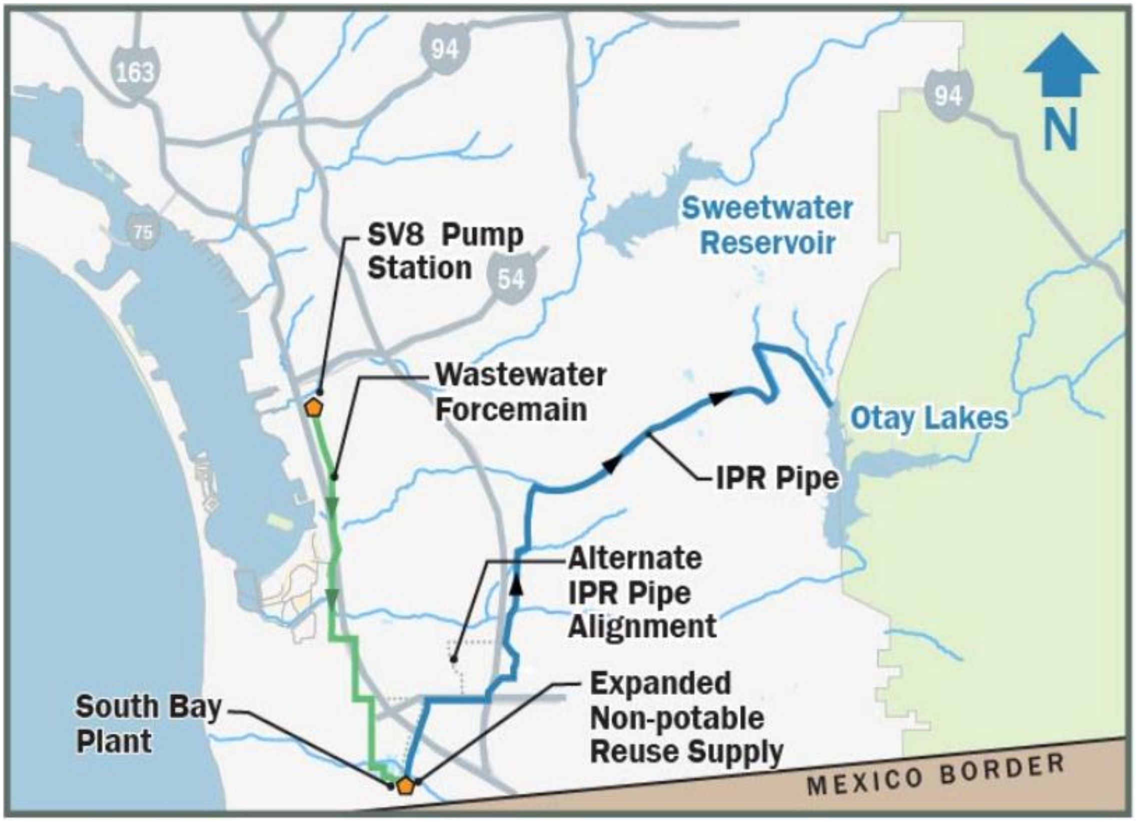


Figure 7-11. South Bay C2 Area Concept

The South Bay C2 Area Concept was advanced to the Integrated Reuse Alternatives described in Chapter 8. The South Bay configuration will ultimately need to be coordinated with the City's September 2011 Draft Wastewater Master Plan, also described in Chapter 8.

7.5.1 South Bay Wastewater Diversions

A key consideration for the South Bay system was determining how much flow needs to be diverted to provide wastewater for the various South Bay Area Concepts. By 2035, the Grove Avenue Pump Station is projected to convey approximately 12.9 mgd of wastewater to the South Bay Plant (Dry Weather Flow). This is not enough to serve the opportunities identified for this area. Additionally, new diversions are needed to increase water reuse in South Bay and further offload the Point Loma Plant in coordination with the City's September 2011 Draft Wastewater Master Plan.

Flow diversions to South Bay have been studied and planned by the City for some time. Interim diversions are also being discussed by the City, Otay, and the City of Chula Vista (Chula Vista). The South Metro Interceptor conveys wastewater northward through Chula Vista and National City toward the Point Loma Plant. Several potential diversion locations generally correspond to where Participating Agency trunk sewers connect to the South Metro Interceptor. Table 7-5 includes the flows available at specific metered locations and the estimated equivalent tertiary treated water (non-potable recycled water) after treatment losses. Figure 7-12 provides a schematic representation of the potential diversion points and flows.

Table 7-5. Wastewater and Tertiary Water Availability in 2035 for South Bay

Tributary Sewer	Wastewater Diversion to South Bay (mgd)		Tertiary Water Available for IPR and Non-potable Reuse (mgd)
	Potential	Cumulative	
Grove Avenue Pump Station (Existing)	12.9	12.9	11.0
Imperial Beach/Palm City	3.8	16.7	14.2
Salt Creek Trunk Sewer CV14	6.2	22.9	19.5
Chula Vista CV2	5.0	27.9	23.8
Chula Vista CV3	2.1	30.0	25.7
Spring Valley Trunk Sewer SV8	14.0	44.0	37.6

Note: Totals shown are annual averages. Wastewater flows based on SANDAG Series 12, with reduced unit generation rates and dry weather conditions. Flows prior to 2035 are lower per Table 4-3. Available tertiary water is after treatment losses of approximately 13 percent.

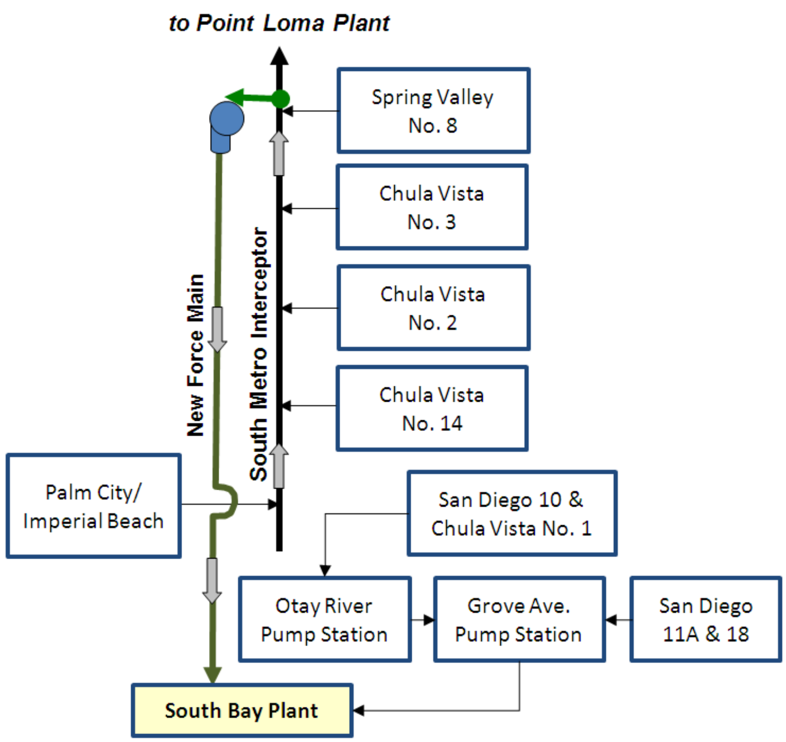


Figure 7-12. South Bay Wastewater Diversions

Different diversion points were considered to redirect wastewater to the South Bay Plant. Although moving the diversion point north increases infrastructure costs, the additional flow increases water reuse opportunities and creates a valuable new water resource.

7.5.2 South Bay Area Concepts Flow Summary

Table 7-6 summarizes the non-potable recycled water and the indirect potable reuse water produced for each of the area concepts.

Table 7-6. South Bay Area Concepts Summary

Option	Tributary Sewer and Point of Diversion	Average Annual Reuse (mgd)	
		Non-potable Recycled Water	Indirect Potable Reuse
South Bay A	Chula Vista No. 14	7.5	0.0
South Bay B	Chula Vista No. 2	6.0	14.5
South Bay C	Chula Vista No. 3	7.5	14.5
South Bay C2	Spring Valley No. 8	9.0	15.0

Notes:

- *Reuse totals shown are average annual demands. The Study analysis also accounted for seasonal influences. See Figure 5-5.*
- *Point Loma Plant 2035 offloads are calculated both with and without the existing Grove Avenue Pump Station. The financial analysis included avoided cost benefits, but only for new facilities identified in this Study.*

7.5.3 Wet Weather Flow Considerations at South Bay

South Bay was considered for further utilization since it has an outfall with available capacity. The concept sizing presented above is based on 2035 Dry Weather Flows, which is appropriate since these are the reliable wastewater supplies that can be depended upon throughout the year for reuse purposes. However, the South Bay Plant sizing is also influenced by the overall wastewater disposal strategy during peak wet weather events. Appendix H summarizes how the concepts presented above were compared to the City's September 2011 Draft Wastewater Master Plan disposal strategy and its critical flow criteria of 2050 Peak Wet Weather Flows, including a 10-year return event.

7.6 Rancho Bernardo/San Pasqual Area Concepts

Three Rancho Bernardo/San Pasqual Area Concepts were presented at the Coarse Screening Session. These Area Concepts include a new water reclamation plant located adjacent to Pump Station 77. Pump Station 77 currently pumps City wastewater to the City of Escondido Hale Avenue Resource Recovery Facility (Hale Avenue Plant). The contracted flow from Pump Station 77 to the Hale Avenue Plant is 5.3 mgd. Building a new treatment facility at Pump Station 77 would allow reusing this water for non-potable recycled water demands at nearby golf courses and landscaping, or for a new indirect potable reuse in the San Pasqual Groundwater Basin or downstream at Lake Hodges. The Rancho Bernardo/San Pasqual Area Concepts are relatively small compared to the other Area Concepts considered in the Study and do not offload flows from the Point Loma Plant.

7.6.1 Rancho Bernardo/San Pasqual Area Concept Options

Three options were developed for the Rancho Bernardo/San Pasqual Area Concepts. These options are summarized in Figure 7-13 and were presented at the Coarse Screening Session. The following summarizes the options:

- **Rancho Bernardo/San Pasqual Option A: Rancho Bernardo/I-15 Corridor Non-potable.** Option A included serving non-potable recycled water opportunities identified in the City's Rancho Bernardo area and the northern portion of the City of Poway. This area includes multiple golf courses. Option A did not include an indirect potable reuse project.
- **Rancho Bernardo/San Pasqual Option B: San Pasqual Indirect Potable Reuse.** San Pasqual Option B included developing an indirect potable reuse project that used the lower San Pasqual groundwater basin. Water would be either recharged or injected at the easterly end of the lower basin and extracted at the west end of the basin just upstream of Lake Hodges. The extracted water would be treated and then delivered to the City's potable water system at the Rancho Bernardo Reservoir. This option did not include serving non-potable reuse demands.
- **Rancho Bernardo/San Pasqual Option C: San Pasqual Indirect Potable Reuse.** San Pasqual Option C was an alternative to Option B. It included an indirect potable reuse project that recharged/injected advance purified water into the lower San Pasqual basin. The difference between Options B and C is that Option C allowed the recharge water to supply Lake Hodges, which could then be extracted through the Olivenhain Dam Pump Storage project and transferred through the San Diego County Water Authority untreated water conveyance system to the City of San Diego and other water agencies.

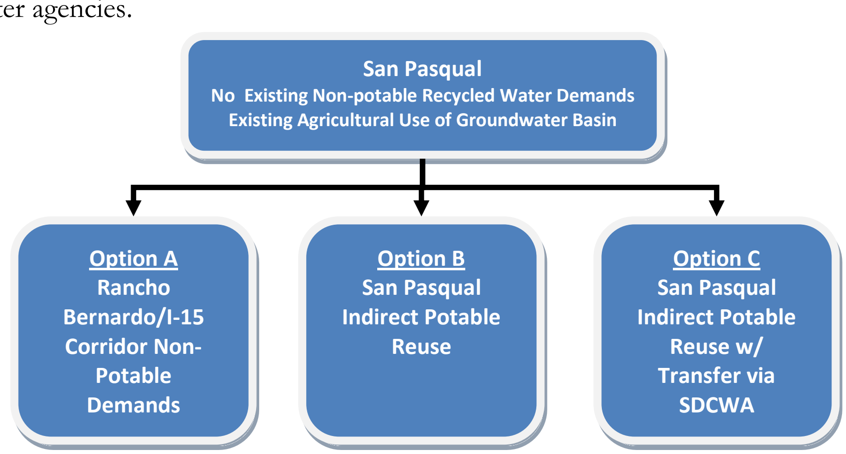


Figure 7-13. Schematic of Rancho Bernardo/San Pasqual Area Concepts.

7.6.2 Rancho Bernardo/San Pasqual Area Concept Conclusions

The Rancho Bernardo/San Pasqual options presented at the Coarse Screening Session are shown on Figures 7-14 through 7-16. The participants concluded that the Rancho Bernardo/San Pasqual Area Concepts provided limited benefits compared to the North City and South Bay Area Concepts. The Rancho Bernardo/San Pasqual Area Concepts did not offload flows to the Point Loma Plant (a major Study goal), provided limited water supply benefits, and were more costly. Therefore, these Area Concepts were not advanced to the Coarse Screening Session. However, it was recognized that the area has substantial non-potable recycled water demand and that a project similar to Option A should be considered for a development offset project, or a privately funded project led by the benefitting customers.

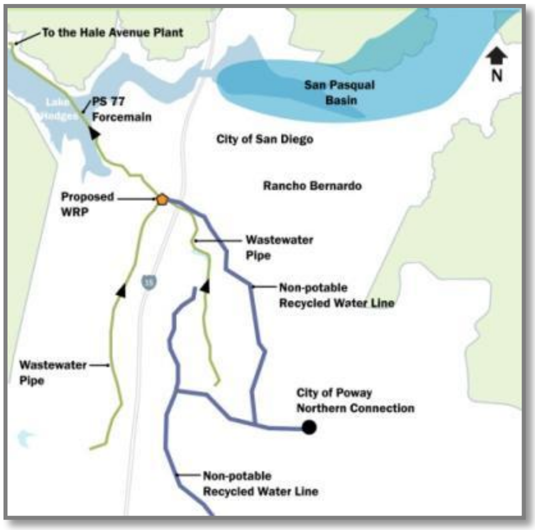


Figure 7-14. Rancho Bernardo/San Pasqual Option A

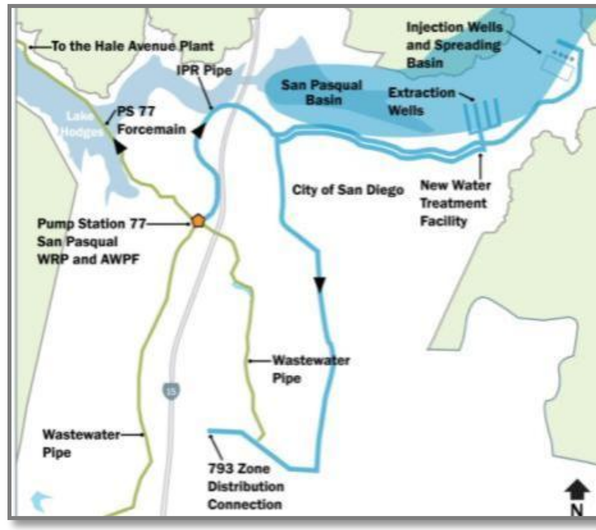


Figure 7-15. Rancho Bernardo/San Pasqual Option B

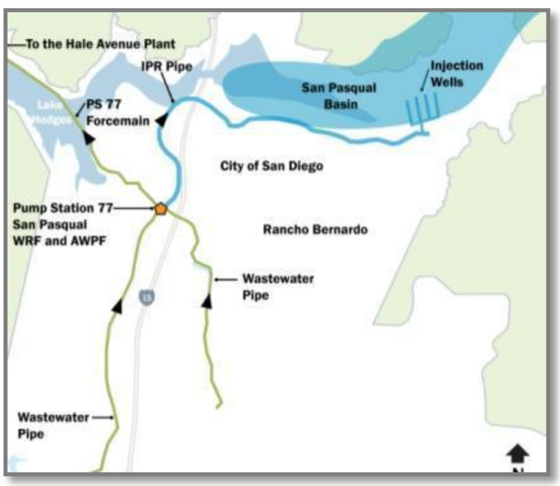


Figure 7-16. Schematic of Rancho Bernardo/San Pasqual Option C

Figures 7-14 through 7-16. Rancho Bernardo/San Pasqual Area Concepts. *The Rancho Bernardo/San Pasqual Area Concepts were smaller in scale than other reuse options, did not offload flows to the Point Loma Plant, and the indirect potable reuse projects would be institutionally complex to implement. However, non-potable recycled water Option A was identified as a possible development offset project or a candidate for private funding.*

7.7 Area Concept Conclusions

The Stakeholder group and the work session participants agreed that the Area Concepts provided appropriate project elements for further refinement in the Fine Screening Session, and ultimately into the Integrated Reuse Alternatives presented in this Report.

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8. INTEGRATED REUSE ALTERNATIVES

Integrated Reuse Alternatives were prepared for policy makers to review, examine, and debate as part of establishing the course for water reuse in the region. The Integrated Reuse Alternatives were compiled from the foundational elements summarized in previous chapters, as shown on Figure 8-1. Integrated Reuse Alternatives were based on the project goals established by the project Stakeholders, the criteria developed at the Framework Planning Session, the screening work performed at the Coarse Screening Session, and the revision and refinement steps performed at the Fine Screening Session and subsequent Stakeholder Status Update Meetings. This chapter first summarizes the water reuse target that influenced these approaches and then summarizes each approach, benefits, considerations, costs, and key implementation steps.

Opportunities
Non-potable recycled water (Chapter 5)
Indirect potable reuse (Chapter 6)

Area Concepts
(with multiple options - Chapter 7)

Integrated Reuse Alternatives
(Chapter 8)

Figure 8-1. Integrated Reuse Alternatives are Area Concepts Compiled to Meet a Water Reuse Target Based on the Study's Goals and Objectives

8.1 Establishing the Study's Water Reuse Target

The size and scope of the projects included in the Integrated Reuse Alternatives were selected to achieve a water reuse target. The water reuse target used in the work sessions and used in the Stakeholder Status Update Meetings was approximately 100 mgd. The following summarizes the considerations that led to developing this water reuse target and the confirmation step that involved a comparison to the City's September 2011 Draft Wastewater Master Plan.

8.1.1 Previous and Current Study Target Basis

The water reuse target, similar to past efforts, was based on Study goals, Stakeholders' input, and findings from preliminary technical analyses. The goal of the 2005 Water Reuse Study was to maximize the available capacities at the North City and South Bay Plants, which coincided with a target of approximately 20 mgd for future water reuse projects. This 2012 Study was initiated with a broader basis: to consider the water reuse goal to be limited *only* by the amount of wastewater available in the Metro Service Area. This is a more comprehensive goal, providing the potential to reuse ten times more water than previous targets.

8.1.2 Water Supply Considerations for the Water Reuse Target

As highlighted in Chapter 2, multiple forces are driving water reuse in Southern California. Water reuse projects produce high-quality, reliable, uninterruptible local water to the region, serving the same purpose as imported untreated water. Imported untreated water rates will continue to rise, and the San Diego County Water Authority may have to build new conveyance system improvements to deliver more imported water to the region's drinking water treatment plants—unless the supply is supplemented with new local supplies. Indirect potable reuse can fulfill this need and over time do so at lower costs. Based on these considerations, the reuse target for this study, especially the indirect potable reuse portion, should be maximized.

8.1.3 Water Quality Considerations for the Water Reuse Target

Two water quality considerations were taken into account in establishing a water reuse target: ocean water quality and imported water salinity. Both are important, and both would be significantly improved through implementation of the water reuse projects identified in this Study. For example, blending advanced purified water with imported water in San Vicente Reservoir and Otay Lakes could reduce salinity levels by 50 percent. Ocean water quality would also improve by removing and diverting solids to the Metropolitan Biosolids Center. On land, the reservoirs that receive the advanced purified water, the residents that use the water, and the soil that is irrigated with the water would benefit from having water with up to half the current salinity levels. Residents would benefit from softer water through extended lives of household appliances such as water heaters, dishwashers, clothes washers and faucets. Based on these considerations, the water reuse target for this Study should be maximized.

8.1.4 Project Size Considerations for the Water Reuse Target

Project sizing (summarized in Chapter 5 for non-potable recycled water opportunities and Chapter 6 for indirect potable reuse opportunities) was considered a limiting factor in developing the water reuse target. Non-potable recycled water projects, while beneficial for targeted areas (such as Otay Water District's planned system expansion), did not have enough demand potential to use a substantial portion of the available wastewater. It also became apparent that developing indirect potable reuse projects to use all wastewater available in the Metro System would not be practical, or provide the right balance of costs and benefits. Therefore, the water reuse target based on project constraints and permit considerations was approximately 80 to 120 mgd (upper end based on estimated regulatory flow limits to the San Vicente Reservoir in conjunction with the South Bay Spring Valley No. 8 Diversion).

8.1.5 Cost Considerations for the Water Reuse Target

As seen with the Groundwater Replenishment Project in Orange County, San Diego has the potential to save substantial costs by investing in water reuse projects instead of certain expensive upgrades of the wastewater system. The savings achieved by investing in the water reuse system in lieu of wastewater system upgrades are referred to as avoided cost savings. The biggest avoided cost identified in this Study is savings related to avoided treatment upgrade costs at the Point Loma Plant. While benefits at the Point Loma Plant are just one of many candidate cost incentives for the City's reuse program, they are the largest and most clearly connected to the recycled water program expansion.

Savings at the Point Loma Plant. *Avoided costs at the Point Loma Plant played an important role in establishing reuse targets. The land available at Point Loma Site is constrained, and any upgrades incur high costs.*

Leading up to the Fine Screening Sessions, a reuse target of approximately 100 mgd was established in part from cost benefits derived by avoiding upgrades at the Point Loma Plant. At 100 mgd, and based on dry weather flows, certain treatment processes (primarily Biological Aerated Filters (BAF)) were avoided. This target was later checked against a wet weather scenario in the City's September 2011 Draft Wastewater Master Plan that included 2050 annual average daily flows with a 10-year return flow event. While the increased flow condition no longer allowed avoiding BAF at Point Loma, there were other benefits. The reduced flows to Point Loma resulting from the reuse program avoided the need for high rate clarifiers, reduced the amount of expensive BAF upgrades needed at the constrained Point Loma Plant site, and reduced operating costs at Pump Stations 1 and 2. For South Bay, the key analysis revolved around the timing of plant improvements and what costs should be attributable to the water system, the wastewater system and the existing reuse system. Multiple scenarios were evaluated to assess the costs. While the scenarios varied, the Net Cost results were within +/- $100/acre-foot of each other and the previous results. Therefore the Study's conclusions remained consistent with the initial evaluation. A summary of the Point Loma, South Bay, and related facilities analysis is included in Appendix H.

8.2 Integrated Reuse Alternatives Summary

The Integrated Reuse Alternatives were grouped into "A" and "B" alternatives, and sub-alternatives "1," "2" and "3." Table 8-1 summarizes the elements in each alternative. The table is followed by a description of the alternatives and the numbering. Additional background on their origin is provided in Chapter 7. Each alternative included projects common to all alternatives and alternative-specific components. The four common elements included: non-potable recycled water demands served by the North City and South Bay Plants, an initial 15 mgd North City Plant indirect potable reuse project to the San Vicente Reservoir, a South Bay Plant 15 mgd indirect potable reuse project to Otay Lakes using the Spring Valley No. 8 Diversion, and a 5 mgd El Monte Groundwater Recharge Project. Conceptual flow schematics of the Alternatives are provided in Appendix K.

Table 8-1. Integrated Reuse Alternative Summary - Elements Included

Elements in the Area Concept	A1	A2	B1	B2	B3
Elements from the North City/San Vicente Area Concept Themes					
Existing non-potable recycled water demands (6.7 mgd)	✓	✓	✓	✓	✓
Planned non-potable recycled water demands (2.4 mgd)	✓	✓	✓	✓	✓
North City Plant w/indirect potable reuse to San Vicente (15.0 mgd)	✓	✓	✓	✓	✓
Morena Diversion w/North City Plant expansion & indirect potable reuse to San Vicente (11.9 mgd)	✓	✓			
Harbor Drive Plant w/indirect potable reuse to San Vicente (capacity varies)	✓	✓	✓	✓	✓
Harbor Drive consolidated WRP/AWPF plant		✓		✓	✓
Harbor Drive WRP/Camino Del Rio AWPF split plant	✓		✓		
Mission Gorge Plant with indirect potable reuse to San Vicente (6.8 mgd)					✓
Elements from South Bay Area Concept C2					
Existing non-potable recycled water demands (4.2 mgd)	✓	✓	✓	✓	✓
Planned non-potable recycled water demands (1.8 mgd)	✓	✓	✓	✓	✓
Additional future non-potable recycled water demands (3.0 mgd)	✓	✓	✓	✓	✓
Spring Valley No. 8 Diversion to South Bay (31.1 mgd)	✓	✓	✓	✓	✓
South Bay indirect potable reuse to Otay Lakes (15.0 mgd)	✓	✓	✓	✓	✓

Note: Flows for non-potable recycled water and indirect potable reuse projects are average annual totals based on the output of the plant. Flows for the Spring Valley diversion are based on 2035 Dry Weather Flows. WRP = Water Reclamation Plant; AWPF = Advanced Water Purification Facility

The following summarizes the numbering system used for each alternative (also see Chapter 7). Each Alternative includes common South Bay components (per Table 8-1):

- **"A" Alternatives.** The "A" Alternatives expand the North City Plant to 45 mgd (the site's master-planned capacity) using the Morena Diversion. The added capacity at North City allows the Harbor Drive Plant to be smaller than the "B" Alternatives.
- **"B" Alternatives.** The "B" Alternatives maximize the existing North City Plant capacity at 30 mgd (which occurs once the initial 15 mgd indirect potable reuse project is complete). The smaller total at the North City Plant requires the Harbor Drive Plant to be larger than the "A" Alternatives.
- **"1" Sub-alternatives.** Alternatives "A1" and "B1" differ from the "2" (A2, B2) and "3" (B3) alternatives by splitting the Harbor Drive water reclamation treatment processes and the advanced purification facility treatment into different sites (the advanced purification processes are located at the Camino Del Rio site described in Chapter 7). This adds a fourth plant site to these alternatives.
- **"2" Sub-alternative.** Alternatives "A2" and "B2" also relate to the Harbor Drive Plant. The "2" Alternatives place all the Harbor Drive water reclamation and advanced purification treatment processes at a combined plant along Harbor Drive (similar to how the proposed North City and South Bay Plants will be configured). The Harbor Drive Plant in these alternatives is larger, but the operation is efficiently consolidated to a single site.
- **"3" Sub-alternative.** Alternative "B3" is the same as Alternative "B2", except that it includes a small plant in Mission Gorge to collect, treat, and convey water to the San Vicente Reservoir. This adds a fourth plant, but it is the closest location to the San Vicente Reservoir.

Major Alternatives

"A" Alternatives = North City at 45 mgd + South Bay with SV8 diversion

"B" Alternatives = North City at 30 mgd + South Bay with SV8 diversion

Siting Sub-alternatives

"1" Alternatives = split plant between Harbor Drive & Camino del Rio

"2" Alternatives = combined Harbor Drive Plant

"3" Alternative = combined Harbor Drive plant and an additional plant at Mission Gorge

The following six pages provide an overview of the Integrated Reuse Alternatives, including the following figures and tables:

Alternative A1/A2

- Figures 8-2 and 8-3
- Tables 8-2 through 8-4

Alternative B1/B2

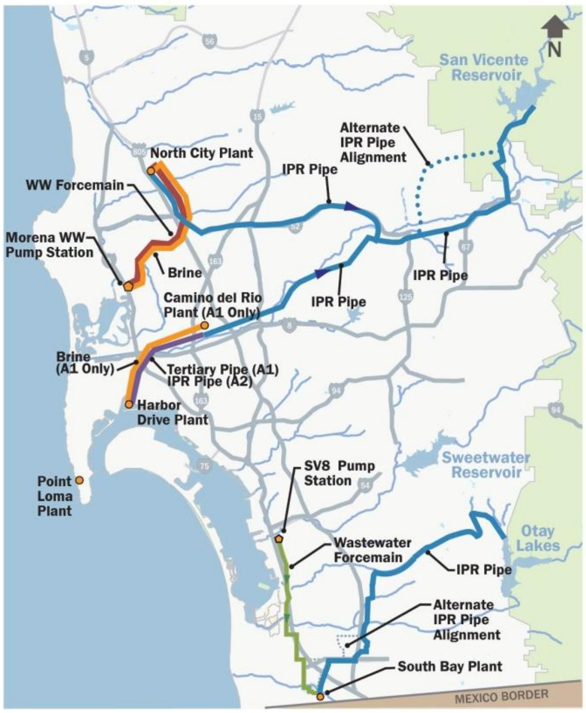
- Figures 8-4 and 8-5
- Tables 8-5 through 8-7

Alternative B3

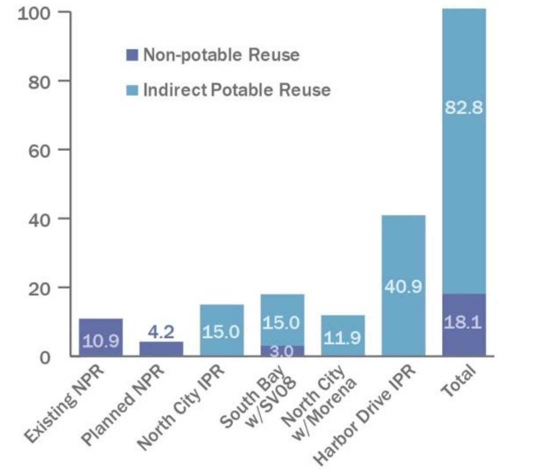
- Figures 8-6 and 8-7
- Tables 8-8 through 8-10

8.2.1 Summary of Integrated Reuse Alternatives A1 and A2

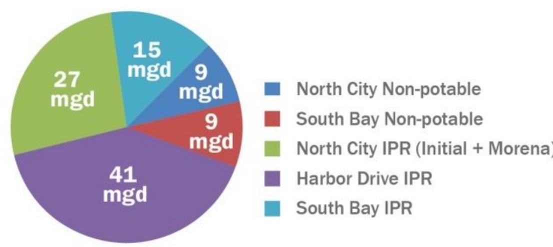
Facility Map



Reuse By Phase



Reuse Per Plant



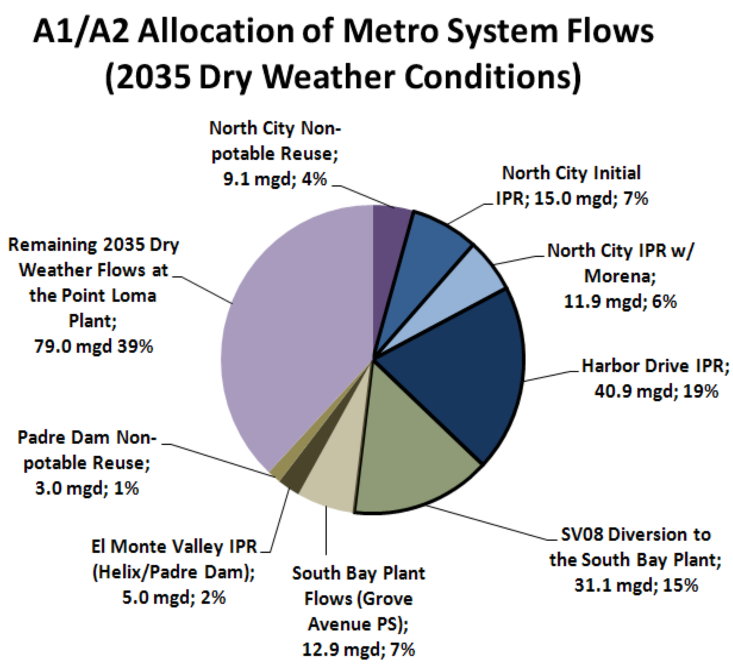


Figure 8-2
Integrated Reuse Alternatives A1 and A2

(upper left) – Displays the facilities included in Alternatives A1 and A2. A1 differs only in that the advanced treatment processes at the Harbor Drive Plant are located at the Camino del Rio site.

(Above) – The charts above include reuse totals per project and per plant for both non-potable recycled water and indirect potable reuse.

(Left) – The pie chart to the left displays the allocation of Metro System Flows estimated for the 2035 dry weather year flow scenario. The black bordered portions represent 99 mgd of offload provided by the facilities included in this Study. Wet weather allocations are presented in Appendix B.

Integrated Reuse Alternatives A1 and A2 (Continued)

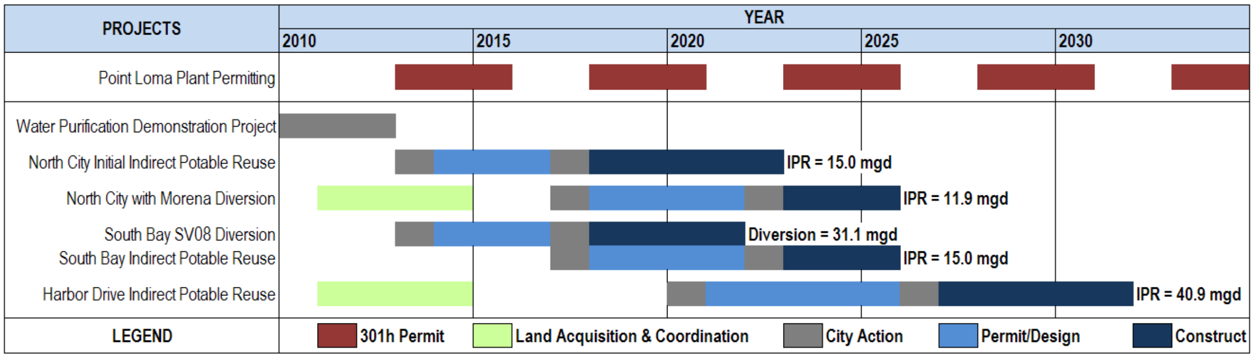


Figure 8-3. Alternative A1/A2 Implementation Schedule

Note: The planned 21 mgd expansion of South Bay as part of the September 2011 Draft Wastewater Master Plan may allow deferring or eliminating the 26 mgd primary and secondary expansion included in this Study. South Bay plant sizing and capacities shall be coordinated with wastewater planning efforts and Point Loma permit discussions per the implementation steps.

Table 8-2. Alternative A1/A2 New Water and Point Loma Offloading (Totals in mgd)

Start of Operations	New Water (mgd)					Wastewater Offload (mgd)		
	North City	Harbor Drive	Mission Gorge	South Bay	Cumulative	Reuse (N/I South Bay)	Diverted to South Bay	Cumulative
2023	15.0	0.0	-	0.0	15.0	15.0	0.0	15.0
2022	0	0.0	-	0.0	15.0	0.0	31.1	46.1
2026	11.9	0.0	-	0.0	26.9	11.9	0.0	58.0
2026	0.0	0.0	-	18.0	44.9	0.0	0.0	58.0
2032	0.0	40.9	-	0.0	85.8	40.9	0.0	98.9

Note: New water and wastewater offloading totals are based on the reuse projects included in the cost estimates for this Study. The totals do not include the proposed El Monte Groundwater Recharge IPR Project (5 mgd); existing and planned non-potable reuse for the North City Plant (9.1 mgd) and Padre Dam Plant (3.0 mgd); and the Grove Ave. Pump Station (12.9 mgd - which accounts for South Bay non-potable reuse thru 2026). South Bay new water totals include: 15 mgd for IPR and 3 mgd for non-potable reuse (Otay Water District, 2026 to 2040).Point Loma offload totals are based on 2035 Dry Weather Flows. Point Loma offloading due to South Bay is accounted for based on the diversion flows, not the new water created.

Table 8-3. Alternative A1/A2 Capital and Annual O&M Costs

Item		2014 North City initial	2014 South Bay Diversion	2018 Morena	2018 South Bay IPR	2021 Harbor Drive (Alternative A1)	2021 Harbor Drive (Alternative A2)
Incremental Costs	Capital	$410,700,000	$20,700,000	$301,300,000	$455,400,000	$1,000,000,000	$1,012,200,000
	O&M	$17,600,000	$300,000	$13,100,000	$22,700,000	$51,000,000	$50,800,000
Cumulative Costs	Capital	$410,700,000	$431,400,000	$732,800,000	$1,188,200,000	$2,188,200,000	$2,200,400,000
	O&M	$17,600,000	$17,900,000	$31,000,000	$53,600,000	$104,700,000	$104,500,000

Note: Capital & O&M Costs shown above are from the Favorable financial model scenario, and include a 20-percent project contingency.

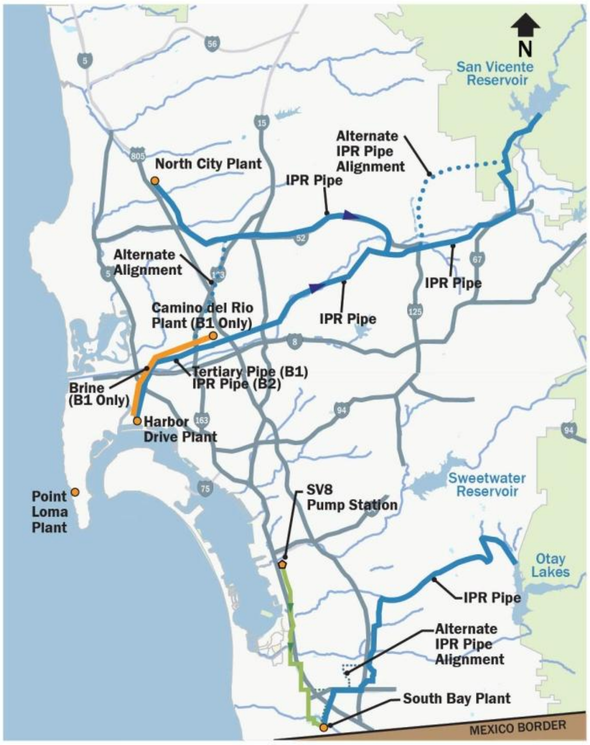
Table 8-4. Alternative A1/A2 Reuse Water Cost Summary (2011 $/AF)

Cost Category	Alternative A1	Alternative A2
Gross Costs (Before Avoided Facilities and Other Offset Savings)	$1,900	$1,900
Tier 1 Net Costs (With Direct Wastewater System Savings)	$1,300	$1,300
Tier 2 Net Costs (With Salt Credit Plus Tier 1 Savings)	$1,200	$1,200
Tier 3 Net Costs (With Indirect Wastewater System Savings Plus Tier 1 and Tier 2 Savings)	$800	$800
2011 Untreated Imported Water Costs (for comparison purposes)	$904	$904

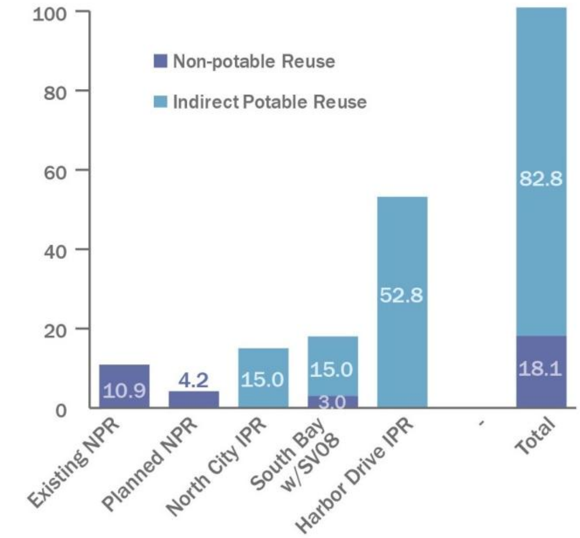
Note: The reuse water cost summary above represents average costs based on the Favorable and Unfavorable financial model scenarios. See Section 8.4 for more details on the financial evaluation and cost descriptions. Tier 1 savings includes wastewater projects no longer necessary due to the reuse projects and offloading included in this Study. Tier 2 savings accounts for savings due to water quality improvements. Tier 3 conceptualizes the savings that could occur if maintaining chemically enhanced primary treatment at the Point Loma Plant was made possible due to the reuse program proposed in this Study. Costs shown above are for comparison of untreated water options, and do not include potable water treatment plant costs.

8.2.2 Summary of Integrated Reuse Alternatives B1 and B2

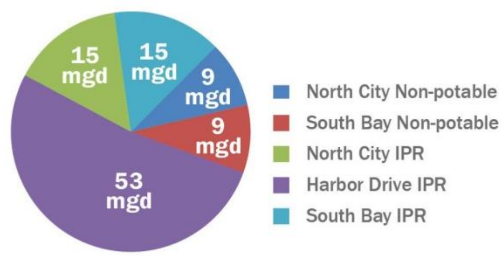
Facility Map



Reuse By Phase



Reuse Per Plant



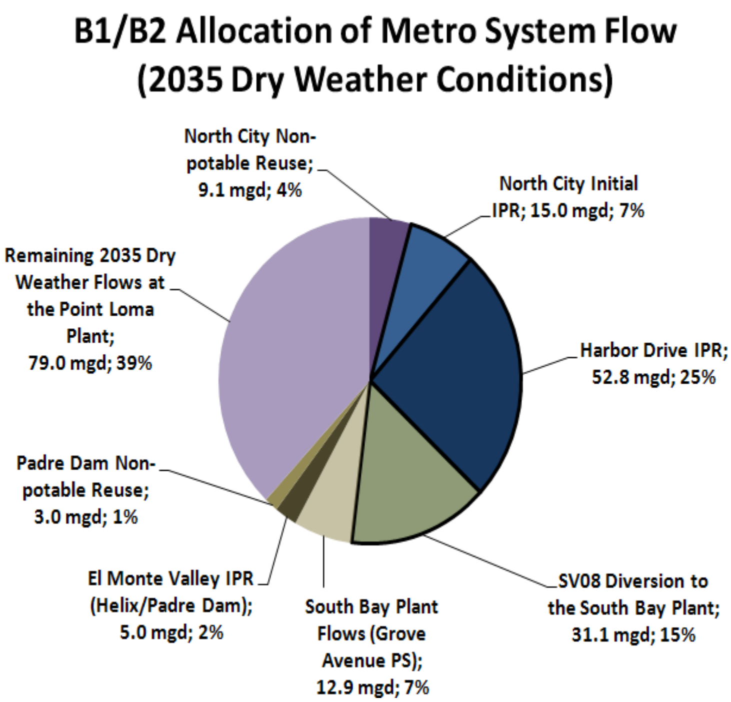


Figure 8-4.
Integrated Reuse Alternatives B1 and B2

(upper left) – Displays the facilities included in Alternatives B1 and B2.B1 differs only in that the advanced treatment processes at the Harbor Drive Plant are located at the Camino del Rio site.

(Above) – The charts above include reuse totals per project and per plant for both non-potable recycled water and indirect potable reuse.

(Left) – The pie chart to the left displays the allocation of Metro System Flows estimated for the 2035 dry weather year flow scenario. The black bordered portions represent 99 mgd of offload provided by the facilities included in this Study. Wet weather allocations are presented in Appendix B.

Summary of Integrated Reuse Alternatives B1 and B2 (Continued)

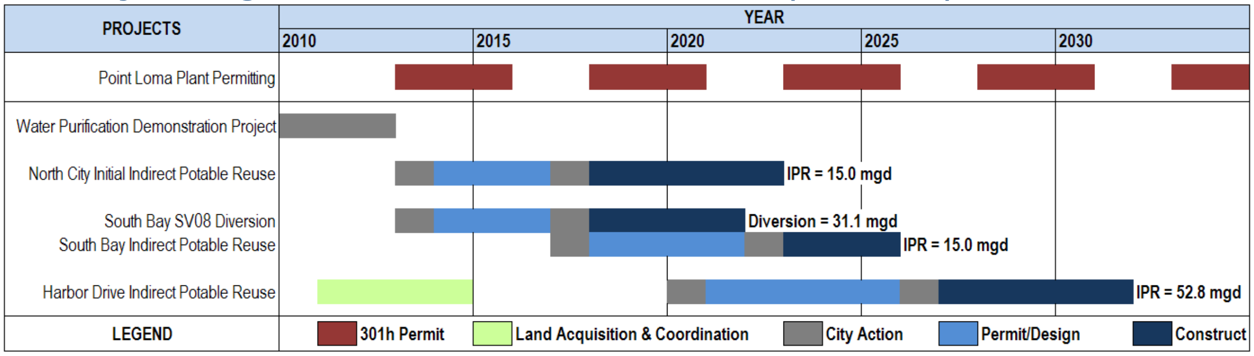


Figure 8-5. Alternative B1/B2 Implementation Schedule

Note: The planned 21 mgd expansion of South Bay as part of the September 2011 Draft Wastewater Master Plan may allow deferring or eliminating the 26 mgd primary and secondary expansion included in this Study. South Bay plant sizing and capacities shall be coordinated with wastewater planning efforts and Point Loma permit discussions per the implementation steps.

Table 8-5. Alternative B1/B2 New Water and Point Loma Offloading (Totals in mgd)

Start of Operations	New Water (mgd)					Wastewater Offload (mgd)		
	North City	Harbor Drive	Mission Gorge	South Bay	Cumulative	Reuse (N/I South Bay)	Diverted to South Bay	Cumulative
2023	15.0	0.0	-	0.0	15.0	15.0	0.0	15.0
2022	0.0	0.0	-	0.0	15.0	0.0	31.1	46.1
2026	0.0	0.0	-	18.0	33.0	0.0	0.0	46.1
2032	0.0	52.8	-	0.0	85.8	52.8	0.0	98.9

Notes: New water and wastewater offloading totals are based on the reuse projects included in the cost estimates for this Study. The totals do not include the proposed El Monte Groundwater Recharge IPR Project (5 mgd); existing and planned non-potable reuse for the North City Plant (9.1 mgd) and Padre Dam Plant (3.0 mgd); and the Grove Ave. Pump Station (12.9 mgd - which accounts for South Bay non-potable reuse thru 2026). South Bay new water totals include: 15 mgd for IPR and 3 mgd for non-potable reuse (Otay Water District, 2026 to 2040).Point Loma offload totals are based on 2035 Dry Weather Flows. Point Loma offloading due to South Bay is accounted for based on the diversion flows, not the new water created.

Table 8-6. Alternative B1/B2 Capital and Annual O&M Costs

Item		2014 North City initial	2014 South Bay Diversion	2018 South Bay IPR & 3 mgd non-potable	2021 Harbor Drive (Alternative B1)	2021 Harbor Drive (Alternative B2)
Incremental Costs	Capital	$340,700,000	$20,700,000	$455,400,000	$1,159,900,000	$1,168,300,000
	O&M	$17,300,000	$300,000	$22,700,000	$61,200,000	$60,500,000
Cumulative Costs	Capital	$340,700,000	$361,400,000	$816,800,000	$1,976,700,000	$1,985,100,000
	O&M	$17,300,000	$17,600,000	$40,300,000	$101,500,000	$100,800,000

Note: Capital & O&M Costs shown above are from the Favorable financial model scenario, and include a 20-percent project contingency.

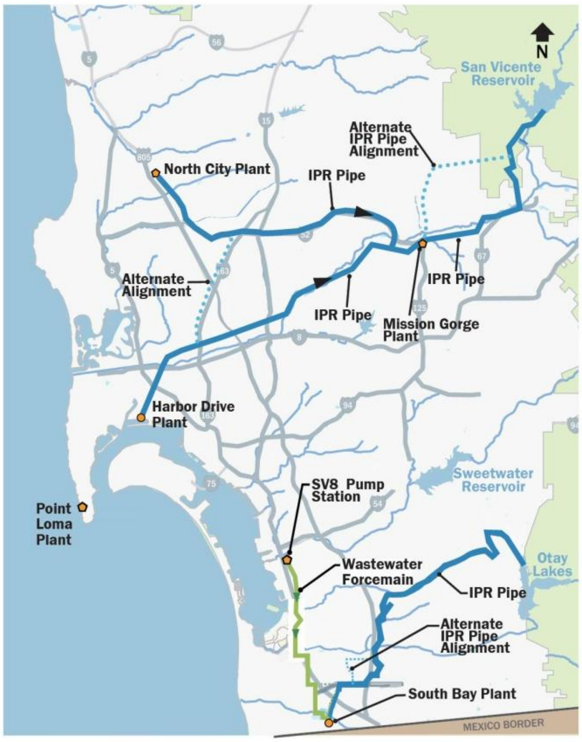
Table 8-7. Alternative B1/B2 Unit Cost Summary (2011 $/AF)

Cost Category	Alternative B1	Alternative B2
Gross Costs (Before Avoided Facilities and Other Offset Savings)	$1,700	$1,700
Tier 1 Net Costs (With Direct Wastewater System Savings)	$1,100	$1,100
Tier 2 Net Costs (With Salt Credit Plus Tier 1 Savings)	$1,000	$1,000
Tier 3 Net Costs (With Indirect Wastewater System Savings Plus Tier 1 and Tier 2 Savings)	$600	$600
2011 Untreated Imported Water Costs (for comparison purposes)	$904	$904

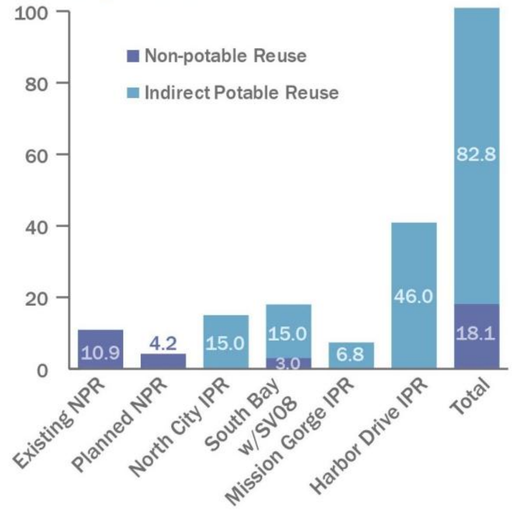
Note: The reuse water cost summary above represents average costs based on the Favorable and Unfavorable financial model scenarios. See Section 8.4 for more details on the financial evaluation and cost descriptions. Tier 1 savings includes wastewater projects no longer necessary due to the reuse projects and offloading included in this Study. Tier 2 savings accounts for savings due to water quality improvements. Tier 3 conceptualizes the savings that could occur if maintaining chemically enhanced primary treatment at the Point Loma Plant was made possible due to the reuse program proposed in this Study. Costs shown above are for comparison of untreated water options, and do not include potable water treatment plant costs.

8.2.3 Summary of Integrated Reuse Alternative B3

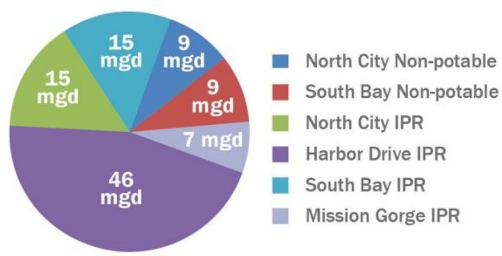
Facility Map



Reuse by Phase



Reuse Per Plant



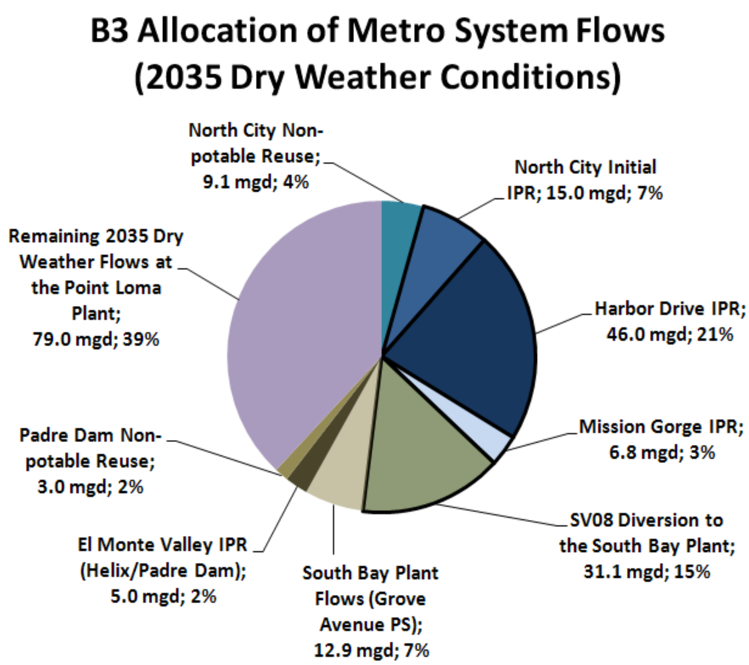


Figure 8-6.
Integrated Reuse Alternative B3

(upper left) – Displays the facilities included in Alternative B3. The Mission Gorge Plant is the only difference between this Alternative and Alternative B2.

(Above) – The charts above include reuse totals per project and per plant for both non-potable recycled water and indirect potable reuse.

(Left) – The pie chart to the left displays the allocation of Metro System Flows estimated for the 2035 dry weather year flow scenario. The black bordered portions represent 99 mgd of offload provided by the facilities included in this Study. Wet weather allocations are presented in Appendix B.

Summary of Integrated Reuse Alternative B3 (Continued)

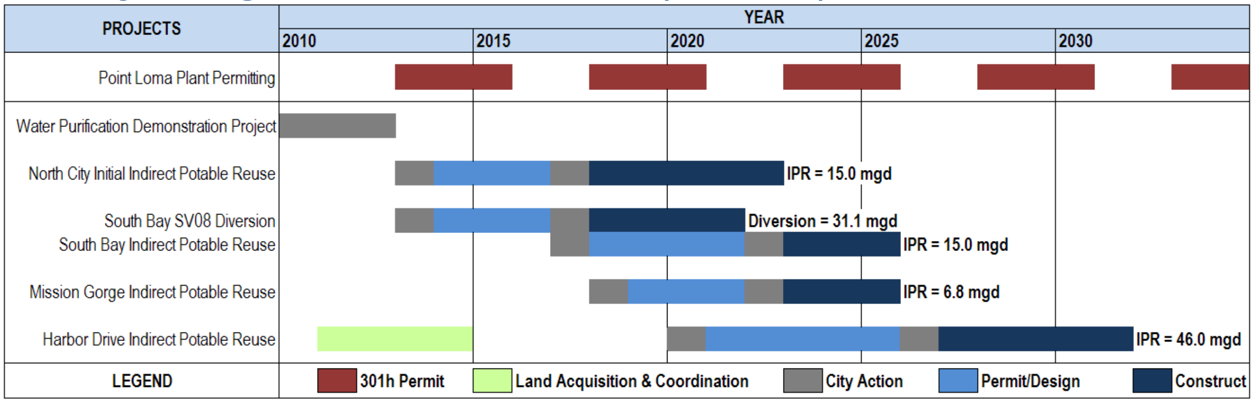


Figure 8-7. Alternative B3 Implementation Schedule

Note: The planned 21 mgd expansion of South Bay as part of the September 2011 Draft Wastewater Master Plan may allow deferring or eliminating the 26 mgd primary and secondary expansion included in this Study. South Bay plant sizing and capacities shall be coordinated with wastewater planning efforts and Point Loma permit discussions per the implementation steps.

Table 8-8. Alternative B3 New Water and Point Loma Offloading (Totals in mgd)

Start of Operations	New Water (mgd)					Wastewater Offload (mgd)		
	North City	Harbor Drive	Mission Gorge	South Bay	Cumulative	Reuse (N/I South Bay)	Diverted to South Bay	Cumulative
2023	15.0	0.0	0.0	0.0	15.0	15.0	0.0	15.0
2022	0.0	0.0	0.0	0.0	15.0	0.0	31.1	46.1
2026	0.0	0.0	0.0	18.0	33.0	0.0	0.0	46.1
2026	0.0	0.0	6.8	0.0	39.8	6.8	0.0	52.9
2032	0.0	46.0	0.0	0.0	85.8	46.0	0.0	98.9

Note: New water and wastewater offloading totals are based on the reuse projects included in the cost estimates for this Study. The totals do not include the proposed El Monte Groundwater Recharge IPR Project (5 mgd); existing and planned non-potable reuse for the North City Plant (9.1 mgd) and Padre Dam Plant (3.0 mgd); and the Grove Ave. Pump Station (12.9 mgd - which accounts for South Bay non-potable reuse thru 2026). South Bay new water totals include: 15 mgd for IPR and 3 mgd for non-potable reuse (Otay Water District, 2026 to 2040).Point Loma offload totals are based on 2035 Dry Weather Flows. Point Loma offloading due to South Bay is accounted for based on the diversion flows, not the new water created.

Table 8-9. Alternative B3 Capital and Annual O&M Costs

Item		2014 North City initial	2014 South Bay Diversion	2018 South Bay IPR & 3 mgd non-potable	2019 Mission Gorge	2021 Harbor Drive
Incremental Costs	Capital	$332,600,000	$20,700,000	$455,400,000	$279,000,000	$1,073,200,000
	O&M	$17,300,000	$300,000	$22,700,000	$13,500,000	$55,000,000
Cumulative Costs	Cumulative Capital Cost	$332,600,000	$353,400,000	$808,800,000	$1,087,800,000	$2,160,900,000
	Cumulative O&M Cost	$17,300,000	$17,600,000	$40,300,000	$53,700,000	$108,700,000

Note: Capital & O&M Costs shown above are from the Favorable financial model scenario, and include a 20-percent project contingency.

Table 8-10. Alternative B3 Unit Cost Summary (2011 $/AF)

Cost Category	Alternative B3
Gross Costs (Before Avoided Facilities and Other Offset Savings)	$1,900
Tier 1 Net Costs (With Direct Wastewater System Savings)	$1,300
Tier 2 Net Costs (With Salt Credit Plus Tier 1 Savings)	$1,200
Tier 3 Net Costs (With Indirect Wastewater System Savings Plus Tier 1 and Tier 2 Savings)	$800
2011 Untreated Imported Water Costs (for comparison purposes)	$904

Note: The reuse water cost summary above represents average costs based on the Favorable and Unfavorable financial model scenarios. See Section 8.4 for more details on the financial evaluation and cost descriptions. Tier 1 savings includes wastewater projects no longer necessary due to the reuse projects and offloading included in this Study. Tier 2 savings accounts for savings due to water quality improvements. Tier 3 conceptualizes the savings that could occur if maintaining chemically enhanced primary treatment at the Point Loma Plant was made possible due to the reuse program proposed in this Study. Costs shown above are for comparison of untreated water options, and do not include potable water treatment plant costs.

8.3 Evaluation Summary for the Integrated Reuse Alternatives

The Integrated Reuse Alternatives were evaluated during the Fine Screening Session and subsequent Stakeholder Status Update Meetings. Each Integrated Reuse Alternative provides common and distinct benefits, as summarized in Table 8-11.

Table 8-11. Integrated Reuse Alternative Comparative Summary

Alternative	Institutional Complexity	Technical Complexity	Treatment Plant Sites	Wastewater Diversions	Key Infrastructure Siting and Complexity Considerations
A1	Med	High (Morena Diversion/Split Split Plant Harbor Drive-Camino del Rio)	4	2	• Smallest area requirement at the Harbor Drive site • Challenging siting at Camino del Rio site • Challenging siting and operation of the Morena Wastewater Diversion Pump Station • Most pumping of all alternatives due to Morena Diversion • Increased costs due to added brine line
A2	Med	Med/High (Morena Diversion)	3	2	• Reduced Harbor Drive Plant siting needs compared to the "B" alternatives • Challenging siting and operation of the Morena Wastewater Diversion Pump Station
B1	Med	Med/High (split Plant Harbor Drive-Camino del Rio)	4	1	• Reduced Harbor Drive Plant siting needs compared to B2 • Minimal wastewater pumping • Challenging siting at the Camino del Rio site • Reduced ability to phase • Increased costs due to added brine line
B2	Med	Med	3	1	• Largest area requirement at the Harbor Drive site • Least cost option • Minimal wastewater and tertiary water pumping • Reduced ability to phase
B3	High (Harbor Drive site & Mission Gorge site)	High (4th Water Reclamation Plant/ Advance Water Purification Facility at Mission Gorge)	4	1	• Multiple agency collaboration could drive further economy of scale benefits • Allows for additional phasing opportunities • Closest plant to San Vicente Reservoir reduces overall pumping • Mission Gorge site requires interagency agreements and administration costs • Mission Gorge Plant is relatively small due to smaller tributary wastewater flows limited and reduces Harbor Drive Plant economy of scale • Larger upstream treatment at Mission Gorge Plant impacts downstream water quality at Harbor Drive Plant • Reduced flows/concentrated waste downstream of Mission Gorge Plant may create maintenance issues • Easterly plant may be less advantageous if direct potable reuse becomes a reality in the future as a majority of the demands are to the west and this would reduce piping and pumping costs from the Harbor Drive Plant furthering benefitting its economy of scale in relation to smaller more remote plants

Notes:
- *Alternative A1 and B1 include a split Harbor Drive Plant at the Harbor Drive site and Camino Del Rio site. Although these facilities work together, they were considered separate treatment plant sites in the table above.*
- *Wastewater Diversions can include the Morena diversion to the North City Plant and the Spring Valley No. 8 Diversion to the South Bay Plant. These diversions require wastewater pump stations.*
- *South Bay facilities not included above since common to all Alternatives.*

8.4 Financial Evaluation of Alternatives

A financial evaluation was performed, which included each Integrated Reuse Alternative considered in this Study. The financial evaluation was prepared to ultimately help decision-makers compare the costs of different water reuse approaches and to aid in making decisions about whether to invest in the water reuse system. The guiding principles for the evaluation included:

- Provide transparent costing of alternatives.
- Provide multiple opportunities at workshops and Stakeholder meetings to review, discuss, and debate project costs.
- Prepare a comparative financial evaluation of the Integrated Reuse Alternatives and include financing costs.
- Compare the water reuse alternative costs to other options facing the City and Participating Agencies.

The financial evaluation included a Net Present Value financial spreadsheet model (financial model). The financial model was used to calculate and compare unit costs (in terms of dollars per acre foot) for each Integrated Reuse Alternative against the current cost of imported untreated water. The financial model included fixed and variable inputs, which were used to perform a sensitivity analysis.

8.4.1 Financial Model Cost Components

The costing process consisted of a multi-step approach. The following summarizes the major steps:

- **Development of Unit Costs for Infrastructure.** Unit costs for treatment and conveyance facilities were prepared to estimate infrastructure costs. The unit costs were based on 23 Bid Summaries, two formal agency estimating tools, 14 project cost estimates, and insight and experience from the three national consulting team members performing this Study. The unit costs were first reviewed in the Coarse Screening Session and updated through the course of the project. One revision included modifying the unit costs to provide economy of scale adjustments (i.e. larger facilities are less expensive to build and operate than smaller facilities with similar processes and construction methods). This adjustment was based on City cost data and the EPA's *Guide to the Selection of Cost-Effective Wastewater Treatment Systems* (EPA-430/9-75-002; July 1975).
- **Integrated Reuse Alternative Costs.** Costs for each alternative were developed and reviewed in the Coarse Screening Session and the Fine Screening Session. The costs included:
  - **Capital Costs.** Capital costs were developed using the Study's unit costs described above. Capital costs were multiplied by cost factors related to the difficulty of construction at each site. Factors varied from 1.0 to 1.5 times the unit costs. Tunneling allowances were also included as an allowance for utility conflicts and for avoiding high traffic areas, streams, freeways, rail, or sensitive environmental areas.
  - **Operation and Maintenance Costs.** Operation and maintenance costs were also developed based on the Study's unit costs (for treatment facilities) and values developed in the 2005 Water Reuse Study (for conveyance facilities including pipelines, pump stations and reservoirs). Treatment facility costs included labor, chemicals, energy, and materials. Costs for conveyance facilities were calculated as a percentage of the capital costs. An electricity cost of $0.12 per kilowatt-hour was used for treatment and pump station operations.
  - **Soft Costs.** A 50-percent soft cost allowance was provided for Engineering, Administration, Legal, Construction Management and Environmental Permitting costs

  - **Land Acquisition.** Although a majority of the facilities planned are located on City parcels, additional land or alignments may need to be acquired. A cost equal to 4 percent of the estimated construction cost was included for these purposes.

- **Financial Model Assumptions.** Financial model assumptions were coordinated for consistency with other City financial model assumptions. These assumptions were fixed for all scenarios. It is the practice of the City to finance 20-percent of all capital projects with rates and fees. Funds derived from rates are the main source of funds for day-to-day operational and maintenance costs and debt coverage requirements. The assumptions related to financing include the following:
  - Interest rate of 5.5 percent on revenue bonds and 2.5 percent on State Revolving Fund (SRF) loans
  - Repayment period of 30 years on revenue bonds and 20 years on SRF loans
  - Issuance costs of 2.5 percent on revenue bonds and 1.0 percent on SRF loans
  - Debt coverage of 1.25 percent on revenue bonds and 1.2 percent on SRF loans
  - Maximum loan under SRF of $50 million per year
  - Complying with revenue bonds requires a reserve amount equal to one payment to be set aside at issuance
  - O&M escalation for chemical, energy, and labor set at 4.0 percent; Capital cost escalation set at 3.0 percent
  - Net Present Value analysis for 50 years
  - ENR Los Angeles cost basis index of 10051.30

8.4.2 Comparative Costs Basis Using a Sensitivity Analysis

The costs for the reuse program proposed in this Study will be compared to the cost of imported untreated water, and other alternative water supply projects (such as desalination). It is important to note that the cost presented for the reuse alternatives in this Study are fully loaded (including capital, O&M and financing costs). It is common for other new alternative water supply costs to be partial costs, including overly optimistic assumptions or certain exclusions. The costs for the alternatives presented in this Report were prepared to provide thorough and realistic budgetary estimates

8.4.3 Gross Costs

Gross Costs were calculated to determine the investment required for each Integrated Reuse Alternative. To achieve a realistic picture of Gross Costs, the financial evaluation included a sensitivity analysis with bracketed (bookend) conditions, using variables described as follows and summarized in Table 8-12:

- **Favorable Condition.** The favorable condition assumed the best-case scenario using the most favorable cost variables. This included 30-percent grant funding, $450 per acre-foot local resource program credits for 20 years, and a 20-percent project contingency.
- **Unfavorable Condition.** The unfavorable condition assumed the worst-case scenario related to the variable costs. This condition included 10-percent grant funding, $100 per acre-foot local resource program credits for 20 years, and a 40-percent project contingency.

Table 8-12. Gross Costs Variables

Item	Description	Favorable Scenario	Unfavorable Scenario	Average
Grants	To help offset the costs associated with projects, the City can apply for grants to help finance a portion of the capital projects. Grants usually consist of funds that are obtained from state or federal agencies and do not need to be paid back. This is the preferred option among municipal utilities. The grants usually have stipulations regarding the type of projects that can be included and how the money is managed; therefore, additional administrative costs also come with the funds. Typically, grant amounts vary depending on the project type. Projects promoting water reuse have generally been well supported, with multiple programs such as the Bureau of Reclamation's Title XVI Program and California's bond measures. The analysis assumes receiving grant funding offsetting 10 to 30-percent of each Integrated Reuse Alternative's capital costs.	30%	10%	20%
Local Resource Program	To help offset the costs associated with new water projects, the City has participated in the Local Resource Program offered by MWD and the Local Water Supply Development funding provided by the SDCWA (these two programs are collectively referred to herein as the LRP). The LRP was created to promote the development of water recycling and groundwater recovery projects in order to replace an existing demand or prevent a new demand on imported water supplies. Since the City relies indirectly on imported water from MWD/SDCWA, it may be eligible to receive a credit up to $450 per acre-foot produced. The program is dependent on available funding and agency approvals and usually comes with a fixed term. For this Study, a 20-year term and a funding level of $100 to $450 per acre-foot were assumed. One caveat is that the LRP credit is discontinued once the cost to produce the alternative water supply source becomes cheaper than the cost of imported water.	$450/acre-foot, 20 years	$100/acre-foot, 20 years	$275/acre-foot, 20 years
Project Contingency	A project contingency was added to the construction costs of all alternatives. Contingencies are important at this level of planning to account for unknown conditions or additional facilities needed once more detailed evaluations or design is complete. The analysis assumes project contingencies adding 20-percent to 40-percent to the Integrated Reuse Alternative's capital costs.	20%	40%	30%

8.4.4 Net Costs

Net Costs are considered "real" or "true" costs for the purposes of comparing reuse projects to imported untreated water and other alternative water sources. Net Costs account for savings, offsets and credits that occur as a result of the reuse projects. For example, constructing a new reuse plant upstream of the Point Loma Plant reduces flows to the Point Loma Plant, resulting in lower capital and operational costs at the Point Loma Plant. These reduced costs are subtracted from the Gross Costs to get the Net Costs or "true" program cost. This is similar to the Orange County Groundwater Replenishment System, which was responsible for substantial savings by avoiding costly outfall improvements.

The variables associated with the Net Cost calculations are described in Table 8-13. Additional information regarding Net Costs is included in a Cost Methodology Summary included in Appendix H. The Cost Methodology Summary is presented in an informative, frequently asked question (FAQ) format. This document summarizes direct and indirect wastewater savings calculations and includes a graphical comparison of the key wastewater facilities included in this Study with the City's September 2011 Draft Wastewater Master Plan facilities.

Table 8-13. Net Cost Variables		
Component	**Description**	**Savings**
Tier 1 - Direct Wastewater System Savings • Reduction of flows to downstream facilities • Remaining Point Loma capacity is upgraded to Secondary	The Study's Alternatives achieve the goal of offloading flows away from the Point Loma Plant, resulting in reduced capital and operating costs at downstream wastewater facilities. The direct wastewater system savings were calculated by comparing the size of the Point Loma Plant proposed in the City's September 2011 Draft Wastewater Master Plan (adjusted to a secondary treatment option) to the smaller Point Loma Plant size (which includes secondary treatment) in this Study (assuming the reuse projects in this Recycled Water Study are implemented). The cost difference is the savings directly attributable to these reuse projects. See Appendix H for additional details.	$557 million (capital savings) $27.6 million/year (operation and maintenance savings)
Tier 2 - Salt Reduction Credit • Water quality improvements to water & wastewater systems due to indirect potable reuse • Homeowner and business benefits not included in total	Similar to the 2005 Water Reuse Study, a salt credit was considered to account for the benefits of salinity reduction in the watershed. The salt credit basis is from the 1999 Salinity Management Study (MWD, USBR). The quantitative credit shown is the financial benefits of extending the life of the municipal water and wastewater treatment systems from having lower salinity levels in the water and wastewater flows. The San Vicente and Otay Lakes Reservoirs could see dramatic reductions in salinity levels from the proposed indirect potable reuse projects. Downstream agency facilities including drinking water treatment plants and the Harbor Drive advanced water purification facilities would benefit from this reduced salinity. In addition to the benefit shown, there is a benefit to water customers, since water heaters, clothes washers, dishwashers, and fixtures will also last longer with lower salinity levels. The combined savings included in the City's 2005 Water Reuse Study was $250/AF. The $100/AF value used in this Study only accounts for the estimated municipal treatment equipment savings.	$100/acre foot (not including customer savings)
Tier 3 - Indirect Wastewater System Savings • Remaining Point Loma capacity maintained at CEPT • Quantifies savings if this approach is attributable to the reuse program	The Point Loma Plant will either continue to use chemically enhanced primary treatment or will require upgrades to secondary treatment. This Study does not provide an opinion on whether CEPT or secondary treatment processes should be employed at the Point Loma Plant. However, it is prudent to summarize the reduced Point Loma capital and operational costs if CEPT status could be maintained for the remaining Point Loma Plant capacity after reuse projects and with the South Bay Diversion. The indirect wastewater savings are therefore calculated as the avoided secondary treatment costs at the Point Loma Plant. See Appendix H for additional details.	$463 million (capital savings) $13.0 million/year (operation and maintenance savings).
Qualitative Water System Savings	The local, regional and statewide water systems were considered for potential savings from increasing water reuse. Since quantitative costs could not be developed with current available information, qualitative benefits were considered, particularly at the regional and statewide level. The region's local water treatment plants treat water from local runoff (which is limited) and imported untreated water from the SDCWA and MWD (which is subject to cutbacks and higher price fluctuations). Indirect potable reuse projects provide a reliable, uninterruptable untreated water equivalent that would help supply the local water treatment plants that ratepayers have invested in over the past decade. Indirect potable reuse projects may defer or eliminate the need to expand the imported untreated water conveyance system needed to serve these treatment plants. The SDCWA Master Plan (currently underway) may help quantify what these benefits are in future updates to this Study. In addition, Stakeholders emphasized an additional benefit related to the need to fix water supply conditions in the California Bay-Delta (which has the potential for substantial cost impacts for Southern California). Water reuse projects reduce the burden on importing water from the Bay-Delta, providing an additional benefit for these projects.	Quantitative benefits are speculative, therefore this category is currently considered qualitatively

8.4.5 Cost Summary for Integrated Reuse Alternatives

The Integrated Reuse Alternative costs are summarized in Table 8-14. The table includes a tiered breakout of summary level costs based on the Gross Costs and Net Costs categories described above. As shown, the costs for A1, A2 and B3 are nearly identical to each other, and slightly higher than B1 and B2. For the A1/A2 comparison to B1/B2, the increased costs occur mainly due to the additional wastewater facilities and pumping needed to divert flows from Morena to the North City Plant. For the B3 comparison to B1/B2, B3 adds an additional plant and does not have the same economy of scale that the B1 and B2 Alternatives have. Implementation steps are included later in this Chapter, which include steps to further develop the Alternatives and look for additional cost savings.

Table 8-14. Cost Summary (2011 $/AF)

Alternative	Average Gross Costs	Net Costs		
		Tier 1 - Direct Wastewater System Savings	**Tier 2 - Salt Reduction Credit**	**Tier 3 - Indirect Wastewater System Savings**
		Remaining Point Loma capacity upgraded to Secondary	*Water Quality Benefit to Water/Wastewater System*	*Remaining Point Loma capacity maintained at CEPT*
A1: North City 45 mgd; Split Harbor Dr. AWPF	$1,900	$1,300	$1,200	$800
A2: North City 45 mgd; Consolidated Harbor Dr. AWPF	$1,900	$1,300	$1,200	$800
B1: North City 30 mgd; Split Harbor Dr. AWPF	$1,700	$1,100	$1,000	$600
B2: North City 30 mgd; Consolidated Harbor Dr. AWPF	$1,700	$1,100	$1,000	$600
B3: North City 30 mgd; Consolidated Harbor Dr. AWPF; Mission Gorge AWPF	$1,900	$1,300	$1,200	$800

Notes:

- *All Alternatives include South Bay Option C2 expansion with the Spring Valley No. 8 Diversion*
- *Direct and indirect wastewater system savings based on a comparison between the City's September 2011 Draft Wastewater Master Plan and the reduced wastewater facility sizing and pumping required as a resulted of the projects included in this Recycled Water Study (see Appendix H).*
- *Totals are in 2011 dollars (ENR Los Angeles Index value of 10,051.30, June 2011) and are based on a net present value analysis using a detailed financial model.*
- *Financial model sensitivity analysis generally produced cost ranging +/- $200/AF of the values shown. Favorable conditions could result in lower costs than shown.*

Key Study Conclusion

The Alternative Net Costs represent the costs that should be compared to other water sources – particularly imported untreated water. The average costs of the Alternatives above are:

- Cost assuming direct wastewater savings = $1,200/AF
- Cost assuming above plus salt credit = $1,100/AF
- Cost assuming above plus indirect wastewater savings = $700/AF

These costs compare well to the 2011 untreated water cost of $904 per acre foot, and are more economical than most other new water supply concepts being proposed.

The net cost tiers are summarized as follows:

- **Tier 1: Net Costs with Direct Wastewater System Savings.** This tier includes the Direct Wastewater System Savings that occur as a result of the water reuse projects in this Study which help to avoid approximately 100 mgd of secondary treatment improvements at the Point Loma Plant. This tier represents the first threshold in which the Alternative costs should be considered for comparison to the cost of other water sources – such as imported untreated water or other new water sources. The comparison, as outlined in the next section, is very favorable compared to untreated water and more economical than most water supply concepts being proposed at this time.
- **Tier 2: Net Costs with the Salt Credit (Including Tier 1 Savings).** This tier includes the Salt Reduction Credit Savings and adds a $100/acre-foot credit occurring as a result of the water quality benefits created by implementing indirect potable reuse projects. The savings included is attributable to benefits received by agency facilities downstream of the new projects, including wastewater facilities. Additional savings (not accounted for in this total) would be experienced by homeowners and business as described in Chapter 6. Although these benefits are real, the ability to recover these savings and allocate them to the reuse program led to extracting this element as a separate unit cost tier so it may be considered separately from other savings.
- **Tier 3: Net Costs with Indirect Wastewater System Savings (including Tier 1 and Tier 2 Savings).** As described in the table above, this Study does not provide an opinion on whether the Point Loma Plant should continue to use CEPT treatment processes or upgrade to secondary processes. However, it was considered appropriate to list the Net Costs of the new water if the water reuse program proposed in this Study led to maintaining CEPT treatment for the remaining flows that reach the Point Loma Plant (i.e., the remaining flows that are not recycled upstream).

The Study Alternative's Net Costs were extrapolated based on a 3.5-percent inflation rate and compared to projected untreated imported water rate as shown in Figure 8-8. The 2011 SDCWA municipal and industrial untreated imported water rate was $904 per acre foot. The existing rate was inflated through 2020 based on the "low-rate" scenario values provided by the SDCWA in April 2011 (which averages to a 5.8-percent annual increase). Beyond 2020, the untreated water cost projectionswere bracketed based on various infiltration scenarios ranging from 3 to 6 percent (shown as the shaded area). These scenarios compare well to the Net Costs of the Study's Alternatives (shown as solid lines). The Study's Net Costs shown are the average of all the Study Alternatives and an average of the Favorable and Unfavorable scenario (i.e., the lower cost B1/B2 Alternatives and the favorable scenario would lower the reuse costs further). As shown, the average Tier 1 and Tier 2 cost curves have Net Costs lower than most of the untreated imported water rate scenarios. If the Tier 3 savings are attributed to the projects in this Study, the program would have significantly lower Net Costs than all untreated imported water rate scenarios. An additional consideration is the long-term effects that other local water projects and reduced demands are causing to MWD/SDCWA rates. As purchases decline, rates must increase to cover fixed costs. This is likely to cause imported water costs to inflate faster than locally controlled projects. Overall, the conclusion of this analysis supports the water reuse program proposed in this Study.

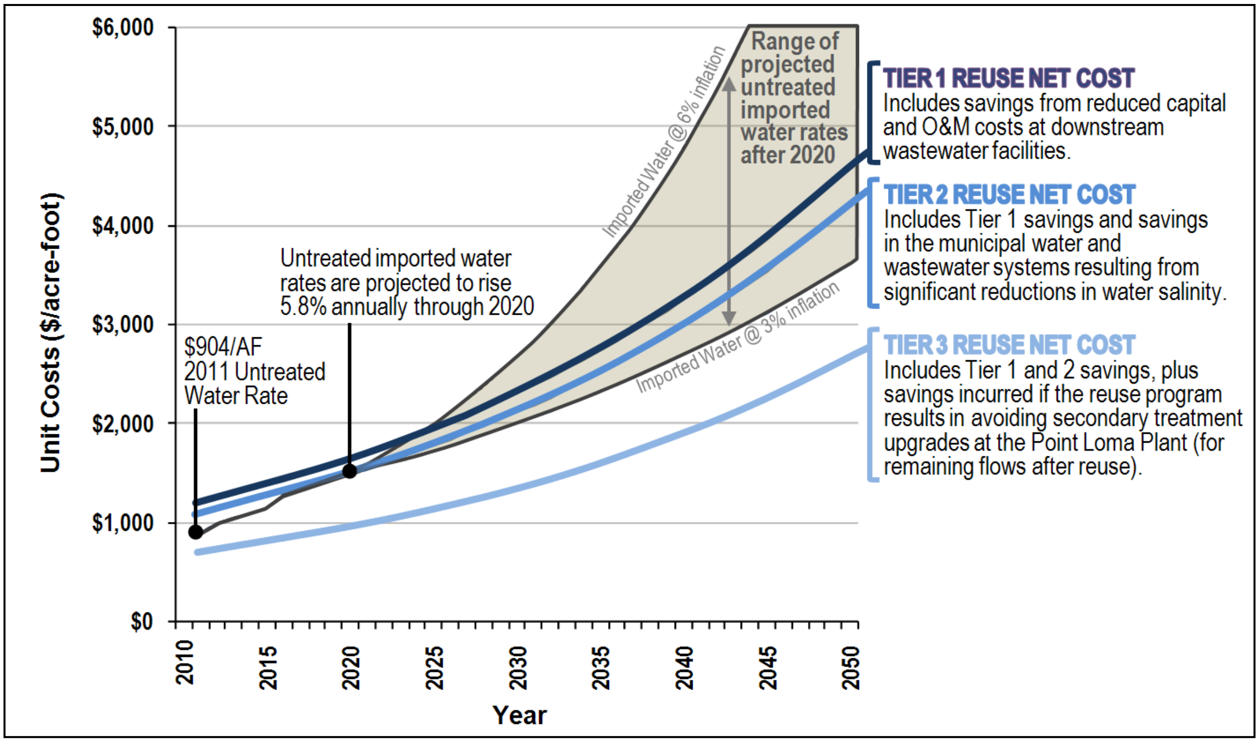


Figure 8-8. Comparison of Reuse Alternative Net Costs to Imported Untreated Water

The Integrated Reuse Alternative Net Costs compare well to projected untreated imported water rates. Untreated water rates are projected to rise 5.8 percent through 2020 and there remain many uncertainties regarding future costs associated with the Bay-Delta fix and imported water.

A detailed cost breakdown for the Favorable and Unfavorable Financial Evaluation scenarios is included in Tables 8-15 and 8-16, respectively. Capital and operation and maintenance cost estimates for each Integrated Reuse Alternative can be found in Appendix F.

Table 8-15. Financial Details for the Favorable Scenario					
Item	**Theme A1**	**Theme A2**	**Theme B1**	**Theme B2**	**Theme B3**
O&M and Capital Debt					-
Interest from Reserve	25,769,150	25,923,958	23,557,882	23,663,931	25,715,525
Operation & Maintenance	1,757,803,600	1,753,642,189	1,612,278,853	1,599,768,756	1,799,893,592
Debt Service	876,467,167	881,123,259	776,617,870	779,795,118	854,165,858
Total PV Cost	$2,608,501,617	$2,608,841,490	$2,365,338,840	$2,355,899,943	$2,628,343,925
Total Cost, Annual Payments	$154,061,888	$154,081,962	$139,700,342	$139,142,867	$155,233,804
Capital (PAYGO Financed)					
PAYGO Financing	321,118,587	322,724,896	283,626,663	284,730,678	311,771,510
Total PV Cost	$321,118,587	$322,724,896	$283,626,663	$284,730,678	$311,771,510
Total Cost, Annual Payments	$18,965,729	$19,060,600	$16,751,402	$16,816,607	$18,413,677
Credits/Avoided Costs					
LRP Credit	200,257,301	200,257,301	191,430,259	191,430,259	196,474,283
Total PV Cost	$200,257,301	$200,257,301	$191,430,259	$191,430,259	$196,474,283
Total Cost, Annual Payments	$11,827,487	$11,827,487	$11,306,149	$11,306,149	$11,604,056
Tier 1: Wastewater O&M Avoided Costs	515,354,315	515,354,315	515,354,315	515,354,315	515,354,315
Wastewater PAYGO/Debt Avoided Costs	436,611,784	436,611,784	436,611,784	436,611,784	436,611,784
Total PV Cost	$951,966,099	$951,966,099	$951,966,099	$951,966,099	$951,966,099
Total Cost, Annual Payments	$56,224,498	$56,224,498	$56,224,498	$56,224,498	$56,224,498
Tier 2: Salt Credit	184,706,087	184,706,087	178,800,483	178,800,483	182,175,128
Total PV Cost	$184,706,087	$184,706,087	$178,800,483	$178,800,483	$182,175,128
Total Cost, Annual Payments	$10,909,009	$10,909,009	$10,560,216	$10,560,216	$10,759,527
Tier 3: CEPT O&M Avoided Costs	242,457,015	242,457,015	242,457,015	242,457,015	242,457,015
CEPT PAYGO/Debt Avoided Costs	362,889,796	362,889,796	362,889,796	362,889,796	362,889,796
Total PV Cost	$605,346,812	$605,346,812	$605,346,812	$605,346,812	$605,346,812
Total Cost, Annual Payments	$35,752,661	$35,752,661	$35,752,661	$35,752,661	$35,752,661
Water Produced (AF)	96,162	96,162	96,162	96,162	96,162
Gross Costs (Includes O&M, Capital, Grants and LRP)					
Total Costs NPV	$2,729,362,903	$2,731,309,085	$2,457,535,244	$2,449,200,361	$2,743,641,152
Total Cost, Annual Payments	$161,200,131	$161,315,075	$145,145,595	$144,653,325	$162,043,425
Total Cost: $/AF (2011)	$1,700	$1,700	$1,500	$1,500	$1,700
Total Cost: $/Gallon (2011)	$0.0052	$0.0052	$0.0046	$0.0046	$0.0052
Net Cost Tier 1 (Direct Wastewater System Savings)					
Total Costs NPV	$1,777,396,804	$1,779,342,987	$1,505,569,145	$1,497,234,263	$1,791,675,053
Total Cost, Annual Payments	$104,975,633	$105,090,577	$88,921,097	$88,428,827	$105,818,927
Total Cost: $/AF (2011)	$1,100	$1,100	$900	$900	$1,100
Total Cost: $/Gallon (2011)	$0.0034	$0.0034	$0.0028	$0.0028	$0.0034
Net Cost Tier 2 (Salt Credit Plus Tier 1 Savings)					
Total Costs NPV	$1,592,690,717	$1,594,636,899	$1,326,768,662	$1,318,433,779	$1,609,499,925
Total Cost, Annual Payments	$94,066,623	$94,181,568	$78,360,881	$77,868,611	$95,059,400
Total Cost: $/AF (2011)	$1,000	$1,000	$800	$800	$1,000
Total Cost: $/Gallon (2011)	$0.0031	$0.0031	$0.0025	$0.0025	$0.0031
Net Cost Tier 3 (Indirect Wastewater System Savings Plus Tier 1 and Tier 2 Savings)					
Total Costs NPV	$987,343,905	$989,290,088	$721,421,850	$713,086,968	$1,004,153,114
Total Cost, Annual Payments	$58,313,963	$58,428,907	$42,608,221	$42,115,950	$59,306,739
Total Cost: $/AF (2011)	$600	$600	$400	$400	$600
Total Cost: $/Gallon (2011)	$0.0018	$0.0018	$0.0012	$0.0012	$0.0018

** See section 8.4 for assumptions. The total costs were adjusted as noted to 2011 $'s for comparison to the SDCWA untreated water costs.*

Table 8-16. Financial Details for the Unfavorable Scenario

Item	Theme A1	Theme A2	Theme B1	Theme B2	Theme B3
O&M and Capital Debt					-
Interest from Reserve	40,515,384	40,756,326	36,991,977	37,156,991	40,385,393
Operation & Maintenance	1,757,803,600	1,753,642,189	1,612,278,853	1,599,768,756	1,799,893,592
Debt Service	1,385,732,744	1,392,960,001	1,224,977,635	1,229,911,800	1,347,713,119
Total PV Cost	$3,103,020,960	$3,105,845,864	$2,800,264,511	$2,792,523,565	$3,107,221,318
Total Cost, Annual Payments	$183,268,918	$183,435,761	$165,387,683	$164,930,491	$183,516,997
Capital (PAYGO Financed)					
PAYGO Financing	357,032,668	358,816,714	315,338,882	316,565,050	346,633,018
Total PV Cost	$357,032,668	$358,816,714	$315,338,882	$316,565,050	$346,633,018
Total Cost, Annual Payments	$21,086,867	$21,192,235	$18,624,372	$18,696,791	$20,472,649
Credits/Avoided Costs					
LRP Credit	44,501,622	44,501,622	42,540,058	42,540,058	43,660,952
Total PV Cost	$44,501,622	$44,501,622	$42,540,058	$42,540,058	$43,660,952
Total Cost, Annual Payments	$2,628,330	$2,628,330	$2,512,477	$2,512,477	$2,578,679
Tier 1: Wastewater O&M Avoided Costs	515,354,315	515,354,315	515,354,315	515,354,315	515,354,315
Wastewater PAYGO/Debt Avoided Costs	436,611,784	436,611,784	436,611,784	436,611,784	436,611,784
Total PV Cost	$951,966,099	$951,966,099	$951,966,099	$951,966,099	$951,966,099
Total Cost, Annual Payments	$56,224,498	$56,224,498	$56,224,498	$56,224,498	$56,224,498
Tier 2: Salt Credit	184,706,087	184,706,087	178,800,483	178,800,483	182,175,128
Total PV Cost	$184,706,087	$184,706,087	$178,800,483	$178,800,483	$182,175,128
Total Cost, Annual Payments	$10,909,009	$10,909,009	$10,560,216	$10,560,216	$10,759,527
Tier 3: CEPT O&M Avoided Costs	242,457,015	242,457,015	242,457,015	242,457,015	242,457,015
CEPT PAYGO/Debt Avoided Costs	362,889,796	362,889,796	362,889,796	362,889,796	362,889,796
Total PV Cost	$605,346,812	$605,346,812	$605,346,812	$605,346,812	$605,346,812
Total Cost, Annual Payments	$35,752,661	$35,752,661	$35,752,661	$35,752,661	$35,752,661
Water Produced (AF)	96,162	96,162	96,162	96,162	96,162
Gross Costs (Includes O&M, Capital, Grants and LRP)					
Total Costs NPV	$3,415,552,006	$3,420,160,956	$3,073,063,335	$3,066,548,557	$3,410,193,384
Total Cost, Annual Payments	$201,727,454	$201,999,666	$181,499,577	$181,114,805	$201,410,966
Total Cost: $/AF (2011)	$2,100	$2,100	$1,900	$1,900	$2,100
Total Cost: $/Gallon (2011)	$0.0064	$0.0064	$0.0058	$0.0058	$0.0064
Net Cost Tier 1 (Direct Wastewater System Savings)					
Total Costs NPV	$2,463,585,907	$2,468,194,857	$2,121,097,236	$2,114,582,458	$2,458,227,285
Total Cost, Annual Payments	$145,502,956	$145,775,167	$125,275,079	$124,890,306	$145,186,468
Total Cost: $/AF (2011)	$1,500	$1,500	$1,300	$1,300	$1,500
Total Cost: $/Gallon (2011)	$0.0046	$0.0046	$0.0040	$0.0040	$0.0046
Net Cost Tier 2 (Salt Credit Plus Tier 1 Savings)					
Total Costs NPV	$2,278,879,820	$2,283,488,770	$1,942,296,753	$1,935,781,975	$2,276,052,157
Total Cost, Annual Payments	$134,593,947	$134,866,158	$114,714,863	$114,330,091	$134,426,941
Total Cost: $/AF (2011)	$1,400	$1,400	$1,200	$1,200	$1,400
Total Cost: $/Gallon (2011)	$0.0043	$0.0043	$0.0037	$0.0037	$0.0043
Net Cost Tier 3 (Indirect Wastewater System Savings Plus Tier 1 and Tier 2 Savings)					
Total Costs NPV	$1,673,533,008	$1,678,141,958	$1,336,949,941	$1,330,435,163	$1,670,705,346
Total Cost, Annual Payments	$98,841,286	$99,113,498	$78,962,202	$78,577,430	$98,674,280
Total Cost: $/AF (2011)	$1,000	$1,000	$800	$800	$1,000
Total Cost: $/Gallon (2011)	$0.0031	$0.0031	$0.0025	$0.0025	$0.0031

** See section 8.4 for assumptions. The total costs were adjusted as noted to 2011 $'s for comparison to the SDCWA untreated water costs.*

8.5 Adaptability and Implementation

The implementation of this reuse plan will need to be adaptable to anticipated and unanticipated needs. Adaptability may be triggered based on financial constraints, changes in regulatory requirements, institutional coordination issues, favorable or unfavorable political and community support, and technical issues. The project implementation proposed below provides a number of key actions to help implement this reuse program and maximize adaptability to changing conditions.

Depending on the influencing forces, the pace and exact implementation may vary – for example the City may elect to pursue expanding or constructing new facilities to producing indirect potable reuse water for delivery to the San Vicente Reservoir. Another example is that the regulatory picture regarding direct potable reuse will become clearer as these projects progress. This may alter the approach, resulting in reduced piping to deliver water, but increased treatment and monitoring. The project implementation plan aims to lay these choices out in a way that can be adapted to meet the City's and Stakeholder's needs. The following details key issues that may affect adaptability through implementation:

- **Wastewater Flows.** Wastewater flows drive the amount of source water available for reuse. The wastewater totals are based on projections. As the City approaches build-out conditions, actual flows may be higher or lower. The diversity of the Integrated Reuse Alternative components and the inclusion of the strategically important Harbor Drive facility promote adaptability for all options.
- **Point Loma Plant Thresholds.** The treatment/cost thresholds for the Point Loma Plant may change over time due to advances in technology, or due to new regulatory permitting requirements. As these conditions develop, the total reuse of some projects may need to be adjusted upwards or downwards to maintain the ideal balance of cost/benefit. Updating these issues will likely be addressed in future master planning efforts.
- **Imported Water Costs.** Imported water costs have risen substantially in the past few years, well outpacing inflation rates. The SDCWA is projecting that above average rate impacts will continue in the near future. Imported water costs, particularly untreated water costs, are an important financial benchmark for new, local water supplies. If untreated water rates rise more than expected, future updates to this Study may adapt to develop even more reuse due to consumer pressure for lower cost water.
- **Direct Potable Reuse.** One of the biggest unknowns, and potentially the most impactful, is whether direct potable reuse will be allowed in California in the near future. SB918 mandated that CDPH "investigate the feasibility of developing uniform water recycling criteria for direct potable reuse" by December 31, 2016. If direct potable reuse is approved, it would directly integrate the advanced water purification facility output water into the potable water treatment plants (without going to San Vicente Reservoir for example), and also allow integration with the regional untreated water aqueduct system. If direct potable reuse is allowed, the Study approaches would most likely be adapted at the Harbor Drive stage. The Harbor Drive Plant discharge pipe length would likely be shortened to deliver the water to Lake Murray and the Alvarado (Potable) Water Treatment Plant.

8.5.1 Implementation Summary

Implementing the Integrated Reuse Alternatives involves a step-by-step process as shown on Figure 8-9. Although part of the implementation process includes common elements regardless of the alternative, it is important to note that the latter steps are affected by these earlier phase projects. Therefore, implementation considerations are important even during the first phase projects. This section summarizes the planned implementation process and the key considerations needed to successfully implement this important program.

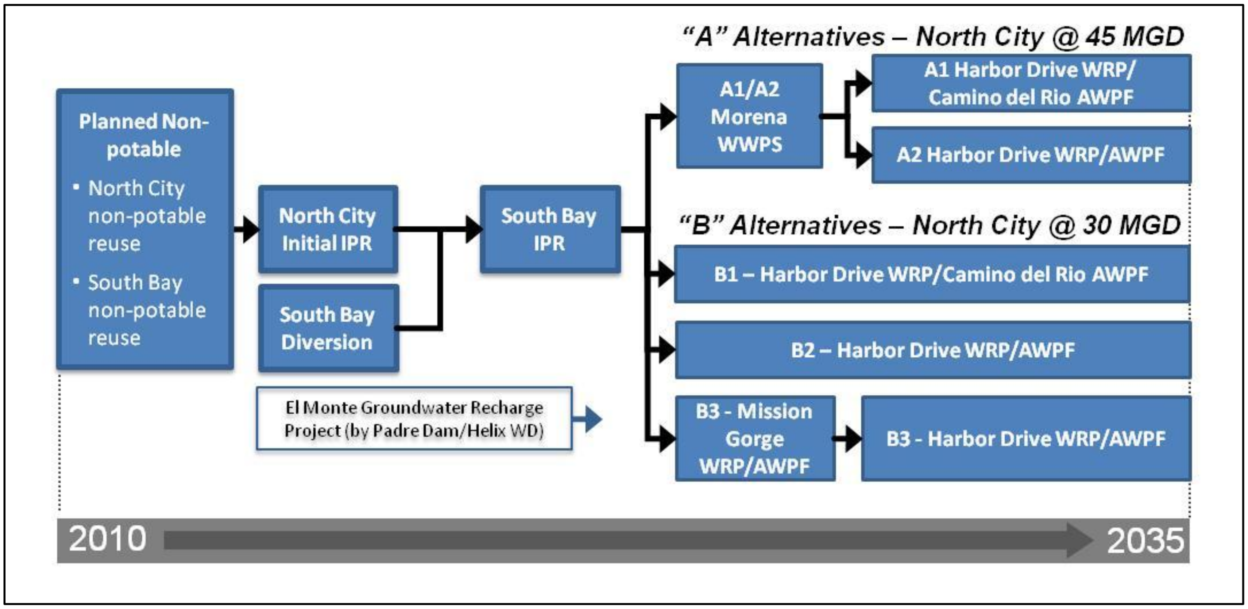


Figure 8-9. Reuse Plan Summary

The implementation plan summarizes the basic roadmap to complete the reuse plan.

Achieving the benefits identified in this report requires an investment. Some of these investments have already been started, such as the Water Purification Demonstration Project now operating at the North City Plant. To proceed to the next steps in this study, additional investments will be needed to plan and develop the program to a level of detail that can be designed, permitted and constructed. These investments are referred to as program implementation steps. The following sections organize these key implementation steps into a number of broad categories.

8.5.2 General

- Develop timeline for implementation steps outlined below.

8.5.3 Water Purification Demonstration Project/Permitting

The Water Purification Demonstration Project (Demonstration Project) and the San Vicente flow modeling are key steps of the public involvement and regulatory permitting processes to confirm the health and safety of the new water supply.

- Obtain Advanced Water Purification Facility water quality and San Vicente limnology model final results.
- Provide on-going public involvement and community outreach.
- Coordinate with CDPH and the Regional Water Quality Control Board on processes and permitting (whether through uniform criteria being developed by CDPH or project specific criteria).

- Promote advocacy by Stakeholder groups with CDPH and the Regional Water Quality Control Board.

8.5.4 Mayor and City Council

Support from the Mayor and City Council is essential to implement such an important program. While the reuse program appears to offer substantial cost savings to ratepayers (compared to upgrading the Point Loma Plant for the full-scale flows), support from policymakers to advance the program will be needed.

- Obtain Independent Rates Oversight Committee support.
- Obtain Natural Resources and Culture Committee approval.
- Obtain stakeholder advocacy support of the Study by the Metro JPA, Independent Rates Oversight Committee, environmental groups, and other interested parties.
- Obtain City Council approval.
- Coordinate implementation with broader water policy issues and programs.

8.5.5 Metro JPA Approval

As partners in the Metro System, support from the Metro JPA is also essential to implement such an important program. Support from JPA policymakers is needed to advance the program.

- Develop and finalize a cost sharing framework, as summarized below. This includes policy and legal issues, costs and consensus.
- Promote stakeholder advocacy in support of the Study by the City, Independent Rates Oversight Committee, environmental groups, and other interested parties.
- Obtain Policymaker support and accept the Study and the reuse program.

8.5.6 Financials/Policy

Fiscal responsibility is important for all parties. For Water and Wastewater ratepayers, there is an important choice required regarding whether to fund this water reuse plan or potentially fund full-scale improvements at the Point Loma Plant.

- Complete discussions on cost share framework concepts and agreements, clarify City and Participating Agency costs, and clarify sources for offset such as the salt credit.
- Provide comparative financial analyses with other alternative water sources (if desired).
- Determine/develop policy on local resource program funding from SDCWA/MWD.
- Determine SDCWA policy on regional supply benefits, interest in joint participation, and potential rate impacts/savings.
- Seek out and apply for grants.
- Develop rate impacts and a detailed financing plan.
- Provide funding and staff to move forward with the program implementation, including the activities needed for near-term and long-term projects.
- Develop policy on SBx7-7 stemming from new locally produced water supply.

8.5.7 Permitting

Implementing the reuse plan will require addressing key permitting activities:

- Point Loma Permitting. Continue permitting coordination amongst Stakeholders as part of the Point Loma Plant 301(h) Modified Permit process. These discussions are assumed to be related to the cost sharing discussions outlined above.
- Project Permitting. Identify, evaluate and obtain permits needed to complete the reuse projects.

8.5.8 Technical/Other

Implementing the reuse plan will require technical evaluations and engineering.

- **Reuse Program/wastewater planning process coordination.** On-going coordination between the proposed reuse program and wastewater planning efforts to refine facilities and costs in support of the cost sharing discussions and Point Loma permitting process.
- **North City treatment.** Determine the North City treatment approach (existing filters, feed source, recovery rates, electrodialysis reversal unit's removal, and other technical design parameters).
- **Non-potable reuse demands and wastewater flow confirmation.** Continue to evaluate non-potable reuse demands and use trends; and wastewater flow generation. These totals will be important to finalize the size of indirect potable reuse projects.
- **New facility siting.** Develop detailed siting studies for new pump stations and treatment plants, including evaluation and confirmation of availability of the Harbor Drive and Camino del Rio sites.
- **Wastewater Treatment pilot testing.** Test high rate systems to develop area-specific values for clarifiers to be used in the design of treatment systems.
- **New conveyance facility alignments.** Perform alignment studies for new conveyance facilities.
- **SV8 Diversion to South Bay.** Update the SV8 Pump Station Predesign and Sweetwater River crossing. Coordinate efforts between the Recycled Water Study needs and the September 2011 Draft Wastewater Master Plan needs.
- **South Bay Plant.** Continue discussion and coordination on South Bay Plant issues, particularly sizing and timing needed for reuse based on recent revisions to the September 2011 Draft Wastewater Master Plan. Key coordination issues include South Bay timing (both from reuse and wastewater perspectives), and the biosolids approach strategy. This includes evaluating/determining whether biosolids will be treated at the South Bay Plant at a dedicated facility instead of continuing to send it to the Point Loma Plant and the MBC for treatment. These coordination items will aid in determining cost responsibilities as outlined in the financial implementation steps above.
- **South Bay indirect potable reuse delivery.** Perform detailed evaluation of the South Bay Plant expansion including pump station and delivery pipeline to Otay Lakes.
- **Otay Lakes operation.** Perform an Otay Lakes operational evaluation in relation to local runoff and indirect potable reuse operation to confirm flow rates and optimal project sizing.
- **Joint Project Evaluation.** Identify opportunities of joint projects, such as brine pipelines or indirect potable reuse delivery pipelines coordinated with other regional projects.
- **Mission Gorge Plant Evaluations.** Coordinate further discussion and evaluation on the merits of a joint plant with Padre Dam Municipal Water District in the Mission Gorge area (conceptualized in Alternative B3). Evaluate possible additional savings at the East Mission Gorge Pump Station and additional avoided facility savings in downstream facilities.
- **Groundwater updates.** Complete groundwater studies including evaluation of the San Diego Formation and San Diego River system for possible inclusion into future master planning efforts.

Update the status of other County groundwater studies including San Pasqual and Padre Dam Municipal Water District's studies.

- **Waste stream recovery.** Evaluate waste stream efficiency and recovery analysis to evaluate ways to further minimize waste streams and explore beneficial uses.
- **San Vicente regulatory limits and operational coordination.** Perform San Vicente analysis to evaluate maximum potential indirect potable reuse. If it is limited, determine options such as further evaluation of the San Diego formation or integration with other reservoirs. Coordinate reuse operational activities with other San Vicente operations after the dam raise is complete.
- **Regulatory update on minimum reservoir capacities.** Check assumptions on smaller sized reservoirs (Lakes Murray, Miramar and Jennings) once indirect potable reuse reservoir augmentation regulations are finalized.
- **SDCWA Coordination.** Coordinate with SDCWA on their Master Plan (currently underway), broader water policy support at the state level, and possible regional collaboration involving funding.
- **Peak Wet Weather Flow Strategies.** Continue to evaluate fail-safe disposal strategies under wet weather conditions, including equalization, live stream discharge, and CEPT-secondary effluent blending at the Point Loma Plant.

8.5.9 Cost Sharing Implementation Considerations

Recognizing that cost sharing would be an important step in implementing this Study, the City engaged the Study's Stakeholder group (which includes Participating Agency representatives) in an initial cost-sharing discussion. This discussion was held during Status Update Meeting No. 9 on March 29, 2011. A follow-up meeting with additional Participating Agency representatives was held on April 11, 2011. The follow-up meeting included a more detailed discussion of cost sharing concepts. It was anticipated that these concepts could become the framework for a cost-sharing agreement between the City and Participating Agencies. The following sections summarize concepts and key issues discussed.

8.5.9.1 Cost Sharing Concepts

Five framework concepts were presented at the April 11, 2011, cost-sharing concepts meeting.

- **Planned Wastewater System Expenses versus this Study.** This concept involves comparing the September 2011 Draft Wastewater Master Plan Capital Improvement Project plan costs with this Study's costs. To accomplish this, secondary treatment upgrade costs for 125 mgd were added to the wastewater system expenses to make both approaches comparable (i.e., both assumed secondary treatment would be required for the remainder of flow still going to the Point Loma Plant).
- **Water Expenses versus Wastewater Expenses.** This concept is similar to the cost-sharing approach used for North City and South Bay Plants, which included allocating the costs through secondary treatment upgrades to the wastewater system and costs beyond secondary treatment upgrades to the water system. Facility costs are identified as either benefitting the water system or the wastewater system.
- **Permit Mandate.** This concept assumed that the entire responsibility for the Recycled Water Study costs would be borne by the City's and Participating Agencies' wastewater customers. This would occur if a future Point Loma Plant permit would require implementing one of the plans contained in this Study.

- **50-percent/50-percent Split.** This concept recognizes that recycled water has significant benefits to both the water and wastewater systems and that splitting the benefits between the two systems is too qualitative to reach a fair, quantifiable split. This concept was considered a possible fit if consensus was not reached on the more detailed cost-share approaches.
- **Value Assessment.** This concept focused on adjusting the cost share to match the value of untreated water. Early in the implementation, recycled water costs will be higher than untreated water. The wastewater system would be responsible for paying the difference between untreated water costs and the recycled water costs. Over time, untreated water costs are anticipated to increase above the recycled water costs. At this time, the water system would bear all the costs of the recycled water system since the overall cost is lower than untreated water.

Participants refined the Coarse Framework Concepts described above into the refined approaches described below.

- **Cost Sharing Concept No. 1 - Planned Wastewater System Expenses vs. this Study.** This concept was maintained since it forms the baseline assumption that there may be sizable wastewater system costs unless offloading occurs at the Point Loma Plant. This concept was also considered important from a policy maker's perspective since it highlights ratepayer impacts.
- **Cost Sharing Concept No. 2 - Water Expenses vs. Wastewater Expenses.** This concept was based on the Value Assessment Concept described above, with two alternatives approaches.
  - **Concept 2A – Water vs. Wastewater (similar to previous North City Plant and South Bay Plant cost-sharing approach).** This approach is best outlined as follows:
    - Identify facility costs associated with water system benefits.
    - Identify facility costs associated with wastewater system benefits.
    - Identify facility costs where the benefits could arguably be for either the water or wastewater systems.
    - Negotiate the facility costs that are listed as a potential to be either a water system or wastewater system benefit.
  - **Concept 2B – Water vs. Wastewater (including value of water).** This approach follows Concept 2A except it includes capturing the value of the water produced in the cost sharing and may include some portion of the revenue generated by the water created as a credit back to the wastewater system.
- **Cost Sharing Concept No. 3 – Permit Mandate.** This concept was maintained similar to Concept No. 1 since it represents a potential regulatory/legal issue that is an important consideration for policy makers.

Lastly, the salt credit will need to be discussed regarding the benefits and how benefits are accounted for.

8.5.9.2 Other Cost Sharing Considerations

Two initial coarse framework concepts were dropped from further refinement; however, it is important to note a few considerations on these approaches. The 50 percent/50 percent split was considered to lack a strong basis, but it was noted that this consideration assumed that an agreement would be met on the more detailed cost-share concepts. If an agreement cannot be reached on a detailed cost-share concept then the 50 percent/50 percent split could be considered. Orange County Water District and Orange County Sanitation District successfully used this approach for their Groundwater Recovery System project when an agreement was not reached using other methods. In addition, the value approach discussed as a coarse concept was not discounted, but incorporated into the water/wastewater system cost-sharing concept 2B. Ultimately, the cost-share discussion will require policy maker input, and this framework is intended to initiate the process.

8.5.10 Point Loma Plant Improvements During Implementation

The City, the Participating Agencies, the Environmental Protection Agency, and the Stakeholder group will be key participants in addressing the Point Loma Plant as the reuse plan is implemented. The plan assumes that any secondary treatment upgrades (if required) at the Point Loma Plant would be determined during the implementation stage of the project. This approach would allow determining the actual solids mass emission rates occurring after the new reuse projects offload flows to the Point Loma Plant and after solids are removed and sent to the Metropolitan Biosolids Center. Although the study looked at both secondary treatment and CEPT approaches at the Point Loma Plant, making a determination on CEPT would clarify the avoided facilities savings element associated with the financial evaluation section above.

8.5.11 Harbor Drive Facility Implementation

The Harbor Drive site is located at the confluence of the City's two largest interceptor sewers: the North Metro Interceptor and the South Metro Interceptor. At this location, a majority of the wastewater generated within the Metro System collects before being pumped to the Point Loma Plant. The City owns approximately 77 acres at the site, 22 of which could potentially be available for a treatment facility. Currently, the site contains a park, Pump Station No. 2, the City's Environmental Monitoring & Technical Services Division facility, and firefighter training facilities.

A new police and firefighter training center is currently planned for a portion of the site. Discussions have begun to determine if the police and firefighter training facilities can be located elsewhere. The City evaluated the potential to locate the treatment facility at another location and determined that no other sites are feasible (Appendix E); therefore, it is critical the City reserve this site for a future Harbor Drive treatment facility.

A membrane bioreactor (MBR) treatment process was selected for the Harbor Drive site because of land constraints. The MBR process requires less land than conventional processes. A preliminary review of the site indicated a 60-mgd MBR facility could potentially fit within the site; however, a more detailed evaluation is required to determine the maximum facility capacity that would fit within the site limits. If it is not possible to co-locate an AWPF at the Harbor Drive site, it is possible to pump tertiary effluent produced by an MBR facility to another location for advanced treatment.

The site is near the airport, San Diego Bay, and several waterfront hotels. This places strict height restrictions on structures and requires ample odor control and aesthetic treatment. In addition, groundwater must be taken into consideration during design and construction because of the proximity to the bay. A detailed siting evaluation that includes facility layouts is needed.

In the event the Harbor Drive facility is not available, the level of indirect potable reuse could be significantly reduced and the cost of producing the same amount of treated water could significantly increase. Options include further investigation of alternative sites, additional diversions to South Bay, or other reuse options evaluated in the Area Concepts. While it is possible to replace the Harbor Drive project with other projects, they will likely be more expensive and impactful to complete.

8.5.12 Pipeline Phasing between the North City Plant and the San Vicente Reservoir

Selection of the pipeline from the North City Plant to the San Vicente Reservoir is critical. The initial North City indirect potable reuse project requires the indirect potable reuse water delivery pipeline be sized between the North City Plant and the San Vicente Reservoir. The pipe size is dependent upon a decision about future steps and whether the ultimate pipe size is constructed to maximize cost savings. If Integrated Reuse Alternative A1 or A2 is selected, a larger pipe is needed. Additionally, the decision must be made whether or not to construct a larger pipeline from Mission Gorge to San Vicente in anticipation of a Harbor Drive or

Mission Gorge project. If **direct** potable reuse becomes viable in the future, then the Harbor Drive facility will likely convey advanced purified water to the Alvarado Water Treatment Plant, and a larger-diameter pipe from Mission Gorge to San Vicente would not be needed.

This is a critical decision that will have cost impacts. A comprehensive plan is required before building the pipeline so that the decisions about future facilities have been made prior to design and construction. A future update to the regulatory considerations regarding direct potable reuse may aid the decision process.

8.6 Conclusion

Overall, the Integrated Reuse Alternatives presented in this Study achieves the Study's goals, provides a bold vision for future water reuse in the Metro Service Area, and provides potential savings to ratepayers. The Study's Stakeholders provided valuable opinions and diverse viewpoints that added value to the process and the alternatives developed. While water reuse has been evolving in San Diego over the past few decades, the region's master plans have helped guide decision makers with a focus on making good investments, while still being flexible to adapt to future changes. This Study endeavors to continue this tradition, and be looked upon as a milestone that helped provide long-term water sustainability to the San Diego region.

9. STUDY OUTREACH AND APPROVALS

The final Stakeholder meeting was held on March 22, 2012 to review and discuss comments submitted by the group, and to finalize the Study report. Representatives from all Stakeholder groups were present. The group agreed that it had been a productive session, that the final document reflected their respective views, and that the process had been inclusive. Following this meeting, the Study team incorporated the final set of comments into the Study document. The Stakeholders requested that the City communicate to them the schedule of any Study presentations they were making so that they could attend if their schedules permitted.

At the request of the Participating Agencies, a presentation on the Study was made to the elected officials of the Metro JPA (Metro Commission/JPA) on May 3, 2012. The Metro Commission/JPA responded favorably to the presentation, asked a number of questions, and provided the team with feedback and suggestions that were subsequently incorporated into the presentation materials. The Metro Commission/JPA requested that the team attend their June meeting to address any additional questions they may have. Representatives from environmental stakeholder groups were also present at this meeting.

On May 21 and 23, respectively, the project team made a presentation on the Study to IROC, and the Natural Resources & Culture Committee (NR&C). The Study report was favorably received by IROC which voted to approve it. A number of speakers spoke in favor of the Study, including representatives from San Diego Coastkeeper, Surfrider Foundation and the business community. The speakers told committee members that they supported the study and its outcome, encouraged Council to move forward with implementation, and spoke of the rising cost of imported water and the importance of a local water supply. NR&C committee members asked a number of questions which were answered at the meeting and in a follow up memorandum. The NR&C voted unanimously to accept the Study.

On June 7, 2012, project team members attended the Metro Commission/JPA meeting. The Metro Commission/JPA unanimously approved a letter to the City formally accepting the Study, and acknowledged that the process was very collaborative (Appendix L). In the letter, the Metro JPA indicated an interest in continuing to work cooperatively with the City on stated Study objectives and implementation activities identified in the report.

On June 19, 2012, City Study team members gave a presentation on the Study to regional water agency general managers attending their monthly meeting convened by the San Diego County Water Authority. The General Managers asked questions and were appreciative of the presentation.

The Study was presented at the July 17, 2012 City Council meeting. Stakeholders representing San Diego Coastkeeper, Surfrider Foundation, IROC, the Metro JPA and TAC all spoke in favor of the Study. San Diego Coastkeeper and Surfrider speakers told the City Council that the Study met their expectations, they were pleased with the final result, and that it fulfilled the City's Cooperative Agreement obligation (Appendix A). Other speakers commented on the collaborative stakeholder process and spoke favorably of the Study meeting its objectives. City Council members were appreciative of Stakeholder involvement, expressed thanks to those in attendance, and voted unanimously to accept the Study (Appendix M).

CONTACTS

The project team consisted of City staff from the Public Utilities Department, and a consulting team from Brown and Caldwell, Black & Veatch, and CDM.

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GLOSSARY

Acre-foot (AF): A unit commonly used for measuring the volume of water, equal to the quantity of water required to cover one acre to a depth of one foot. An acre-foot is 325,851 gallons and is considered enough water to meet the needs of two families of four for one year.

Acre-feet per year (AFY): The amount of water (in acre-feet) used, bought or produced in one year. City of San Diego Assembly on Water Reuse: American Assembly-style workshop that brought together diverse stakeholders to examine public policy questions and recommend action.

Advanced Treatment: Additional treatment provided to remove suspended and dissolved substances after conventional secondary treatment. Often, this term is used to mean additional treatment after tertiary treatment for the purpose of further removing contaminants of concern to public health. This may include membrane filtration, reverse osmosis (RO), advanced oxidation, and disinfection with ultraviolet light (UV) and hydrogen peroxide (H_2O_2).

Advanced Water Purification Facility (AWPF): A treatment facility that utilizes advanced treatment to treat tertiary water.

Aquifer: A geologic formation that stores water and yields significant quantities of water to wells or springs.

Area Concepts: A term used to describe conceptual reuse opportunities developed for a specific area of the Metro System service area.

Augmentation: The process of adding recycled water that has received advanced treatment to an existing untreated water supply (such as a reservoir, lake, river, wetland, and/or groundwater basin) that could eventually be used for drinking water after further treatment.

Annual Average Daily Flow with 10-year Return Event (AADF). The AADF 10-year storm condition used in this Study is based on 2050 wastewater flows, represents the amount of wastewater generated over one year, and contains a wet weather component based on a 10-year return period. This flow condition was peaked to determine the peak wet weather flow condition used in sizing the Point Loma and South Bay Plants during critical flow conditions.

Avoided Costs: The cost savings that may accrue to a water provider if a given water reuse project delays or eliminates the need for a water or wastewater system improvement project.

Beneficial Use (of water): A use of water resulting in appreciable gain or benefit to the user, consistent with state law, which varies from one state to another. In California, beneficial uses of waters of the state that may be protected against quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural, and industrial supply, power generation, recreation, aesthetic enjoyment, navigation, as well as preservation and enhancement of fish, wildlife, and other aquatic resources or preserves. (Water Code, Section 13050(f)).

Biochemical Oxygen Demand (BOD): A widely used parameter used to determine the level of organic pollution in a sample of water. It is the measurement of dissolved oxygen used by microorganisms to biochemically oxidize organic matter in a water sample in 5 days at 20 degrees Celsius.

Blending: Mixing or combining one water source with another.

Caltrans: California Department of Transportation

CDPH: California Department of Public Health

Chemically Enhanced Primary Treatment (CEPT): The process by which chemicals are added to primary sedimentation basins causing the suspended particles to clump together and settle faster, thereby enhancing treatment efficiency, measured as removal of solids, organic matter and nutrients from the wastewater. The chemicals utilized in CEPT are the same ones commonly added in potable water treatment. This is the level of treatment currently employed at the Point Loma Wastewater Treatment Plant.

City: City of San Diego

Coarse Screening Session: A work session held August 2-3, 2010 that was attended by the City, the City's consultant team, the Study's independent technical reviewer, and JPA representatives. The focus of the session was to evaluate non-potable and indirect potable reuse opportunities throughout the region.

Contaminant: An undesirable substance not normally present or an unusually high concentration of a naturally occurring substance in water, soil or other environmental medium.

Contaminants of Emerging Concern (CECs): Chemicals are being discovered in water that previously had not been detected or are being detected at levels that may be significantly different than expected. These are often generally referred to as "contaminants of emerging concern" (CECs) because the risk to human health and the environment associated with their presence, frequency of occurrence, or source may not be known. EPA is working to improve its understanding of a number of CECs, particularly pharmaceuticals and personal care products (PPCPs) and perfluorinated compounds among others. *(EPA Website, http://water.epa.gov/scitech/cec/)*

Costs: The capital and operating expenses of constructing and operating a water reuse project, typically consisting of (1) capital costs, the initial expenditures to design and construct project facilities; and (2) operating costs, the ongoing annual expenses associated with operating the project, including labor, material, and energy costs.

Council: The City Council of San Diego

CWA: Federal Clean Water Act

Demineralization: A process that removes dissolved minerals from water. In some cases, a percentage of water is demineralized and blended back in with the original source water to dilute the level of dissolved solids in the source water.

Detention Time: In storage reservoirs, the length of time water will be held before being extracted from the reservoir for treatment.

Direct Injection: Injecting recycled water through an injection well directly into a groundwater basin. If the water will later be used for drinking, the recycled water will receive advanced treatment prior to injection.

Direct Potable Reuse: The planned introduction of advanced purified water either directly into a public water system, or into an untreated water supply, immediately upstream of a water treatment plant.

Disinfection: Removal, destruction or inactivation of any harmful microorganism

Disinfection By-Products: Compounds formed when chlorine combines with naturally occurring or pollution-derived organic, carbon-based materials, such as the acids from soils or decaying vegetation and bromide (salt).

Drinking Water: See "Potable Water."

Dry Weather Flow (DWF). The DWF condition used is based on 2035 wastewater flow projections and represents the amount of wastewater generated over one year without any consideration of the wet weather component (infiltration and inflow). This flow condition was used to size recycling facilities that are upstream of the Point Loma Wastewater Treatment Plant and that have no outfall.

Endocrine Disrupting Compounds (EDCs): Chemicals that can interfere with the normal hormone function in humans and animals.

EPA: United States Environmental Protection Agency

Eutrophication: The process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates, promoting excessive growth of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. Eutrophication is a natural, slow-aging process for a water body, but human activity greatly speeds up the process. *(USGS Website)*

Fine Screening Session: A work session held October 19, 2010 that was attended by the City, the City's consultant team, the Study's independent technical reviewer, and JPA representatives. This work session focused on refining the Area Concepts into the final integrated reuse alternatives.

Firm Supply: A water supply is considered firm if it is a reliable source for a community, either by legal rights or by natural availability. Recycled water is usually considered to be a firm supply as its source remains available even during dry years.

Framework Planning Session: A work session held on March 2, 2010 that was attended by the City, the City's consultant team, and the Study's independent technical reviewer. This work session was held to align the City, the consultant team, and stakeholders on key project issues, processes, and future steps.

Groundwater: Water beneath the Earth's surface that could supply wells or natural springs.

Groundwater Basin: A groundwater reservoir, defined by an overlying land surface and the underlying aquifers that contain water stored in the reservoir. In some cases, the boundaries of successively deeper aquifers may differ and make it difficult to define the limits of the basin.

Groundwater Recharge: Naturally or artificially adding water back into a groundwater basin by allowing the water to seep through the ground or by injection.

Grove Avenue Pump Station (GAPS): A pump station located in the South Bay that conveys wastewater to the South Bay Water Reclamation Plant.

Hale Avenue Resource Recovery Facility (HARRF): An 18 mgd wastewater treatment facility owned and operated by the City of Escondido.

Harbor Drive Plant: Refers to a new treatment facility conceptualized during this Study. The proposed location is on Harbor Drive near Pump Station No. 2.

Helix: Helix Water District

IBWC: International Boundary and Water Commission.

Imported Water: Water transported from one region or area to another.

Indirect Potable Reuse: Indirect potable reuse is the planned use of advanced purified water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system, or the planned placement of recycled water into a surface water reservoir used as a source of domestic drinking water supply.

Infill: Increase water reuse demand through connection of large users within 1,320 feet (quarter-mile) of the existing reclaimed water pipeline.

Integrated Reuse Alternatives: Regional recycled water plans developed by combining Area Concepts. These alternatives were developed for policy makers to review, examine and debate as part of establishing the course for reuse in the region. The Integrated Reuse Alternatives were formed based on the project goals established by the project stakeholders.

JPA: The San Diego Metropolitan Wastewater Joint Powers Authority. A coalition of municipalities and special districts in San Diego County that share in the use of the City of San Diego's region wastewater system. The JPA member agencies are the cities of Chula Vista, Coronado, Del Mar, El Cajon, Imperial Beach, La Mesa, National City and Poway; the Lemon Grove Sanitation District; the Padre Dam Municipal and Otay Water Districts; and the County of San Diego (on behalf of the Winter Gardens Sewer Maintenance District, and the Alpine, Lakeside and Spring Valley Sanitation Districts).

Mass Emission Rate (MER): The rate of discharge of a pollutant expressed as a weight per unit time, usually as pounds or kilograms per day or metric tons per year .

MCL: Maximum Contaminant Level as defined in the EPA Drinking Water Standards.

Membrane Bioreactor (MBR): A type of biological wastewater treatment process that uses membranes to filter the wastewater.

Metropolitan Biosolids Center (MBC): The City of San Diego's solids processing facility located north of State 52 and adjacent to the Miramar Landfill.

Metro System: The Metropolitan Wastewater System.

MG: Million gallons.

MGD: Million gallons per day.

Microfiltration (MF): The separation or removal from a liquid of particulates and microorganisms in the size range of 0.1 to 2 microns in diameter. (A micron is a millionth of a meter. A sheet of ordinary 20-weight copier paper is about 90 microns thick.)

Mission Gorge Plant: Refers to a new treatment facility conceptualized during this Study that could either be located near the East Mission Gorge Pump Station or at the Padre Dam Water Reclamation Facility.

Multi-Barrier Approach: Treatment barriers designed to remove various types of contaminants using independent processes, insuring that treatment will not be compromised if any process were to fail.

Multiple Treatment Barriers: Each barrier is designed to provide substantial protection with redundant barriers for each type of treatment. A requirement for multiple barriers assures the overall water treatment process will remain effective if one treatment barrier were to fail.

MWD: Metropolitan Water District of Southern California.

National Pollutant Discharge Elimination System (NPDES): The program established by the Federal Clean Water Act that requires all sources of pollution discharging into any "waters of the United States" to obtain a permit issued by the Environmental Protection Agency or a state agency authorized by the federal agency. The NPDES permit lists permissible discharges and/or the level of cleanup technology required for wastewater.

North City Plant: The abbreviated name for the North City Water Reclamation Plant, a water reclamation plant in the Eastgate Mall area, bordered by Interstate 805 to the west, Miramar Road to the south and Eastgate Mall Road to the north, and an open wildlife preserve of the east. The plant is owned and operated by the City of San Diego.

North City Water Reclamation Plant: See North City Plant.

Non-potable Recycled Water: Synonymous with Non-potable Reclaimed Water, State of California Title 22 Water, and tertiary treated water. Non-potable recycled water is a form of water reuse that includes primary, secondary and tertiary treatment to produce water suitable for a variety of applications, most notably for landscaping irrigation and industrial uses. Further treatment is required for integration with drinking water systems – see indirect potable reuse.

NRC: National Research Council

NWRI: National Water Research Institute

O&M: Operation and Maintenance

Ocean Outfall: A large pipeline used to dispose of treated wastewater offshore.

OPRA: Federal Ocean Pollution Reduction Act.

Otay: Otay Water District.

Padre Dam: Refers to the Padre Dam Municipal Water District.

Participating Agency: A JPA member agency. See "JPA".

Pathogens: Disease-causing organisms (generally viruses, bacteria, protozoa, or fungi).

Peak: An identified period of time when the maximum amount of water is used or the maximum amount of wastewater is measured or received at a treatment plant (typically during wet weather periods).

Peak Wet Weather Flow (PWWF). The 10-year return PWWF condition used in this Study is based on 2050 wastewater flow projections and is determined by applying a peaking factor to the 10-year return AADF to obtain the peak daily flow occurring during the 10-year return event (i.e., AADF is the annual average flow including the wet weather return period and PWWF is the peak daily flow during the return event). This flow condition applies to the strategy and design of the Point Loma and South Bay Plants to handle a peak wet weather event.

Potable Water: Synonymous with drinking water. Specifically, fresh water that meets the level of quality as established in the EPA Drinking Water Standards.

Poway: City of Poway

PPCPs: Pharmaceuticals and personal care products.

Preliminary Treatment: The first major stage of treatment encountered by domestic wastewater where rags, screenings and grit are removed.

Primary Treatment: The removal of particulate materials from domestic wastewater, usually by allowing the solid materials to settle as a result of gravity.

Public Utilities Department (PUD): The City department responsible for the management and operation of the water and wastewater facilities owned by the City.

Pump Station No. 1 (PS1): A City wastewater pump station located on Harbor Drive near National City. This pump station pumps wastewater from the South Bay area to PS 2.

Pump Station No. 2 (PS2): A City wastewater pump station located on Harbor Drive just west of San Diego International Airport. This pump station pumps wastewater from the Metro System collection area to the Point Loma Plant.

Purified, Advanced Purified, or Advanced Treated Water: Purified, advanced purified, or advanced treated water undergoes advanced treatment processes to convert non-potable recycled water to a highly purified water quality, suitable for augmentation to an untreated drinking water source. Advanced purified water is currently used for indirect potable reuse projects.

Reclaimed Water: The end product of wastewater reclamation that meets water quality requirements for biodegradable materials, suspended matter, toxicants, and pathogens. Reclaimed water is sometimes another name for recycled water.

Recycled Water: Reclaimed water that meets appropriate water quality requirements and is reused for a specific purpose.

Recycled Water Master Plan (RWMP): Refers to the City of San Diego Recycled Water Master Plan. The update of this plan was developed in conjunction with this Study.

Repurified Water: Recycled water treated to an advanced level suitable for augmentation to a drinking water source.

Residence Time: See "Detention Time."

Reverse Osmosis (RO): A common water filtration process that uses a semi-permeable membrane which allows water to pass through it, while removing contaminants.

Regional Water Quality Control Board (Regional Water Boards): Refers to the Region 9 Board of the California State Water Resources Control Board, which includes the San Diego Region. The RWQCB develops basin plans for the San Diego hydrologic areas, govern requirements/issue waste discharge permits, take enforcement action against violators, and monitor water quality.

SANDAG: San Diego Association of Governments.

SDCWA: San Diego County Water Authority.

Secondary Treatment: Treatment following primary treatment. Removal of biodegradable organic matter and suspended solids from wastewater.

Senate Bill 918 (SB 918): A California Senate Bill approved in 2010 that requires the California Department of Public Health to adopt uniform water recycling criteria for groundwater recharge by December 31, 2013, develop and adopt uniform water recycling criteria for surface water augmentation by December 31, 2016, and investigate and develop a report on the feasibility of direct potable reuse by December 31, 2016.

Soil-Aquifer Treatment: The process of water being purified by percolating through soil and into an underground aquifer.

South Bay Plant: Also known as the South Bay Water Reclamation Plant, a water reclamation plant in the South Bay owned and operated by the City of San Diego.

South Bay Water Reclamation Plant: See South Bay Plant.

Stakeholders: Individuals and organizations who are involved in or may be affected by a proposed action, such as construction and operation of a water recycling project.

Status Update Meetings: Meetings held every two months throughout the Study to update Stakeholders on the Study's progress and findings, and to solicit input from Stakeholders.

Study: City of San Diego Recycled Water Study.

Supply Reliability: The reliability of the City's combined sources of supply of water under a variety of hydrologic and other conditions.

Tertiary Treatment: Treatment beyond secondary treatment typically involving the removal of residual particulate matter by granular media, surface, or membrane filtration.

Title 22 Treatment (Title 22): A method of tertiary wastewater treatment approved by DHS for many water reuse applications. Title 22, Chapter 4 of the California Code of Regulations, outlines the level of treatment required for allowable uses for recycled water, including irrigation, fire fighting, residential landscape watering, industrial uses, food crop production, construction activities, commercial laundries, road cleaning, recreational purposes, decorative fountains, and ponds.

Total Dissolved Solids (TDS): A measure of the amount of material dissolved in water (mostly inorganic salts). An important use of the measure involves the examination of the quality of drinking water.

Total Suspended Solids (TSS): All particles suspended in water which will not pass through a 0.45 micron glass-fiber filter.

Ultrafiltration (UF): A membrane filtration process that falls between reverse osmosis (RO) and microfiltration (MF) in terms of the size of particles removed. UF removes particles in the 0.002 to 0.1 micron range, and typically removes large organic molecules, while allowing smaller molecules to pass.

Ultraviolet Treatment (UV): The use of ultraviolet light for disinfection.

Uninterruptible Water Supply: Indirect potable reuse water is considered uninterruptible because it is not influenced by drought, water rights, or other supply interruptions such as the decision to decrease Southern California water supply because of endangered species in the California Bay-Delta.

Untreated Water (sometimes referred to as Raw Water): Water that is collected and stored in local surface water reservoirs and groundwater basins prior to treatment at a potable (drinking) water treatment plant. Untreated water examples include Colorado River water, water from the California Bay-Delta, and runoff from local rainfall.

Wastewater: Wastewater is generally used to describe sewage that comes from homes, industry or businesses. Wastewater is collected and treated at wastewater treatment plants. In San Diego, some wastewater is currently reclaimed as non-potable recycled water; however, the majority is treated and discharged to the ocean. Wastewater is needed for water reuse. Wastewater does not include stormwater in San Diego. Stormwater is collected in separate systems and typically not treated before discharge to streams and the ocean.

Wastewater Master Plan (WWMP): Refers to the City of San Diego, September 2011 Draft Metropolitan Wastewater Plan.

Water Purification Demonstration Project (WPDP): A project currently underway at the City's North City Plant that is evaluating advanced treatment technologies to help determine the feasibility of reservoir augmentation in San Diego. A study of the San Vicente Reservoir is also being conducted to test the key functions of reservoir augmentation and to determine the viability of a full-scale project. No purified water will be sent to the reservoir during the demonstration phase.

Water Reclamation: (1) The treatment of water of impaired quality, including brackish water and seawater, to produce a water of suitable quality for the intended use; and (2) A term synonymous with water recycling.

Water Recycling: The process of treating wastewater for beneficial use, storing and distributing recycled water, and the actual use of recycled water. Also see Water Reuse.

Water Reuse: Water reuse is a broad term used to describe the process of converting wastewater to a valuable water resource through treatment processes. Water reuse includes non-potable recycled water development and indirect potable reuse involving integration with drinking water supplies. Synonymous with water recycling.

Water Reuse Study: Refers to the 2005 City of San Diego Water Reuse Study.

Wetland: An area periodically inundated by surface water or groundwater. Wetlands support plant and animal life, filter pollutants in stream courses, provide flood control and erosion prevention, and may provide recreational opportunities.

Wholesale Customer: A water agency or utility that purchases non-potable recycled water from the City and then sells it to customers within their own service area.

LIMITATIONS

This document was prepared solely for City of San Diego, Public Utilities Department in accordance with professional standards at the time the services were performed and in accordance with the contract between City of San Diego, Public Utilities Department and Brown and Caldwell dated July 21, 2009. This document is governed by the specific scope of work authorized by City of San Diego, Public Utilities Department; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by City of San Diego, Public Utilities Department and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

2012 Recycled Water Study

Appendices A through M

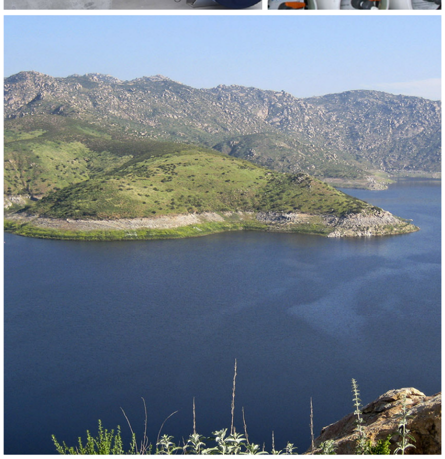
The following 2012 Recycled Water Study appendices are not re-produced herein but are available for download as part of the entire project report at the following City of San Diego website:

http://www.sandiego.gov/water/pdf/purewater/2012/recycledfinaldraft120510.pdf

Appendix B.3
WATER PURIFICATION DEMONSTRATION PROJECT

Renewal of NPDES CA0107409

THE CITY OF SAN DIEGO



CITY OF SAN DIEGO

Water Purification Demonstration Project

Project Report (Final Draft)

MARCH 2013

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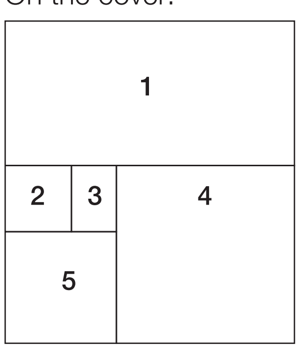

1. The Advanced Water Purification Facility
2. Ultraviolet Light/Advanced Oxidation equipment
3. Reverse Osmosis canisters
4. Microfiltration and Ultrafiltration systems
5. San Vicente Reservoir

Acknowledgements

This Water Purification Demonstration Project Report is the culmination of a multi-year program to assess the feasibility of supplementing one of San Diego's local water supply reservoirs, San Vicente Reservoir, with purified water produced at an advanced water purification facility. The combined contributions of the project team, regulatory agency representatives, Independent Advisory Panel members, and local stakeholders were invaluable in implementing a comprehensive project. This section recognizes participants who contributed substantially to this effort.

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APPENDICES

Figures and Tables

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Terms and Abbreviations

AF	Acre-feet
AFY	Acre-feet per year
AWP Facility	Advanced Water Purification Facility – the existing demonstration-scale facility constructed and operated for the Water Purification Demonstration Project
Basin Plan	Water Quality Control Plan for the San Diego Basin
Bureau of Reclamation	United States Bureau of Reclamation
CDPH	California Department of Public Health
CEC	Constituent of emerging concern
CEQA	California Environmental Quality Act
City	City of San Diego
City Council	San Diego City Council
CTR	California Toxics Rule
Demonstration Project	Water Purification Demonstration Project
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
Full-scale AWP facility	Full-scale AWP facility that would be implemented for future full-scale reservoir augmentation
GIS	Geographic Information Systems
IAP	Independent Advisory Panel
IROC	Independent Rates Oversight Committee
kWh	Kilowatt hours
LRWRP	Long-Range Water Resources Plan
MCL	Maximum Contaminant Level
mgd	Million gallons per day
NDMA	N-Nitrosodimethylamine
North City	North City Water Reclamation Plant
NR&C	Natural Resources & Culture Committee
NPDES	National Pollutant Discharge Elimination System
NWRI	National Water Research Institute
O&M	Operations and maintenance
Orange County GWRS	Orange County Groundwater Replenishment System
Point Loma	Point Loma Wastewater Treatment Plant

Regional Board	San Diego Regional Water Quality Control Board
RWS	City of San Diego Recycled Water Study, 2012
SR-52	State Route 52
State Board	State Water Resources Control Board
Water Authority	San Diego County Water Authority
WDR	Waste Discharge Requirements

Glossary of Terms

1,4-dioxane	A solvent used in industrial and commercial applications. The California Department of Public Health uses 1,4-dioxane as an indicator compound to assess the performance of advanced oxidation since it is difficult to remove from water. The ability of a purification process to remove 1,4-dioxane indicates to the California Department of Public Health that the purification process provides a robust barrier to a wide array of chemicals.
Acre-feet (AF)	A term commonly used in the water industry to measure large quantities of water. An acre-foot is defined as the amount of water required to cover one acre to a depth of one foot. An acre-foot is equivalent to 325,851 gallons and is considered enough water to meet the needs of two families of four with a house and a yard for one year.
Advanced oxidation	A set of chemical treatment processes designed to destroy organic material by breaking down its molecular structure. The advanced oxidation process used at the Advanced Water Purification Facility employs ultraviolet light and hydrogen peroxide, which break down organic molecules into natural elements, such as carbon, hydrogen, and nitrogen.
Advanced Water Purification Facility	The one-mgd demonstration-scale facility located at the North City Water Reclamation Plant. Generally abbreviated as the AWP Facility. The facility is considered "advanced" because of the high level of treatment using reverse osmosis and advanced oxidation. The AWP Facility was one element of the multi-faceted Demonstration Project.
Augmentation of water supply	The process of adding purified water to an existing raw or untreated water supply such as a reservoir, lake, river, wetland, and/or groundwater basin where it will blend with raw water supplies.
Beneficial reuse	The use of recycled water for purposes that contribute to the economy or environment of a community, such as landscape irrigation and industrial purposes.
Beneficial use	Specific designated water uses such as municipal, recreation, and agricultural, which are provided water quality protections to allow those uses to continue to occur in the future.
Blending	Mixing or combining one water source with another, such as combining purified water with imported water sources.

Brackish water	Water that has a higher salt content than fresh water, but not as high as seawater. Usually, the salts must be removed or reduced before the water is usable.
California Department of Public Health (CDPH)	The state agency responsible for public health in California. It is a subdivision of the California Health and Human Services Agency. One of its functions is to develop and enforce drinking water quality standards and regulations for public water systems.
Clean Water Act	The federal law passed in 1977 that establishes how the United States will restore and maintain the chemical, physical, and biological integrity of the country's waters, including oceans, lakes, streams and rivers, groundwater, and wetlands.
Conductivity	The ability to conduct or transmit electricity. Conductivity of water increases with the concentration of dissolved ions, so measuring conductivity provides a measure of the concentration of dissolved ions in water.
Constituent	A dissolved chemical element or compound, or a suspended material that is carried in the water.
Constituents of emerging concern	Unregulated contaminants, including commonly used pharmaceuticals, personal care products, flame retardants, and unregulated pesticides.
Contaminant	An organic or inorganic substance found in water. Some contaminants cause adverse health effects in humans and, therefore, are regulated in drinking water (see Maximum Contaminant Level). Not all contaminants are unsafe.
Conventional wastewater treatment	A combination of treatment steps that stabilizes and removes solids and organic material from wastewater.
Demonstration Project	See Water Purification Demonstration Project
Disinfection	The removal, inactivation, or destruction of microorganisms present in a water supply that may be harmful to humans. Commonly used disinfectants include chlorine and its derivatives, ultraviolet light, and ozone. Chlorine and its derivatives can also be used to provide residual disinfection that protects the water as it goes through the pipes to homes and businesses.
Disinfection byproduct	Chemicals formed during water treatment as a byproduct of reactions between natural organic matter in the water and an added disinfectant. In drinking water, some disinfection byproducts may have potential health concerns.

Drinking water	Water that meets federal drinking water standards as well as state and local water quality standards so that it is safe for human consumption. Water treatment facilities that produce drinking water require a state permit. Also referred to as potable or treated water.
Drinking water treatment plant	In the San Diego region, drinking water treatment plants draw unfiltered water from reservoirs and use a four-step process of coagulation, settling, filtration, and disinfection to produce water that is safe to drink (see drinking water).
Drought	A defined period of time when rainfall and runoff in a geographic area are much less than average.
Environmental buffer	A water body such as a groundwater basin or a surface water reservoir that provides additional dilution and retention of purified water prior to its use as drinking water.
Environmental Impact Statement/Environmental Impact Report	Detailed analysis of impacts of a project on all aspects of the natural and human environment. An Environmental Impact Statement is required by the federal National Environmental Policy Act for federal permitting or use of federal funds. An Environmental Impact Report is required by the California Environmental Quality Act for local projects.
Epilimnion	The top-most layer of warm water present within a stratified water reservoir (see stratification).
Filtration	A process that separates small particles from water by using a porous barrier to trap the particles while allowing the water to pass through.
Groundwater	Water beneath the earth's surface that supplies wells and natural springs. A groundwater basin is any underground area that contains and can store water.
Groundwater Replenishment Reuse Draft Regulation (California Department of Public Health Groundwater Recharge Criteria)	Draft regulation released by the California Department of Public Health in 2011, which reflects the California Department of Public Health Drinking Water Program's proposed regulation for replenishing groundwater with purified water.
Full-scale reservoir augmentation project	A potential third phase of the City's Water Reuse Program, which would include implementation of a full-scale reservoir augmentation project at San Vicente Reservoir (see reservoir augmentation).
Hydrogen peroxide	Chemical added in the ultraviolet disinfection/advanced oxidation step of the advanced water purification process.
Hypolimnion	The bottom-most layer of cool water present within a stratified water reservoir (see stratification).

Imported water	A water source that originates in one hydrologic region and is transferred to another hydrologic region. In San Diego's case, water is imported from Northern California or the Colorado River and travels to San Diego in large above-ground aqueducts or underground pipelines.
Independent Advisory Panel (IAP)	An independent panel of experts convened to provide expert peer review of the technical, scientific, and regulatory aspects of the Demonstration Project.
Indicator compounds or indicator organisms	A common method to evaluate water or wastewater quality using representative chemicals or organisms that are characteristic of a larger group of related chemicals or organisms. Coliform bacteria are common indicator organisms, and trihalomethanes, benzene, 1,4-dioxane, and NDMA are examples of indicator compounds.
Indirect potable reuse	An industry term referring to projects that augment groundwater and surface waters with purified water. This term was originally used to distinguish between direct potable reuse, which is the introduction of purified water into the drinking water system without an intermediate environmental buffer, and systems that did incorporate an environmental buffer. Potable reuse is a general term used to refer to both direct and indirect purified water projects.
Local limits	Local limits are wastewater limitations that apply to commercial and industrial facilities discharging wastewater to a municipal public system. Local limits control the pollutants in wastewater discharges.
Maximum Contaminant Level (MCL)	The highest allowable amount of a contaminant in drinking water, established by the United States Environmental Protection Agency.
Membrane filtration	A type of filtration used to separate particles from water. Membrane filters are characterized by the size of the openings (pores), which are ranked from the largest to the smallest pore size: microfiltration, ultrafiltration, nanofiltration and reverse osmosis.
Microfiltration	A low-pressure membrane filtration process where tiny, hollow, straw-like membranes separate small suspended particles, bacteria and other materials from water. Microfiltration provides efficient preparation of water for reverse osmosis and is used to process food, fruit juices and sodas; and to sterilize medicines that cannot be heated.
Million gallons per day	This term is used to describe the flow of water treated and distributed from a treatment plant each day.

N-nitrosodimethylamine (NDMA)	N-nitrosodimethylamine is a chemical that is found in a variety of natural and man-made sources and can be formed during wastewater treatment. It is used by the California Department of Public Health as an indicator compound to assess the performance of advanced oxidation since it is difficult to remove from water. The ability of a purification process to achieve removal indicates to the California Department of Public Health that the process provides a robust barrier to a wide array of chemicals.
National Pollutant Discharge Elimination System (NPDES)	A federal permit authorized by the Clean Water Act, Title IV, which is required for discharge of pollutants to waters of the United States, and includes any discharge to lakes, streams, rivers, bays, the ocean, wetlands, storm sewer, or tributary to any surface water body.
Non-potable water	Water that is not suitable for drinking because it has not been treated to drinking water standards (see drinking water). Includes recycled water as well as raw or untreated water.
North City Water Reclamation Plant (North City)	Wastewater treatment plant that produces recycled water through a combination of conventional wastewater treatment and tertiary treatment (see conventional wastewater treatment and tertiary treatment).
Orange County Groundwater Replenishment System (GWRS)	A project that employs water purification processes similar to those tested at the AWP Facility, which has been operational since 2008. This project provides a model for the City's potential reservoir augmentation project in that it uses similar water purification technology and is permitted under a similar regulatory framework.
Oxidation	A treatment step used in disinfection, in which oxygen or ozone is added to water to produce a chemical reaction that removes potentially harmful substances.
Pathogens	Disease-causing organisms. The general groupings of pathogens are viruses, bacteria, protozoa, and fungi.
Pipeline system	Pipeline system, including pump station and reservoir inlet structure, which would convey purified water from North City to San Vicente Reservoir. Also referred to as purified water pipeline system.
Point Loma Wastewater Treatment Plant (Point Loma)	Advanced primary wastewater treatment plant that discharges treated wastewater to the Pacific Ocean.
Pretreatment	The treatment of wastewater near its source to remove harmful pollutants before being discharged to a sewer system.
Primary drinking water standards	Legally enforceable federal and state standards that must be met by public water systems. Primary drinking water standards protect public health by limiting the levels of contaminants in drinking water.

Purified water	Water that starts out as wastewater from homes or businesses and is collected and put through a series of treatment and purification steps such that it meets all drinking water standards and can be added to water supplies ultimately used for drinking water. The treatment includes membrane filtration with microfiltration or ultrafiltration, reverse osmosis, and advanced oxidation that consists of disinfection with ultraviolet light and hydrogen peroxide. Purified water may be released into a groundwater basin or surface water reservoir that supplies water to a drinking water treatment facility.
Raw water	Water that has not been treated for use. Examples of raw water are water in the Colorado River aqueduct, the State Water Project aqueduct, open reservoirs (whether filled with imported water or runoff), rivers, naturally-occurring lakes and some well water.
Recycled water	Water that originated from homes and businesses as municipal wastewater and has undergone a high degree of treatment at a water reclamation facility so that it can be beneficially reused for a variety of purposes. This is the type of water that is produced at North City and is the source water for the AWP Facility.
Reservoir augmentation	The process of adding purified water to a surface water reservoir. The purified water undergoes advanced treatment prior to being blended with untreated water in a reservoir. The blended water is then treated and disinfected at a conventional drinking water treatment plant and is distributed into the drinking water delivery system.
Reverse osmosis	A high-pressure membrane filtration process that forces water through the molecular structure of several sheets of thin plastic membranes to filter out minerals and contaminants, including salts, viruses, pesticides, and other materials. The reverse osmosis membranes are like microscopic strainers; bacteria and viruses as well as inorganic and most organic molecules cannot pass through the membranes. Reverse osmosis membranes have a smaller pore size than all other types of membranes.
Retention time	The amount of time that purified water is retained in a water body such as a groundwater basin or surface water reservoir prior to being extracted.
Secondary drinking water standards	Drinking water quality standards that are not enforced, but serve as guidelines to assist public water systems in managing drinking water aesthetic conditions such as taste, color and odor.

Source control	Programs and/or processes in place to provide regulatory oversight of sewer discharges in order to protect the pipeline system and the wastewater treatment plant from harmful discharges. Source control programs typically focus on industrial and commercial (non-residential) customers and may include a variety of activities such as permitting, sampling, enforcement and oversight related to industrial discharges. For projects where purified water would enter the drinking water system via groundwater or surface water augmentation, the California Department of Public Health requires that source control programs be augmented to address residential and commercial facilities, and focus on an expanded set of contaminants that may have public health relevance, such as industrial chemicals, pharmaceuticals, and personal care product residuals sometimes found in wastewater.
Stratification	The formation of layers of water within a reservoir. This is a natural phenomenon that occurs in all reservoirs in North America. During the period of stratification, warm water that is naturally heated by the sun is contained within the top-most layer, or epilimnion, and denser cooler water is contained within the lower layer, or hypolimnion.
Tertiary treatment	Treatment of wastewater to a level beyond secondary treatment but less than water purification. Water treated to this level is considered to be recycled water, which is suitable for many beneficial uses including irrigation and industrial processes. Tertiary water meets treatment and reliability criteria established by Title 22, Chapter 4, of the California Code of Regulations.
Total organic carbon (TOC)	Total organic carbon is a measure of the amount of carbon that is bound in organic molecules, including all natural and man-made organic chemicals.
Ultrafiltration	A membrane filtration process with pore size openings smaller than microfiltration and larger than nanofiltration or reverse osmosis. Also used to characterize the size of particles removed.
Ultraviolet disinfection/advanced oxidation	Process by which water is exposed to ultraviolet light to provide disinfection, similar to the process for disinfecting instruments in medical and dental offices. Additionally, ultraviolet light combined with hydrogen peroxide creates an advanced oxidation reaction that eliminates any remaining compounds in water by breaking them down into harmless compounds.
United States Environmental Protection Agency (EPA)	The federal agency responsible for protecting public and environmental health in the United States. Its functions include developing and enforcing water quality standards for drinking water as well as man-made and naturally-occurring waters of the United States.

Wastewater	Untreated water collected in the sewer system from residences and businesses (e.g., from bathtubs, showers, bathroom sinks, clothes washers, toilets, kitchen sinks, dishwashers, and industrial processes). Wastewater is more than 99 percent water with impurities.
Wastewater collection system (collection system)	System that conveys wastewater from residences and businesses to a wastewater treatment plant such as North City.
Water Purification Demonstration Project (Demonstration Project)	The second phase of the City of San Diego's Water Reuse Program. During this test phase, the Advanced Water Purification Facility was operated for approximately one year to collect operating data, producing one million gallons of purified water per day. The Advanced Water Purification Facility remains online. A study of San Vicente Reservoir was conducted to test the key functions of reservoir augmentation and to determine the viability of a full-scale project. No purified water was sent to San Vicente Reservoir during the demonstration phase.
Water purification process	The process of using water purification technology on recycled water to produce a water supply that can be used for reservoir augmentation and ultimately for drinking water purposes. The process of water purification begins with recycled water, which has already been treated to produce a supply of water safe enough for use in irrigation and industrial purposes. This recycled water is then further treated using water purification technology. The resulting purified water can be used to augment local surface water supplies, which would be treated once more at a drinking water treatment plant to produce drinking water.
Water Quality Control Plan for the San Diego Basin (Basin Plan)	This plan establishes water quality objectives and implementation plans to protect different beneficial uses that are established for specific water bodies in the San Diego Regional Water Quality Control Board region (see beneficial use).
Water Reuse Program	The City's three-phased program, which is a potential local option to increase water supply reliability through the beneficial reuse of water.

Using This Report

This Project Report provides an overview of the technical studies, advanced water purification facility testing, and public education and outreach efforts conducted as part of the City of San Diego's Water Purification Demonstration Project. It also presents findings that support the conclusion that implementation of a reservoir augmentation project at San Vicente Reservoir is feasible.

This Project Report presents background information, key findings for each of the core components of the Demonstration Project, and considerations for full-scale project implementation. It is organized as shown in the following table.

Section A |	Introduction and Summary of Findings
Section B |	Advanced Water Purification Facility
Section C |	San Vicente Reservoir Study
Section D |	Regulatory Coordination
Section E |	Public Outreach and Education
Section F |	Full-Scale Project Considerations
Section G |	Summary and Conclusions

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Section A: Introduction and Summary of Findings

The Water Purification Demonstration Project was a multi-year project designed to assess the feasibility of supplementing one of San Diego's local water supply reservoirs, San Vicente Reservoir, with purified water produced at an advanced water purification facility. The project is an integral component of the City's plan to improve water supply reliability by developing local, drought-tolerant water supplies. The Water Purification Demonstration Project involved installing and operating a demonstration-scale advanced water purification facility, studying San Vicente Reservoir, implementing a public outreach and education program, developing conceptual design criteria and costs for a full-scale advanced water purification facility and pipeline facilities, and developing a conceptual pipeline alignment.

The advanced water purification facility is a component of the Water Purification Demonstration Project.

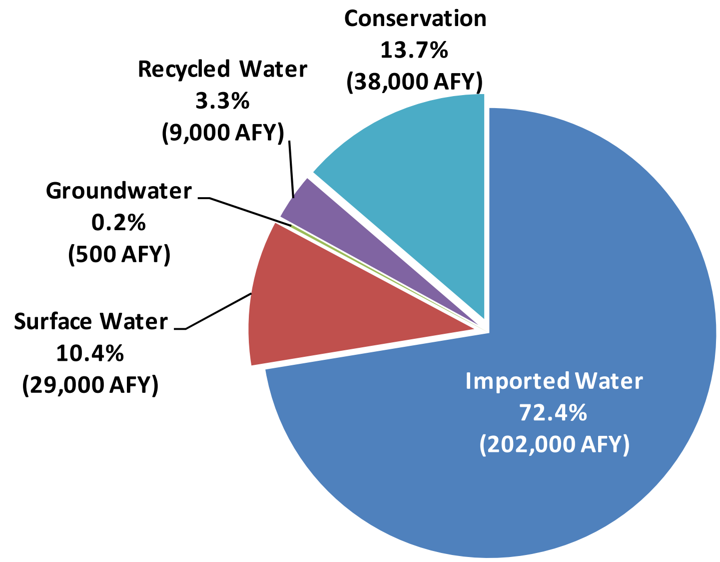
This Project Report provides an overview of the technical studies, advanced water purification facility testing, and public education and outreach efforts conducted as part of the Water Purification Demonstration Project. It also presents findings that support the conclusion that implementation of a reservoir augmentation project at San Vicente Reservoir would be feasible.

In 1813 Spanish settlers and missionaries completed a dam and flume on the San Diego River to supply water to Mission San Diego de Alcala. This effort to secure a dependable water source for the mission was the first water supply project on the West Coast. Two hundred years later San Diego continues its quest to secure reliable and locally controlled sources of water. Using modern technologies and advanced science, the Water Purification Demonstration Project moves the City toward a future of dependable water supplies.

San Diego's Water Supply Reliability Challenges

The City of San Diego (City) provides drinking water to more than 1.3 million people. In addition to supplying approximately 274,000 metered service connections within its own incorporated boundaries, the City supplies water to the City of Del Mar; Santa Fe and San Dieguito Irrigation Districts; and California American Water Company, which, in turn, serves the Cities of Coronado and Imperial Beach and portions of south San Diego (City of San Diego, 2011a). The City's projected total water use in 2015, including wholesale deliveries to other agencies, is

240,000 acre-feet (AF), which is equivalent to 78,000 million gallons, or 210 million gallons per day (mgd) (City of San Diego, 2011a). The City's actual water use in fiscal year 2012, which also included wholesale deliveries to other agencies, was 190,000 AF,(based on data from the City of San Diego, Public Utilities Department, Water Operations Division. This is equivalent to 63 million gallons or 170 mgd. Actual water use varies from year to year because of climatic and economic conditions. Further, the mandatory use restrictions enforced during the 2009/2010 drought appear to have had a lasting effect on water use, as demands have not yet rebounded to their pre-drought levels. The City meets water demands with the following supplies:



Existing water resource mix projected for 2015 normal/average hydrologic conditions (AFY = acre-feet per year) (City of San Diego, 2012c)

- Imported water, which includes water imported from the San Francisco Bay / Sacramento – San Joaquin Delta (Bay-Delta) in Northern California or the Colorado River
- Local surface water
- Groundwater
- Recycled water

San Diego is situated at the end of a complex network of state, federal, and local water projects.

In an average year, approximately 85 to 90 percent of the City's water supplies are imported water, which is water that is supplied from the Bay-Delta in Northern California or the Colorado River through a network of state, federal, and local pipeline facilities (City of San Diego, 2012b). The cost of imported water has increased significantly and is expected to continue to increase into the future. From 2007 to 2012, Metropolitan Water District's (MWD's) imported water costs increased by more than 12 percent annually, and MWD projects its 2014 full service water rate to be seven percent greater than its 2012 rate. Going forward, the San Diego County Water Authority (Water Authority) projects that its untreated water rates will double in less than 10 years (City of San Diego, 2012c).

Environmental stressors, such as ongoing drought in the Colorado River Basin, reduced snowpack and runoff in Northern California, and court-ordered pumping restrictions necessary to protect endangered species, have decreased the reliability of imported water supplies (City of San Diego, 2012b).

Imported water reliability issues, coupled with recurring droughts in the San Diego region, have placed considerable strain on the City's ability to meet water demands. The City has taken a variety of actions to maximize water resources and improve water supply reliability, including the following.

- The City supports a wide array of **water conservation measures** designed to reduce water demands and maximize water use efficiency. A signatory to the Memorandum of Understanding with the California Urban Water Conservation Council since 1991, the City employs a variety of urban Best Management Practices for conserving water (City of San Diego, 2011a). City-wide conservation efforts resulted in an approximate water savings of 34,000 AF in 2010 (City of San Diego, 2011a).
- In 2002, the City developed a **Long-Range Water Resources Plan** (LRWRP) that defines a plan to reduce reliance on imported water supplies and develop and maximize local water resources. The LRWRP is currently being updated (draft 2012 LRWRP) to reflect recent changes in the availability, costs, and reliability of various water supply sources (City of San Diego, 2012c).

A Word About Imported Water Reliability

Water is essential to our quality of life. The City imports 85-90 percent of its water supply from the Bay-Delta in Northern California and the Colorado River. In recent years, both Southern California and the Colorado River system have experienced drought conditions. In addition, legal and regulatory decisions to protect endangered species have restricted the amount of water that can be pumped from Northern California. Since San Diego is at the end of the imported water pipeline, and receives an average of 10-12 inches of rain each year, local, drought-tolerant water supplies are critical to securing a reliable supply of water now and in the future.

Local reservoir levels have been lower than typical due to dry conditions.

Pumping from the Bay-Delta is limited to protect endangered species such as the Delta Smelt.

- The City is a member of the Regional Water Management Group administering the **San Diego Integrated Regional Water Management Program**, which uses an integrated regional approach to address water management issues.
- The City is conducting independent studies as well as participating with the United States Geological Survey and the United States Bureau of Reclamation (Bureau of Reclamation) on **groundwater basin studies and hydrogeologic investigations** to better understand the complex hydrogeology of the San Diego coastal area, the water supply potential of the local groundwater basins, and the potential for desalination of saline groundwater located near the coast (brackish groundwater) (City of San Diego, 2011a).
- The City is implementing a **Water Reuse Program** designed to maximize water reuse.

The following sections discuss the elements of the Water Reuse Program, including the Water Purification Demonstration Project, in more detail.

Maximizing Local Supplies with the Water Reuse Program

In response to San Diego's ongoing water supply challenges, the City initiated a comprehensive Water Reuse Program in the early 2000's. The Water Purification Demonstration Project is the second phase of this initiative designed to maximize the use of recycled water throughout the City.

Phase 1: Water Reuse Study

In 2006, the City completed the Water Reuse Study, which included a comprehensive evaluation of all viable options to maximize the use of recycled water produced by the City's two water reclamation plants (City of San Diego, 2006). The study included analysis and research on the health effects of reuse options and implemented a comprehensive public participation process. Based on the information presented in the Water Reuse Study, a stakeholder group determined that the preferred option for maximizing use of the City's recycled water supply would be to augment existing supplies in the City's San Vicente Reservoir with recycled water—this option is referred to as "reservoir augmentation at San Vicente Reservoir." In response to both the Water Reuse Study and the stakeholder recommendation, the San Diego City Council (City Council) approved the second phase of the Water Reuse Program: the Water Purification Demonstration Project.

What is Reservoir Augmentation?

Reservoir augmentation is the practice of augmenting an existing drinking water supply reservoir by adding purified water. Purified water starts out as wastewater from homes or businesses. It is then collected and put through a series of treatment and purification steps designed to produce purified water that meets all drinking water standards.

Reservoir augmentation as identified in the Water Reuse Study would adhere to the multiple barrier concept that is fundamental to the provision of public health safeguards. These barriers include conventional water recycling treatment as practiced in the San Diego region for more than 30 years, advanced water purification technologies, blending with imported water in San Vicente Reservoir, drinking water treatment at a municipal water treatment plant, and distribution to the City's drinking water system.

Phase 2: Water Purification Demonstration Project

Phase 2 of the Water Reuse Program is the Water Purification Demonstration Project (Demonstration Project). The Demonstration Project, which is the focus of this Project Report, evaluated the feasibility of using water purification technology to produce water that could be sent to San Vicente Reservoir where it would be mixed with a combination of local and imported water supplies prior to being treated at a water treatment plant and distributed as drinking water (see Figure A-1).

(Potential) Phase 3: Reservoir Augmentation at San Vicente Reservoir

Because the concept of using purified water to augment San Vicente Reservoir has been determined to be feasible (as discussed in greater detail in subsequent sections of this Project Report), the Mayor and City Council may consider implementing a reservoir augmentation project at San Vicente Reservoir. The key facilities associated with a reservoir augmentation project at San Vicente Reservoir are presented in Figure A-2.

The City of San Diego's Water Reuse Program

- Phase 1 – The Water Reuse Study, published in 2006
- Phase 2 – The Demonstration Project, which evaluated the feasibility of using purified water to augment San Vicente Reservoir (No purified water was actually sent to the reservoir in Phase 2.)
- (Potential) Phase 3 – The future Full-Scale Reservoir Augmentation Project at San Vicente Reservoir

Figure A - 1: Phase 2 and Potential Phase 3 of the City's Water Reuse Program

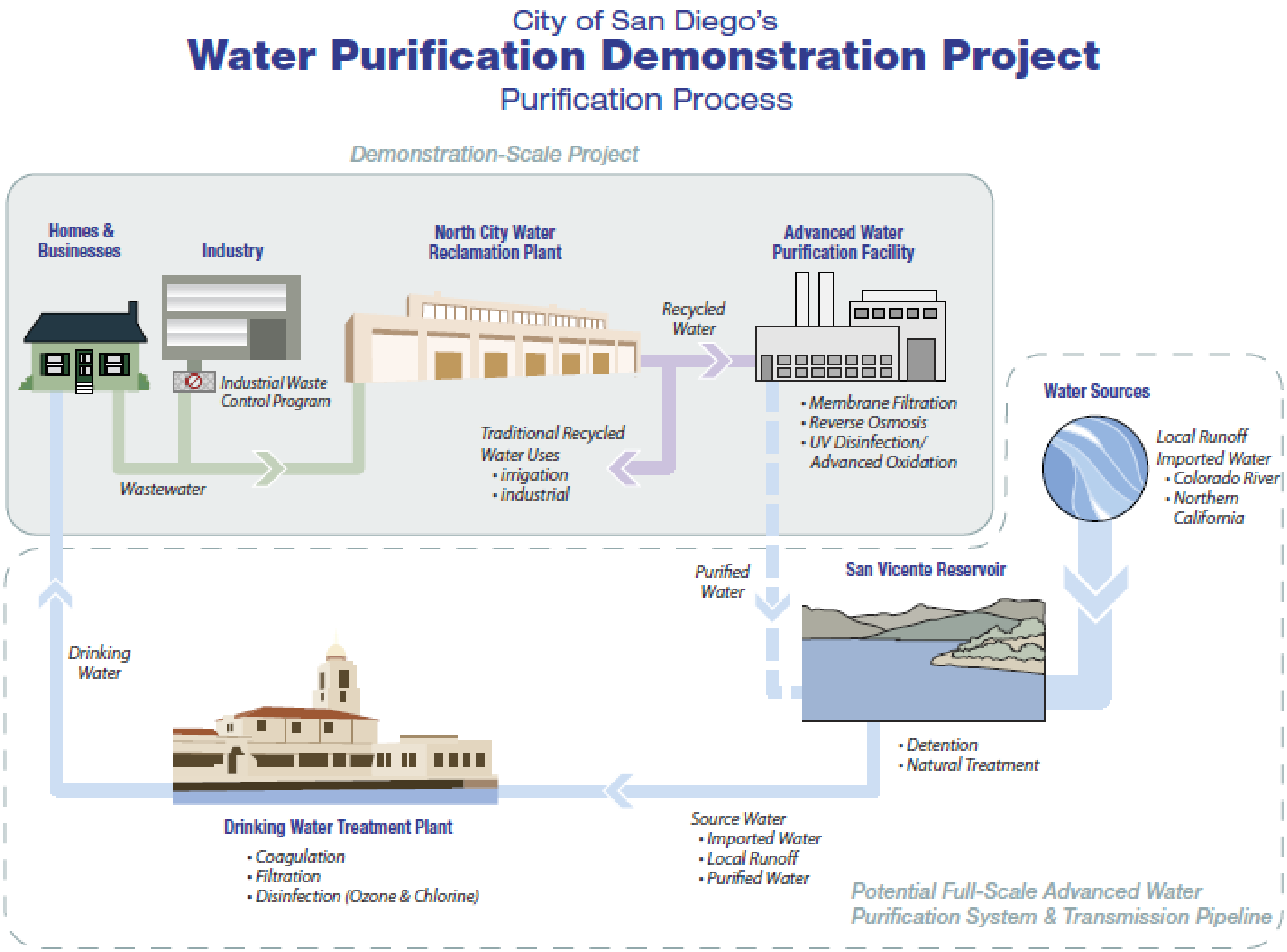
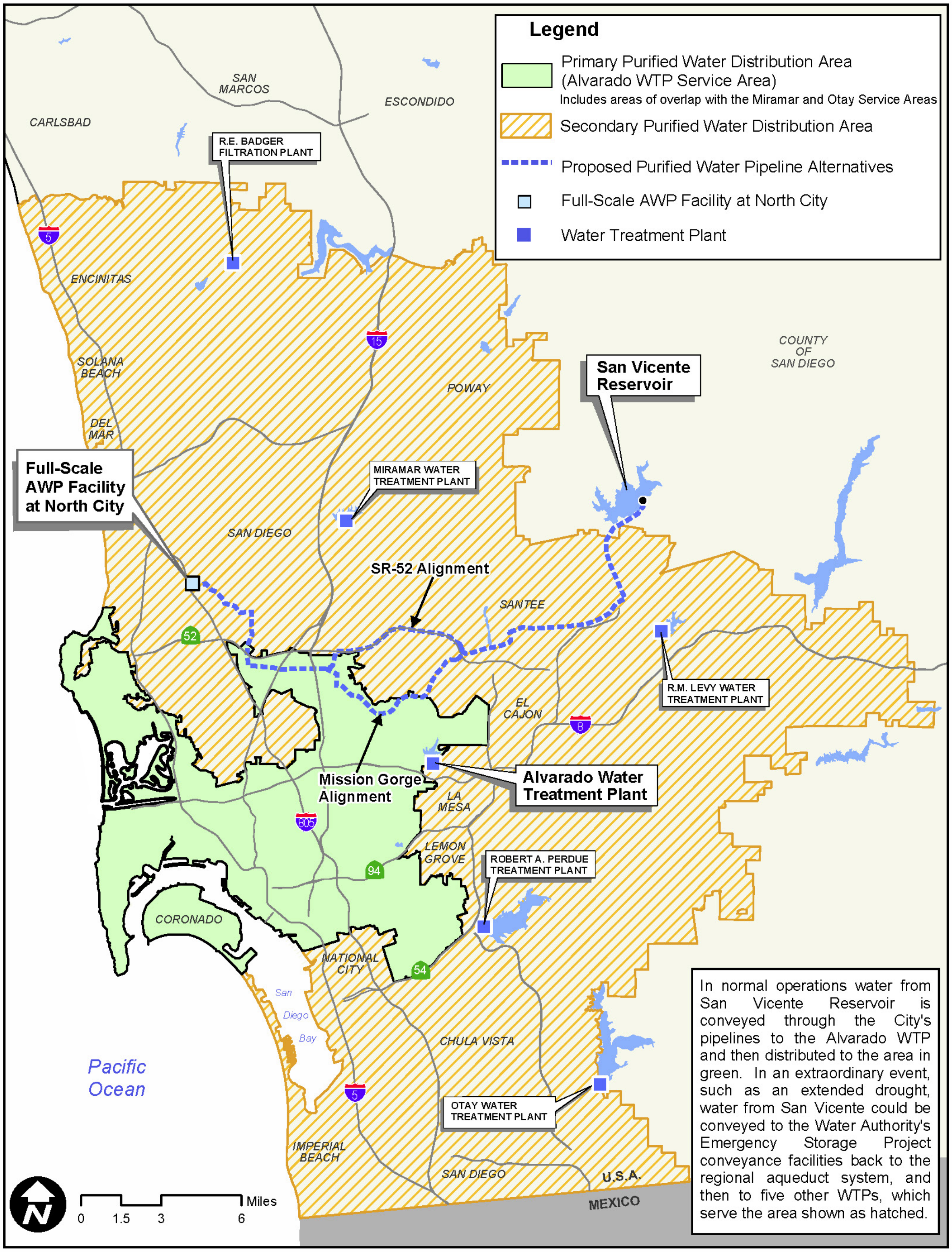


Figure A - 2: Service Area and Facilities of Full-Scale Reservoir Augmentation Project at San Vicente Reservoir



Navigating a Complex Regulatory Setting

Projects in California that involve supplementing ground and surface waters with purified water are regulated by both the California Department of Public Health (CDPH) and the State Water Resources Control Board (State Board) through nine Regional Water Quality Control Boards. To date, seven projects that augment local supplies with purified water have been permitted in California, shown in Table A-1.

Table A - 1: Purified Water Projects Permitted in California

Project Name	Agency	Start Year	Treatment Capacity (mgd)	Actual Deliveries (AFY)[3]
Montebello Forebay Groundwater Recharge Project	Los Angeles County Sanitation District	1962	47.5	50,000
Water Factory 21[1]	Orange County Water District	1977	15.0	10,000
West Coast Basin Seawater Barrier Project	West Basin Municipal Water District	1995	30	5,000
Alamitos Seawater Barrier Project	Water Replenishment District of Southern California	2005	3	3,000
Chino Basin Groundwater Recharge Project[2]	Inland Empire Utilities Agency	2005	18.0	10,000
Dominguez Gap Seawater Barrier Project	Water Replenishment District of Southern California	2006	4.5	1,000
Groundwater Replenishment System Seawater Barrier and Groundwater Replenishment Projects	Orange County Water District	2008	70	66,000 – 72,000

Footnotes:

1. Water Factory 21 began operation in 1976 implementing granular activated carbon. Reverse osmosis was added to treat half the flow in 1977.
2. Full capacity of the Chino Basin Groundwater Recharge Project is 84.4 mgd; however, only 18.0 mgd receives soil aquifer treatment (SAT).
3. AFY = acre-feet per year.

Although these seven permitted projects differ from the City's potential reservoir augmentation project at San Vicente Reservoir—they all focus on augmentation of groundwater supplies as opposed to augmentation of surface water supplies—most use the same water purification technology and have been permitted within the same regulatory framework as the City's potential project. Reservoir augmentation is practiced in other parts of the United States with less rigorous water purification processes. For example, since 1978 the Upper Occoquan Service Authority has added recycled water into a stream above Occoquan Reservoir, which supplies a drinking water treatment plant in Fairfax County, Virginia.

A key component of the Demonstration Project was coordination with both CDPH and the San Diego Regional Water Quality Control Board (Regional Board) to clarify permit conditions and develop sufficient information to determine the regulatory feasibility of a reservoir augmentation project at San Vicente Reservoir. A detailed discussion of regulatory coordination activities conducted as part of the Demonstration Project is presented in Section D of this Project Report.

California Department of Public Health

CDPH is responsible for overseeing public health issues in California and permitting public water supply projects, including projects using purified water to supplement a local water supply. CDPH is in the process of finalizing draft regulations for groundwater augmentation projects using purified water. State legislation passed in 2010 requires CDPH to establish regulations for water purification via surface water augmentation by 2016. In the meantime, surface water augmentation projects like the City's potential reservoir augmentation project at San Vicente Reservoir can be permitted on a case-by-case basis, using the pending groundwater augmentation regulations as guidance. The City's reservoir augmentation project at San Vicente Reservoir would need to meet all state and federal drinking water standards applicable to public water systems, as well as the water purification standards in California's draft groundwater augmentation regulations. The draft groundwater augmentation regulations are very stringent—in many cases exceeding drinking water standards.

Regional Water Quality Control Board

The Regional Board is responsible for developing and enforcing water quality objectives for surface and groundwater bodies within the San Diego region. Because the City's potential reservoir augmentation project at San Vicente Reservoir would involve releasing purified water into San Vicente Reservoir, the project would fall under the jurisdiction of the Regional Board. Unlike groundwater augmentation projects, which often require only a Waste Discharge Requirements (WDR) permit, projects involving release of purified water into surface water bodies require National Pollutant Discharge Elimination System (NPDES) permits. Approval of NPDES permits involves the United States Environmental Protection Agency (EPA) as well as the Regional Board.

An NPDES permit for the City's reservoir augmentation project at San Vicente Reservoir would place limitations on the purified water released into San Vicente Reservoir and incorporate water quality requirements and limits. Surface water quality objectives for San Vicente Reservoir are established by the Regional Board in the *Water Quality Control Plan for the San Diego Basin* (Basin Plan). The Basin Plan establishes water quality objectives for specific water bodies depending on established beneficial uses, which serve as the basis for some NPDES permit limits and conditions.

Regulatory acceptance of the City's Demonstration Project was validated through a Concept Approval letter from the CDPH, a Resolution of Support from the Regional Board, and a Letter of Concurrence from the Regional Board strongly supporting the efforts of the City and concurring on the preferred regulatory pathway.

Independent Advisory Panel

Demonstration Project IAP Members

One example of the high standards established by CDPH for projects involving water purification is the requirement to convene an Independent Advisory Panel (IAP) to provide expert peer review of the technical, scientific, and regulatory aspects of the City's water purification concept. An IAP, organized and managed by the National Water Research Institute (NWRI), was convened in 2009 to oversee the Demonstration Project.

The IAP consisted of 10 academics and professionals with extensive expertise in the science of water reuse, including chemistry, microbiology, treatment engineering, operations engineering, water reuse regulatory criteria, limnology, research science, toxicology, and public and environmental health. The IAP reviewed work products associated with the Demonstration Project and provided feedback on various aspects of the project.

The IAP is a fundamental component of the regulatory framework for the City's reservoir augmentation project at San Vicente Reservoir. This requirement is further discussed in Section D: Regulatory Coordination. Table A-2 summarizes the IAP meetings held in support of the Demonstration Project. Information on the IAP and its review and advisory activities can be found in Appendix F.

Table A - 2: Summary of IAP Meetings

Meeting No.	Date	Topic
1	May 11-12, 2009	Introductory meeting for the full IAP to discuss the Demonstration Project Scope
2	March 29-30, 2010	Limnology (reservoir-related) Subcommittee Meeting No. 1 to discuss set-up and calibration of the San Vicente Reservoir Model[1]
3	September 2, 2010	Limnology Working Group Meeting No. 1 to specify and discuss details pertaining to the San Vicente Reservoir Model[2]
4	October 21, 2010	Advanced Water Purification (AWP) Facility Subcommittee Meeting No. 1 to discuss the draft Testing and Monitoring Plan[3]
5	March 17, 2011	Limnology Working Group Meeting No. 2 to review San Vicente Reservoir modeling scenarios, determine potential "worst case scenarios," and discuss pathogen removal[2]
6	June 6-7, 2011	Second meeting of the full IAP to update the group on the Limnology Subcommittee, Limnology Working Group, and AWP Facility Subcommittee activities, and tour the AWP Facility
7	December 6, 2011	Limnology Subcommittee Meeting No. 2 to review and receive comments on the draft San Vicente Reservoir modeling study, and receive input on proposed reservoir public health-related regulatory conditions[1]
8	December 19, 2011	AWP Facility Subcommittee Meeting No. 2 to review AWP Facility operational and water quality data[3]
9	March 9-21, 2012	Conference calls to review and discuss Draft CDPH Proposal[4]
10	March 13, 2012	Limnology Subcommittee Meeting No. 3 to review the San Vicente Reservoir Water Quality Report[1]
11	November 15-16, 2012	Third meeting of the full IAP to review and comment on the Demonstration Project Report and Quarterly Testing Report No. 4 (CDM Smith and MWH, 2013b)

Footnotes:

1. The Limnology Subcommittee was comprised of four IAP members focused on the Limnology Study.
2. The Limnology Working Group was comprised of two IAP members and project staff specifically assigned to vetting the details of the reservoir study.
3. The AWP Facility Subcommittee was comprised of four IAP members focused on the operation and results of the AWP Facility.
4. An ad-hoc subcommittee provided review and comment via a series of conference calls in lieu of face-to-face meetings.

The Demonstration Project – a Path Forward

On October 29, 2007, the City Council voted to accept the Water Reuse Study and directed the Mayor and City staff to implement actions to demonstrate the feasibility of reservoir augmentation at San Vicente Reservoir. These actions, known as the Demonstration Project, were intended to evaluate the feasibility of implementing a reservoir augmentation project at San Vicente Reservoir by determining whether advanced water purification technology can safely and reliably produce purified water that could be sent to a reservoir and later treated at a drinking water treatment plant and distributed as drinking water.

Evolving Terminology

Over time, terminology associated with the City's reservoir augmentation project at San Vicente Reservoir has evolved in response to changes within the industry. When the project was first conceptualized, it was described as an Indirect Potable Reuse / Reservoir Augmentation Demonstration Project. This report refers to the same concept as the Water Purification Demonstration Project (Demonstration Project). Similarly, the Advanced Water Treatment Plant (AWT) conceptualized in early stages of the project is referred to in this report as the advanced water purification (AWP) facility. These changes in terminology reflect an industry-wide recognition that the processes implemented in the AWP facility extend beyond advanced water treatment, and may be more accurately described as water purification processes.

The budget for the Demonstration Project was $11.8 million. Funding for the project was secured through a $1.07 million California Department of Water Resources Integrated Regional Water Management Program (IRWM) grant, a $2.95 million grant from the Bureau of Reclamation, and a temporary water rate increase approved by City Council in November 2008. This temporary rate increase was in effect from January 2009 to September 2010.

Demonstration Project Components

1. Convene an Independent Advisory Panel
2. Design, construct, and operate a demonstration-scale advanced water purification facility at the North City Water Reclamation Plant
3. Conduct a study of San Vicente Reservoir to establish residence time and water quality parameters and conditions of purified water in the reservoir
4. Perform an energy and economic analysis
5. Define the state's regulatory requirements for a full-scale reservoir augmentation project at San Vicente Reservoir
6. Perform a pipeline alignment study
7. Conduct a public outreach and education program

Note: the 2007 City Council directive referred to the advanced water purification facility as the advanced water treatment (AWT) plant and purified water as AWT water. This has been modified to reflect industry-wide changes in terminology.

Figure A-3 presents an overview of the tasks completed as part of the Demonstration Project, consistent with the City Council's aforementioned actions in 2007 and 2008. Key tasks and meetings, reports, and important outcomes are highlighted.

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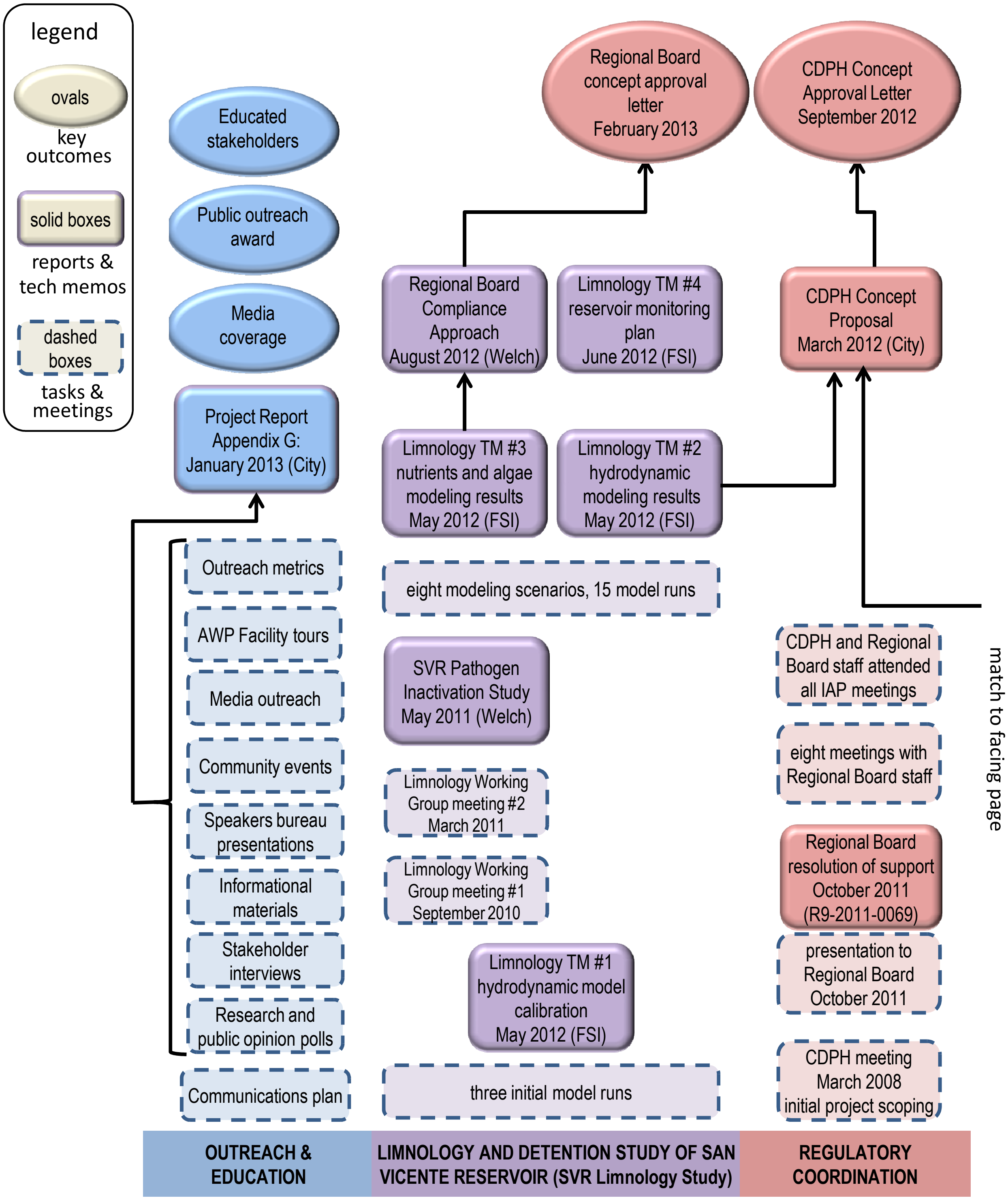
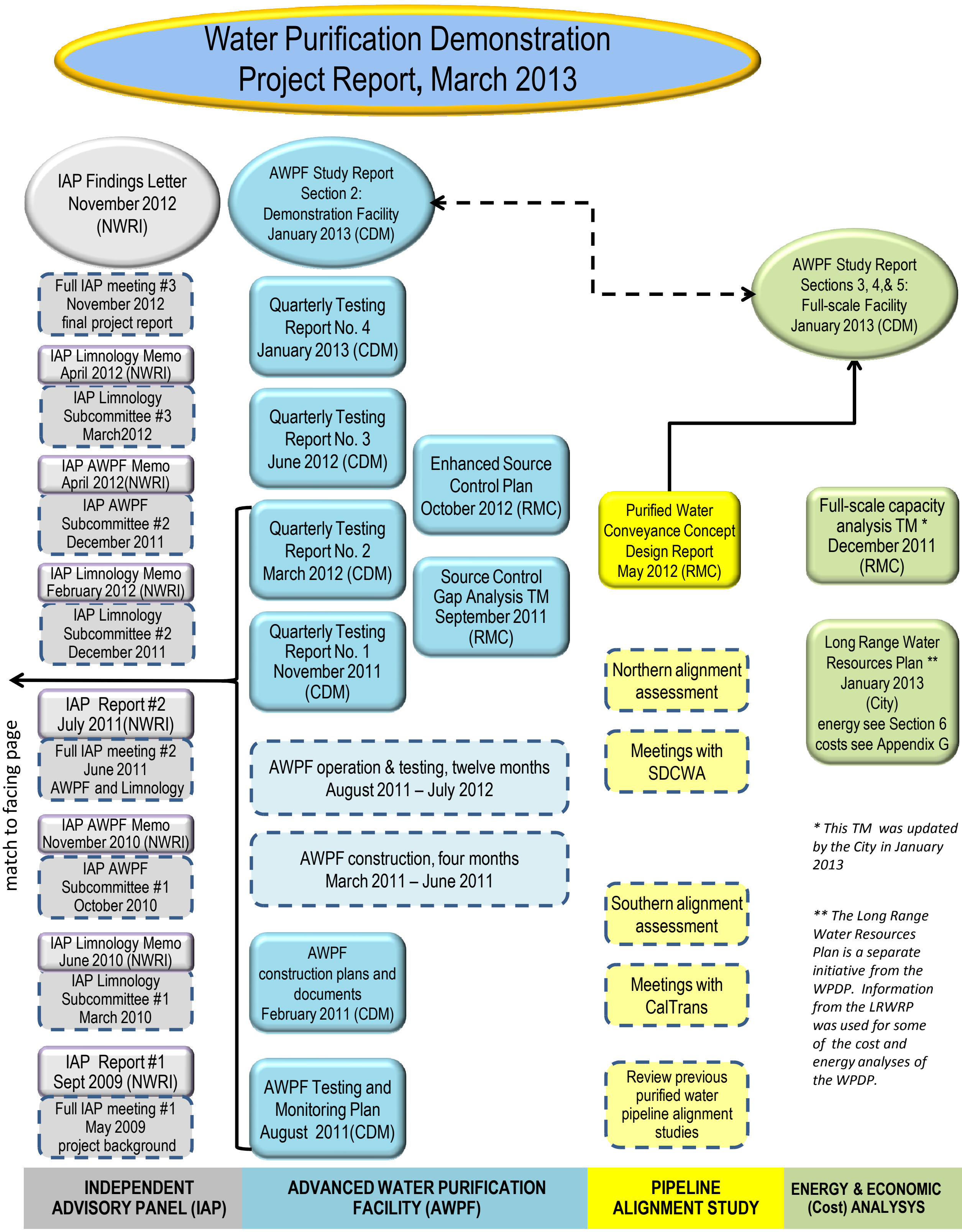
Figure A-3: Key tasks, meetings, reports, and outcomes of the Water Purification Demonstration Project, from project start in 2009 through project completion in 2013





Water Purification Demonstration Project Report, March 2013
IAP Findings Letter November 2012 (NWRI)
AWPF Study Report Section 2: Demonstration Facility January 2013 (CDM)
AWPF Study Report Sections 3, 4,& 5: Full-scale Facility January 2013 (CDM)
Full IAP meeting #3 November 2012 final project report
IAP Limnology Memo April 2012 (NWRI)
IAP Limnology Subcommittee #3 March2012
IAP AWPF Memo April 2012(NWRI)
IAP AWPF Subcommittee #2 December 2011
IAP Limnology Memo February 2012 (NWRI)
IAP Limnology Subcommittee #2 December 2011
IAP Report #2 July 2011(NWRI)
Full IAP meeting #2 June 2011 AWPF and Limnology
IAP AWPF Memo November 2010 (NWRI)
IAP AWPF Subcommittee #1 October 2010
IAP Limnology Memo June 2010 (NWRI)
IAP Limnology Subcommittee #1 March 2010
IAP Report #1 Sept 2009 (NWRI)
Full IAP meeting #1 May 2009 project background
match to facing page
Quarterly Testing Report No. 4 January 2013 (CDM)
Quarterly Testing Report No. 3 June 2012 (CDM)
Quarterly Testing Report No. 2 March 2012 (CDM)
Quarterly Testing Report No. 1 November 2011 (CDM)
Enhanced Source Control Plan October 2012 (RMC)
Source Control Gap Analysis TM September 2011 (RMC)
AWPF operation & testing, twelve months August 2011 – July 2012
AWPF construction, four months March 2011 – June 2011
AWPF construction plans and documents February 2011 (CDM)
AWPF Testing and Monitoring Plan August 2011(CDM)
Purified Water Conveyance Concept Design Report May 2012 (RMC)
Northern alignment assessment
Meetings with SDCWA
Southern alignment assessment
Meetings with CalTrans
Review previous purified water pipeline alignment studies
Full-scale capacity analysis TM * December 2011 (RMC)
Long Range Water Resources Plan ** January 2013 (City) energy see Section 6 costs see Appendix G
* This TM was updated by the City in January 2013
** The Long Range Water Resources Plan is a separate initiative from the WPDP. Information from the LRWRP was used for some of the cost and energy analyses of the WPDP.
INDEPENDENT ADVISORY PANEL (IAP)
ADVANCED WATER PURIFICATION FACILITY (AWPF)
PIPELINE ALIGNMENT STUDY
ENERGY & ECONOMIC (Cost) ANALYSYS

Summary of Findings

The Demonstration Project generated a substantial amount of data related to expected performance of a reservoir augmentation project at San Vicente Reservoir. Major findings of the Demonstration Project are summarized in the following discussion by project component. Each Demonstration Project component is described in further detail later in this Project Report.

Demonstration Advanced Water Purification Facility

The City operated a demonstration-scale Advanced Water Purification Facility (AWP Facility) to gather information on water quality, equipment reliability, regulatory requirements, capital and operating cost, and energy consumption that could be expected if a full-scale advanced water purification facility (full-scale AWP facility) were constructed. Additional benefits included verifying accuracy of online monitoring equipment, optimizing process cost, conducting public tours, and securing regulatory approval.

The AWP Facility was designed, installed, operated, and tested between September 2010 and July 2012. Start-up of the AWP Facility occurred over a one-and-a-half month period (mid-June 2011 through the end of July 2011), and facility testing spanned the following year (August 2011 through July 2012). Although the testing period is complete, the AWP Facility continues to operate for public tours (refer to Section E of this report) and to gather additional equipment performance data.

The Demonstration Facility was installed and operated to produce and test purified water.

The AWP Facility was designed in accordance with the industry-standard multiple barrier approach for water purification processes established by CDPH in the Groundwater Replenishment Reuse Draft Regulation (CDPH, 2011). The major process components were membrane filtration, reverse osmosis, and ultraviolet (UV) disinfection/advanced oxidation.

Key findings from the AWP Facility include:

<u>Monitoring</u>

- Daily testing to identify potential breaches in the membrane filtration units
- Continuous measurement of total organic carbon (TOC) and conductivity to demonstrate that the reverse osmosis system was performing as expected
- Continuous UV reactor power level monitoring to confirm UV lamp operations
- Daily monitoring of hydrogen peroxide dose and continuous flow confirmation to demonstrate that the target hydrogen peroxide dose was achieved

This daily and continuous testing was conducted throughout the 12-month testing period. This extensive monitoring showed that the AWP Facility equipment met the intended treatment performance on a continuous basis and was reliable throughout the operational period.

Comprehensive Water Quality Testing

- Comprehensive water quality testing at the AWP Facility included more than 9,000 tests of the purified water at various points in the treatment process and for 342 different constituents.
- Water quality of the purified water was compared to regulatory limits, verifying that purified water met all applicable water quality standards.

This comprehensive water quality testing shows that the purified water produced at the AWP Facility is pure, approaching distilled water quality. For example, the total dissolved solids (TDS, a measure of salt content) in the purified water is about 15 milligrams per liter (mg/L), compared to TDS in San Diego's source and drinking water of about 500 mg/L. As a second example, the TOC (a measure of carbon that is bound in organic molecules) in the purified water is about 0.1 mg/L compared to TOC of 3.0 mg/L in San Diego's source water and 2.5 mg/L in San Diego's drinking water (City of San Diego, 2012a, City of San Diego, 2012g).

San Vicente Reservoir Study

Supplementing local water sources with purified water is a practice that is gaining wide-ranging support, due in part to projects such as the Orange County Groundwater Replenishment System (GWRS). Although water purification technology is widely recognized as capable of making recycled water into purified water that is drinkable, the regulatory community requires that purified water be retained in an environmental buffer, such as a groundwater basin or a surface water reservoir, prior to being blended into a drinking water system. Retaining purified water in an environmental buffer is considered an additional public health protection feature since it provides dilution by blending the purified water with other water sources and adequate retention time by holding the purified water prior to its release to a drinking water treatment plant. It should be noted that purified water is the best quality water supply available to San Diego. Introducing purified water into San Vicente Reservoir and blending it with lesser quality raw water sources could improve the overall water quality in San Diego's drinking water system.

San Vicente Reservoir is capable of providing environmental buffer features required by regulatory agencies.

San Vicente Reservoir could serve as a highly effective environmental buffer because, in addition to having sufficient storage available to accommodate fluctuating purified water flows throughout the year, it has unique characteristics that would assist in meeting regulatory requirements. Specifically, its large capacity and other natural characteristics, described in detail in Section C of this report, would allow the reservoir to retain the purified water for a substantial period of time before delivery to a municipal drinking water treatment plant such as the Alvarado Water Treatment Plant for final treatment.

To clearly demonstrate the potential reliability characteristics provided by San Vicente Reservoir, a three-dimensional hydrodynamic computer model of the reservoir was set up, including retention time and dilution components as well as a water quality component. The model was used in conjunction with both the Regional Board and CDPH, whose feedback was important to this process due to regulatory requirements for dilution, retention, and water quality conditions. Model set up and validation were also reviewed by the Demonstration Project's IAP, which formed a subcommittee specifically to work closely with the City and its consultants to review and comment on the various scenarios and data.

For the San Vicente Reservoir Study, 18 separate runs of the three-dimensional hydrodynamic model were performed. From these model runs, the project team - with input from the IAP - selected eight modeling scenarios for further assessment and analysis. These modeling scenarios were selected because they represent the full range of operational conditions that a reservoir augmentation project at San Vicente Reservoir could encounter, ranging from average water supply and demand conditions to extreme drought conditions when water demand would be higher than average and natural water levels (water surface level) within the reservoir would be lower than average. The reservoir model also tested four potential locations where purified water could enter San Vicente Reservoir to determine if the location of the purified water's entrance into the reservoir had an impact on water quality, retention, or dilution. Lastly, the reservoir model took into consideration the San Vicente Dam Raise Project, which will more than double the size of the reservoir. The model was used to simulate water movement through the enlarged reservoir. Table A-3 summarizes the eight model scenarios evaluated. The modeling results were provided in five "sets" of modeling runs and captured the expected result of adding purified water to San Vicente Reservoir under the anticipated operating conditions.

More detailed information on the completed modeling runs is provided in Section C, Table C-1 and the Flow Science reports cited in the References section of this report.

Table A - 3: Summary of Model Scenarios Evaluated

No.	Operating Scenario Evaluated
1	**Base Case – Design Inlet Location:** simulated reservoir conditions under median expected storage and normal expected operations with purified water inlet simulated at the Design Inlet Location, shown on Figure C-2.
2	**Base Case – Existing Aqueduct Inlet Location:** simulated reservoir conditions under median expected storage and normal expected operations, with purified water inlet simulated at the Existing Aqueduct Inlet Location, shown on Figure C-2.
3	**Base Case – New Aqueduct Inlet Location:** simulated reservoir conditions under median expected storage and normal expected operations, with purified water inlet at the New Aqueduct Inlet Location, shown on Figure C-2.
4	**Base Case – Barona Arm Inlet Location:** simulated reservoir conditions under median expected storage and normal expected operations with purified water inlet simulated at the Existing Barona Arm Inlet Location, shown on Figure C-2.
5	**No Purified Water Additions:** simulated reservoir conditions similar to Base Case, except there are no purified water additions and an equal reduction in reservoir outflow.
6	**Extended Drought – Design Inlet Location:** simulated reservoir conditions in a hypothetical two-year drought where a large and constant volume of water is withdrawn monthly from the reservoir without importing additional water to refill the reservoir. Purified water inlet was simulated at the Design Inlet Location, shown on Figure C-2.
7	**Extended Drought – New Aqueduct Inlet Location:** simulated reservoir conditions in a hypothetical two-year drought where a large and constant volume of water is withdrawn monthly from the reservoir without importing additional water to refill the reservoir. Purified water inlet was simulated at the New Aqueduct Inlet Location, shown on Figure C-2.
8	**Emergency Drawdown:** simulates reservoir conditions in a hypothetical emergency drawdown situation.

Key findings from the San Vicente Reservoir Study include:

- The addition of purified water into San Vicente Reservoir would not affect natural hydrologic characteristics of the reservoir, seasonal stratification, or mixing. This finding demonstrates that the addition of purified water would not impede the natural blending and retention in the reservoir.
- Dilution and retention of purified water in San Vicente Reservoir would constitute a substantial environmental barrier, sufficient to meet regulatory requirements.
- For all anticipated reservoir operating scenarios and purified water inlet locations, the reservoir would dilute the purified water at all times by at least a factor of 200 to one prior to conveying to the drinking water treatment plant.

- The addition of purified water would not affect water quality in San Vicente Reservoir. The dam raise and reservoir expansion, which is independent of the Demonstration Project, will improve overall water quality in the reservoir by reducing nutrients that cause water quality issues, and the addition of purified water will not change these improvements. In addition, purified water would reduce the salt concentration in the reservoir and improve drinking water quality.

Regulatory Coordination

Prior to moving forward with implementation, the City's reservoir augmentation project at San Vicente Reservoir would require approval by CDPH and the Regional Board. Neither CDPH nor the Regional Board has specific regulations in place for reservoir augmentation projects. A key objective of the Demonstration Project was to work with these regulatory agencies to establish the project features and operating requirements that would ensure public health protection, enabling approval of the City's reservoir augmentation project at San Vicente Reservoir.

Coordination with applicable regulatory agencies was a critical component of the Demonstration Project.

CDPH has authority to approve reservoir augmentation projects on a case-by-case basis. An additional goal of the Demonstration Project was to facilitate concept approval from CDPH for a reservoir augmentation project at San Vicente Reservoir. The City submitted a proposal to CDPH in March 2012 that presented specific public health protections provided by a reservoir augmentation project at San Vicente Reservoir and summarized technical study results obtained throughout the Demonstration Project and validated by the IAP (City of San Diego, 2012d). The City's proposal, provided in Appendix A, articulated how a reservoir augmentation project at San Vicente Reservoir would provide a robust, multiple barrier approach fundamental to public health protection by incorporating the following elements:

- **Enhanced source control** to prevent potential contaminants from entering the wastewater stream
- **Control of pathogens** (potential disease-causing organisms such as viruses, bacteria, protozoa, and fungi) through the use of existing recycled water treatment and implementation of advanced water purification processes
- **Control of nitrogen compounds** through implementation of advanced water purification processes

- **Reliable removal of regulated contaminants and constituents of emerging concern**, achieved through implementation of an advanced water purification process and monitoring plan focused on removal and frequent measurement of these constituents
- **Reliability and redundancy** to meet regulatory requirements and to prevent purified water from entering San Vicente Reservoir if necessary
- **Monitoring and response plan** designed to detect any unexpected operational issues at the full-scale AWP facility or source water contamination before the purified water reaches San Vicente Reservoir

Based on the multiple barrier approach outlined in the City's proposal, CDPH sent the City a Concept Approval Letter for a reservoir augmentation project at San Vicente Reservoir on September 7, 2012 (Appendix B).

The City also convened a series of meetings with the Regional Board throughout the Demonstration Project that focused on clarifying the Regional Board's regulatory framework for permitting a reservoir augmentation project at San Vicente Reservoir. On October 12, 2011, the Regional Board adopted Resolution No. R9-2011-0069 (provided as Appendix C), which documented the Regional Board's support for a reservoir augmentation project at San Vicente Reservoir. The resolution also established that the Regional Board would regulate the City's project at San Vicente Reservoir through an NPDES permit. In August 2012 the City submitted to the Regional Board a document entitled *Proposed Regional Water Quality Control Board Compliance Approach,* provided as Appendix D (City of San Diego, 2012e). This document summarizes the City's potential reservoir augmentation project at San Vicente Reservoir, identifies key permitting issues, and proposes a regulatory pathway that the Regional Board could follow to approve a full-scale project at San Vicente Reservoir. The Regional Board, working together with the EPA, reviewed the City's submittal and acknowledged in a February 2013 letter that an NPDES permit could be issued for a reservoir augmentation project at San Vicente Reservoir based on the City's preferred regulatory pathway. That letter, provided in Appendix E, also acknowledged both the Regional Board's and EPA's strong support for the City's efforts in considering a full-scale reservoir augmentation project at San Vicente Reservoir.

Key findings from the regulatory coordination effort include:

- The combination of advanced water purification technology and San Vicente Reservoir conditions would provide the necessary safeguards to make reservoir augmentation feasible from a regulatory perspective.
- Regulatory acceptance of the City's Demonstration Project was validated through a Concept Approval letter from CDPH and a Resolution of Support and Letter of Concurrence from the Regional Board.

Public Outreach and Education

The public outreach and education program for the Demonstration Project was a continuation of outreach efforts that started with the Water Reuse Study, building on the foundation laid during that study. A strategic outreach plan was developed at the outset of the Demonstration Project to guide the continuation of this program. Throughout the duration of the Demonstration Project, the City sought to ensure that information was presented in a clear, understandable, and accessible way to residents in all areas of the City. Information about the Demonstration Project was also provided through a variety of formats including direct contact with individuals, written and electronic materials, traditional and social media, group presentations, community events, and tours of the AWP Facility. Additional information on the public outreach and education program for the Demonstration Project can be found in the companion CD, which is Appendix H of this report. The following outreach activities were completed as part of the Demonstration Project:

- Developed the outreach plan
- Conducted research, including one-on-one stakeholder interviews
- Produced informational materials
- Assembled a speakers bureau composed of project team members and Public Utilities Department staff
- Created a presentation about the project for community groups
- Requested community group recommendations from City Council members to contact for presentation opportunities
- Conducted project presentations to community organizations, internal staff, the City's Independent Rates Oversight Committee (IROC) and Natural Resources & Culture Committee (NR&C)
- Participated in industry conferences
- Developed an email list database of individuals interested in the project
- Distributed eUpdates and electronic newsletters to interested parties
- Participated in community events
- Provided project information to a broad group of media representatives and outlets
- Compiled quarterly metrics reports and analyzed them to guide future outreach activities
- Launched the Urban Water Cycle Tour program, which culminated in AWP Facility tours
- Invited elected officials and project stakeholders to visit the AWP Facility when it began operation in mid-2011
- Developed informational materials, such as a virtual tour video, project white papers and a tour brochure
- Established a social media presence online using Facebook, Twitter, and YouTube
- Implemented continuous improvements in the AWP Facility tours based on feedback from tour guests
- Continuously enhanced the community presentations based on attendee feedback

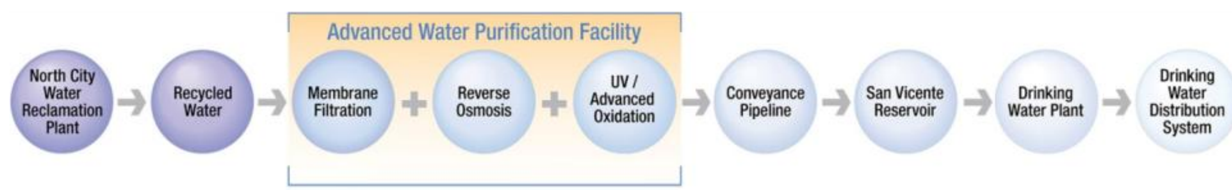
Key findings from the public outreach effort include:

- Feedback from more than 3,200 individuals who have toured the AWP Facility shows that providing an opportunity to tour the facility increases understanding about water purification processes.
- Survey research shows a steady increase from 2004 (26 percent) to 2011 (68 percent) to 2012 (73 percent) in City residents who favor using advanced treated recycled water as an addition to the City's drinking water supply.

Full-Scale Project Considerations

Potential implications of a full-scale project need to be well understood before a decision to implement such a project can be made. Full-scale project components evaluated during the Demonstration Project included source control enhancement, North City Water Reclamation Plant (North City) operations, full-scale AWP facility construction, pipeline system construction, environmental and regulatory permitting, economic and energy implications, and public outreach. Figure A-4 presents the components of a full-scale reservoir augmentation project at San Vicente Reservoir.

Figure A - 4: Components of a Multiple Barrier Reservoir Augmentation Project at San Vicente Reservoir



Full-scale project considerations include the following.

- **Source Control Enhancement:** The first barrier in the City's multiple barrier approach to water purification is source control, which is the prevention of contaminants from entering the wastewater stream processed at North City. The City already implements a robust Industrial Waste Control Program (IWCP) to protect wastewater treatment processes, recycled water quality, and coastal ocean resources as required by the Point Loma Wastewater Treatment Plant (Point Loma) discharge permit (refer to Section F for more information). The IWCP includes a pretreatment program for the City of San Diego and each of the 15 Participating Agencies, as well as other source control programs. Despite the extensive program currently in place, CDPH requires heightened vigilance and inclusion of residential and commercial programs in systems in which the purified water end product would enter the drinking water system. Orange County Sanitation District (OCSD) has implemented an enhanced source control program to support the GWRS. The City has reviewed that program and concluded that the following components would be appropriate enhancements to the City's existing IWCP, should the City pursue reservoir augmentation at San Vicente Reservoir.

  - Develop a Chemical Inventory Program and Geographic Information System (GIS) Tracking system, which is an expanded industrial and commercial discharger chemical inventory database linked to discharger locations that are tracked using GIS software
  - Implement a Pollutant Prioritization Program, which would involve prioritizing pollutants through sampling, characterizing constituents of emerging concern (CECs) at the full-scale AWP facility, and determining if pollutants can be controlled through targeted source control for individual dischargers or commercial sectors
  - Perform an annual Local Limits Evaluation, which would consider including additional pollutants of concern on North City's list of local limits, and potentially lowering the limit of pollutants already on the list

- **North City Water Reclamation Plant Operations:** The IAP noted that North City already has key reliability features, including conservative operating criteria and flow equalization, to support a reservoir augmentation project at San Vicente Reservoir.
- **Full-Scale AWP Facility and Pipeline System Components:** The City evaluated construction considerations for a potential full-scale AWP facility with a capacity of 18 mgd and an estimated average production of 15 mgd, including facility components; production capacity; site location and layout; system controls, reliability, and redundancy; and full-scale AWP facility costs. Average production (15 mgd) is expected to be slightly lower than maximum treatment capacity (18 mgd) because production will vary throughout the year due to routine maintenance requirements and seasonal fluctuations in recycled water demand. During periods of low recycled water demand, full production capacity maybe attained, while in months of peak recycled water demand, it will be less than capacity, averaging approximately 15 mgd on a year-round basis. The City completed a conceptual design study for the purified water pipeline system that would be needed to transport water from a full-scale AWP facility (located at North City) to San Vicente Reservoir. This conceptual design study reviewed potential pipeline alignments and pump station specifications. Capital costs for full-scale AWP facility and pipeline system construction, which reflect data and information developed as part of the Demonstration Project, are estimated to be approximately $370 million, with annual operations and maintenance costs estimated to be approximately $16 million per year. This corresponds to a unit cost of approximately $2,000/ AF. This estimate is consistent with the 2012 LRWRP, which estimated that a full-scale reservoir augmentation project at San Vicente Reservoir would cost approximately $2,100/AF, including initial capital and annual operating costs (and energy). This would result in an increase of approximately $6.87 to an average monthly residential water bill. However, the project would also result in approximately $1,000/AF in avoided wastewater costs, resulting in a net cost of approximately $1,000/AF. Projected costs are described in further detail in the AWP Facility and Pipeline System Costs portion of Section F.

- **Environmental and Regulatory Permitting:** The Demonstration Project documented the regulatory requirements associated with a reservoir augmentation project at San Vicente Reservoir. Required regulatory documentation would likely include an Environmental Impact Report (EIR) and an Environmental Impact Statement (EIS); CDPH permitting, which would include developing an Engineering Report, convening three CDPH-led public hearings to comply with Section 116551 of the Health and Safety Code - Augmentation of Source with Recycled Water, issuing CDPH Findings of Fact, and amending the City's Water Supply Permit by CDPH to acknowledge a change of source water; and Regional Board permitting, which would include issuing a tentative permit, holding a public hearing, and issuing the formal permit.
- **LRWRP Energy Analysis:** Energy usage was estimated for a reservoir augmentation project at San Vicente Reservoir through development of the City's draft 2012 LRWRP, which provides the City with a water resources strategy to meet future water needs through 2035. The full-scale reservoir augmentation project at San Vicente Reservoir evaluated in development of the draft 2012 LRWRP would require approximately 2,500 kilowatt hours per acre-foot (kWh/AF) of energy, and would produce approximately 1.0 metric tons of greenhouse gases/AF. By comparison, imported water requires a range of 2,000 kWh/AF to 3,300 kWh/AF of energy, depending on the blend of water from the Colorado River or the Bay-Delta in Northern California, respectively. This corresponds to a range of 0.8 to 1.3 metric tons of greenhouse gases/AF (City of San Diego, 2012c). Since 2003, the blend delivered to the Water Authority has averaged approximately two-thirds Colorado River and one-third water from the Bay-Delta. Future imported water energy consumption will vary depending on actual blend. However, for practical purposes, the reservoir augmentation project at San Vicente Reservoir energy consumption is equivalent to that of imported water.
- **Public Outreach and Education Program:** The City has conducted extensive public outreach and education to make City residents aware of the potential implications and benefits of reservoir augmentation at San Vicente Reservoir. Should the City decide to move forward with a full-scale project, the interest level of the general population would be expected to increase and comprehensive outreach and education would need to continue. It is recommended that, should the City decide to move forward with a reservoir augmentation project at San Vicente Reservoir, the outreach activities conducted during the Demonstration Project be continued.

Summary of Findings

Table A-4 summarizes the Demonstration Project components and findings.

Table A - 4: Summary of Demonstration Project Findings

Project Component	Key Findings
Convene an Independent Advisory Panel	The IAP unanimously concluded that a reservoir augmentation project at San Vicente Reservoir would be a landmark project in the acceptance and furtherance of indirect potable reuse and would contribute to the City of San Diego's water portfolio.
Design, construct, and operate a demonstration-scale advanced water purification facility at the North City Water Reclamation Plant	The AWP Facility was designed, installed, operated, and tested between 2010 and 2012. Purified water produced at the AWP Facility reliably met applicable water quality standards.
Conduct a study of San Vicente Reservoir to establish residence time and water quality parameters and conditions of purified water in the reservoir	Addition of purified water into San Vicente Reservoir would not affect natural reservoir conditions and would meet regulatory requirements.
	San Vicente Reservoir would provide significant dilution of purified water.
	The addition of purified water would not impair existing conditions of San Vicente Reservoir, and could improve nutrient-related water quality issues.
Perform an energy and economic analysis	The estimated capital and annual operational and maintenance costs for a reservoir augmentation project at San Vicente Reservoir are $369 million and $15.5 million/year, respectively. This equates to approximately $2,000/AF, or an increase of approximately $6.87 to an average monthly household water bill. These costs are consistent with the City's draft 2012 LRWRP, which projected a reservoir augmentation project at San Vicente Reservoir to cost approximately $2,100/AF. In addition, the project would generate approximately $1,000/AF in avoided wastewater management costs.
	The reservoir augmentation project at San Vicente Reservoir would require approximately the same amount of energy and produce approximately the same amount of greenhouse gas emissions compared to imported water supplies.
	All three of the highest ranked portfolios in the 2012 LRWRP included a reservoir augmentation project at San Vicente Reservoir as a common resource option.

Project Component	Key Findings
Define the state's regulatory requirements for a full-scale reservoir augmentation project at San Vicente Reservoir	Results from the AWP Facility and reservoir studies provided evidence that the combination of advanced water purification technology and San Vicente Reservoir conditions would provide public health and environmental safeguards that would make reservoir augmentation feasible from a regulatory perspective. Regulatory participation in all IAP meetings and working groups addressing all technical aspects of reservoir augmentation conducted throughout the Demonstration Project enabled the regulators to establish specific guidelines and regulatory pathways to permitting a reservoir augmentation project. CDPH issued a Concept Approval Letter in September 2012 acknowledging that a reservoir augmentation project at San Vicente Reservoir would meet CDPH requirements. The Regional Board issued a letter in February 2013 concurring with the recommended permitting pathway for a reservoir augmentation project at San Vicente Reservoir.
Perform a pipeline alignment study	Conceptual design identified preferred pipeline alignments and estimated capital and annual operations and maintenance costs for the conveyance system to be $225 million and $3.4 million per year, respectively
Conduct a public outreach and education program	Survey research shows a steady increase from 2004 (26 percent) to 2011 (68 percent) to 2012 (73 percent) of City residents who favor using advanced treated recycled water as an addition to the City's drinking water supply.
	Feedback from individuals who have toured the AWP Facility shows that providing an opportunity to tour the facility increases understanding about water purification.

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Section B: Advanced Water Purification Facility

Advanced Water Purification Facility Findings

- Comprehensive water quality program at the AWP Facility included more than 9,000 tests at various points in the treatment process for 342 different chemical constituents, microbial constituents, and water quality parameters. Water quality of the purified water was compared to regulatory limits, verifying that purified water met all applicable water quality standards. This comprehensive water quality testing shows that the purified water produced at the AWP Facility is very pure – approaching distilled water quality.
- Operational data gathered during the 12 month testing period verified continuous and daily monitoring of each water purification process can assure the integrity of the process and that only the highest quality water is produced.

The City recognizes the importance of developing a thorough understanding of the technology, operations, and quality of purified water prior to moving forward with construction of a full-scale AWP facility. In addition, CDPH required the City to demonstrate the ability of the water purification process to produce purified water suitable for addition to San Vicente Reservoir prior to issuing concept approval for a reservoir augmentation project at San Vicente Reservoir.

To this end, the City installed and operated a demonstration-scale facility, referred to as the AWP Facility. An integral component of the Demonstration Project, the AWP Facility generated valuable information that will aid the City in selecting specific process equipment, understanding the quality of water that would be produced by a full-scale AWP facility, securing regulatory approval, and estimating full-scale AWP facility costs, should the City decide to move forward with construction of a full-scale AWP facility.

This section describes the characteristics and performance of the AWP Facility. Additional information on the AWP Facility can be found in AWP Facility Study Report (CDM Smith and MWH 2013a).

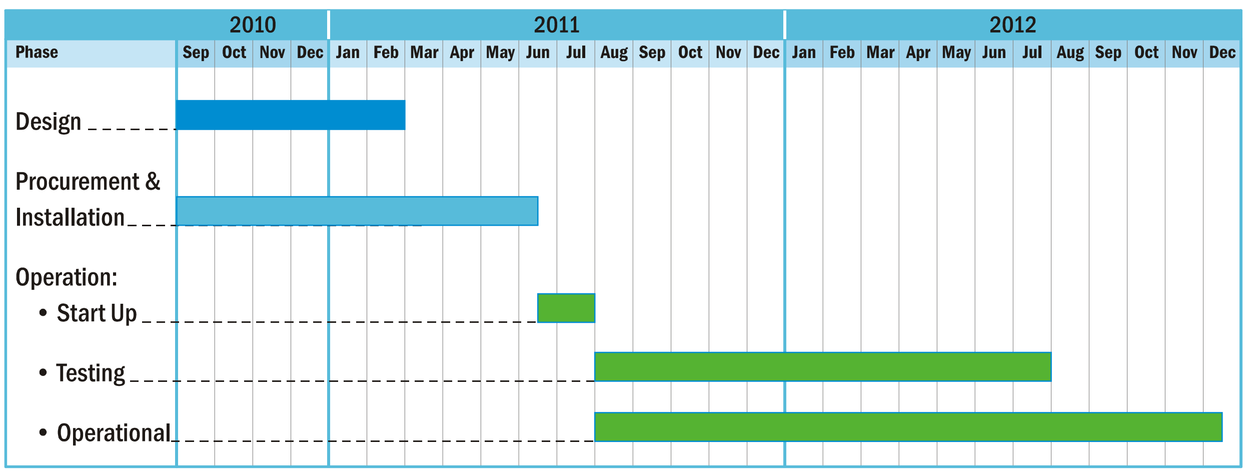
The AWP Facility produced purified water using the same processes as a potential full-scale facility.

What is the AWP Facility?

The main purpose of the AWP Facility was to demonstrate the expected performance of a potential full-scale AWP facility prior to investing in and constructing the larger facility. Demonstration facilities such as the AWP Facility generate valuable information to guide full-scale facility planning and design, support permitting, and confirm the ability of potential full-scale facilities to meet project objectives.

The AWP Facility was designed, installed, operated, and tested between September 2010 and July 2012, as shown graphically in Figure B-1. AWP Facility start-up occurred over a one-and-a-half month period (mid-June 2011 through the end of July 2011), and facility testing spanned the following one year (August 2011 through July 2012). This section summarizes results and conclusions from that test period. Although the testing period is complete, the AWP Facility continues to operate for public tours and to gather additional equipment performance data. More information on public tours conducted at the AWP Facility is included in Section E.

Figure B - 1: AWP Facility Schedule



The AWP Facility produces one mgd of purified water using the same process components and multiple barrier strategy as those currently implemented at the 70 mgd GWRS, which has been operated by the Orange County Water District since 2008.

The AWP Facility provided a venue for conducting tours and educating the public on water purification processes. The facility layout accommodated public viewing and included signage and other visual aids to explain the water purification processes.

The water treated by the AWP Facility was recycled water from North City. No purified water was sent from the AWP Facility to San Vicente Reservoir during the Demonstration Project. All purified water produced at the AWP Facility was returned to the existing North City recycled water system and used for irrigation and industrial purposes.

The Water Purification Process

The AWP Facility was designed in accordance with industry standards for water purification processes established by CDPH in the Groundwater Replenishment Reuse Draft Regulation (CDPH, 2008). CDPH-specified process components included membrane filtration, reverse osmosis, and UV disinfection/advanced oxidation. Each process element is described below.

- **Membrane Filtration:** Membrane filtration is the first step in the water purification process. Water is passed through a material called a membrane, which has openings or "pores" that are large enough for water to pass through, but small enough to prevent particles such as suspended solids, bacteria, and protozoa from passing through.

  The AWP Facility included two types of membrane filtration: microfiltration and ultrafiltration. The microfiltration system had a nominal pore size of 0.1 microns. This means that any contaminants greater than 0.1 micron in size (approximately 300 times smaller than the diameter of a human hair) were removed from the purified water in the microfiltration process. The ultrafiltration process had a nominal pore size of 0.01 microns, meaning that any contaminants greater than 0.01 micron in size (approximately 3,000 times smaller than the diameter of a human hair) were removed.

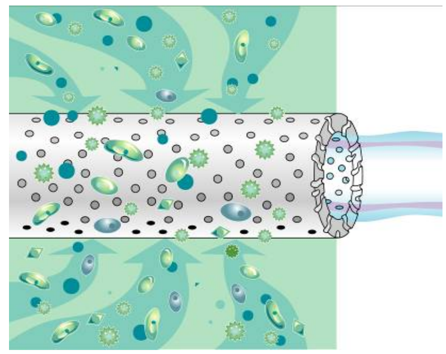


Illustration of membranes used for the membrane filtration process

- **Reverse Osmosis:** The second step in the water purification process, reverse osmosis, is a common water treatment process that is used in many industries to produce purified water. In reverse osmosis, water is forced under pressure through membranes capable of separating extremely small molecules, including salts, viruses, pesticides, and most organic compounds from water. Reverse osmosis produces water that is similar in quality to distilled water. The AWP Facility included two side-by-side reverse osmosis systems, enabling the City to compare the performance of equipment from two manufacturers and two system configurations.

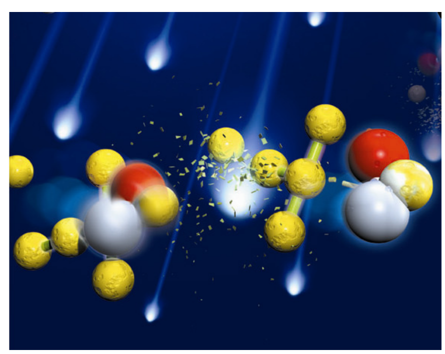


Illustration of UV light photons and hydroxyl radicals breaking up, and effectively destroying, trace contaminants in water.

- **UV Disinfection/Advanced Oxidation:** UV disinfection/advanced oxidation is the third step in the water purification process, providing both the primary disinfection step and a second barrier to chemical compounds. In this step, hydrogen peroxide, which is a common household disinfectant, is added to the purified water. The purified water is then exposed to UV light, which is similar to concentrated sunlight. UV light is a powerful disinfectant that is commonly used to disinfect medical and dental equipment.

Advanced oxidation is achieved when UV light breaks chemical bonds and converts hydrogen peroxide into reactive particles known as hydroxyl radicals. These hydroxyl radicals destroy low molecular weight contaminants such as 1,4-dioxane that are known to penetrate the reverse osmosis membrane. In this way, advanced oxidation destroys trace contaminants that may have passed through the reverse osmosis process. The hydroxyl radicals are combined into other molecules in this process and do not persist in the purified water.

AWP Facility Testing Approach

A formal Testing and Monitoring Plan was prepared at the outset of the Demonstration Project with oversight and input from both the IAP and regulatory agencies (CDM and MWH, 2011a). This comprehensive Testing and Monitoring Plan was designed to achieve the following objectives:

1. Validate the overall performance of the water purification process in meeting regulatory requirements.
2. Demonstrate that continuous and daily monitoring of each water purification process can assure the integrity of the process and that only the highest quality water is produced.

AWPFacility Purification Process

The AWP Facility purification process included membrane filtration, reverse osmosis, and ultraviolet disinfection/advancedoxidation This purification process is being successfully used by multiple other projects currently operating in California, including Orange County's GWRS.

Step 1: Membrane Filtration

Step 2: Reverse Osmosis

Step 3: Ultraviolet Disinfection/Advanced Oxidation

Water quality constituents, which are dissolved chemical compounds or suspended materials that may be present in water, were identified for testing and monitoring based on regulatory standards and guidance provided in the following documents:

- Standard water quality criteria established for drinking water (primary and secondary maximum contaminant levels) (EPA, 2009)
- CDPH Drinking Water Notification Levels (CDPH, 2010)
- EPA Total Coliform Rule (EPA, 1989)
- CDPH Groundwater Replenishment Reuse Draft Regulation (CDPH, 2011)
- Environmental Protection Agency California Toxics Rule National Recommended Water Quality Criteria pertaining to aquatic life and human health (EPA, 2000)
- Regional Board Basin Plan Water Quality Objectives (Regional Board, 1994)
- State Board Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Board, 2005)
- State Board Monitoring Strategies for Chemicals of Emerging Concern in Recycled Water (State Board, 2010)

In total, more than 9,000 laboratory tests were conducted on 342 chemical constituents, microbial constituents, and water quality parameters. The samples collected at the AWP Facility were analyzed by certified outside laboratories. A quality assurance/quality control program using multiple laboratories further verified sampling results.

Water Quality Results

Water quality samples of recycled water, imported water, and purified water were collected and analyzed on a quarterly basis during the 12-month testing period. More frequent samples were collected upstream and downstream of each of the process steps for constituents that indicated process performance (CDM and MWH, 2011a, CDM Smith and MWH, 2012a, CDM Smith and MWH, 2012b and CDM Smith and MWH, 2013b). As shown in Table B-1, purified water was tested for all regulated constituents and met all applicable regulations.

Table B - 1: Water Quality –Regulated Constituent Results

Regulations / Guidelines	Number of Constituents	Purified Water Results
California Department of Public Health Goals		
Primary Drinking Water Maximum Contaminant Levels (MCLs) [1]	90	Meets All Regulations
Secondary Drinking Water MCLs[2]	18	Meets All Regulations
Microbial[3]	4	Not Detected
Notification Levels[4]	30	Meets All Regulations
Groundwater Replenishment Criteria[5]	142	Meets All Regulations
State Board Goals for Reservoir Augmentation at San Vicente Reservoir (projected)		
San Vicente Reservoir Limits[6]	143	Meets All Regulations
Total[7]	**231**	

Footnotes:

1. Primary drinking water MCLs are enforceable, human health-based water quality limits.
2. Secondary drinking water MCLs are unenforceable water quality goals related to aesthetic water characteristics such as taste and odor. Purified water met all Federal and State Secondary MCLs with the exception of pH and corrosivity. The potential full-scale AWP facility would include post treatment to meet these requirements.
3. Total Coliform, Fecal Coliform, and Viruses (Somatic and Male Specific Bacteriophage)
4. Notification levels are drinking water quality advisory limits.
5. Groundwater Replenishment Criteria are water quality limits specifically developed for indirect potable reuse via groundwater replenishment.
6. Reservoir limits are EPA Numeric Criteria for Priority Pollutants and San Diego Basin Numeric Objectives.
7. Because some contaminants and parameters are in multiple regulations / guidelines the total of unique parameters is less than the sum.

Relevant unregulated constituents were also measured, including 30 constituents listed in the EPA Unregulated Contaminant Monitoring Rule 3, 90 CECs (pharmaceuticals, and other products typically found in treated wastewater), six nitrosamines, three radionuclides, and lithium.[3] Accounting for overlap, this totals 111 unique additional unregulated constituents. Of these, six constituents were detected in the purified water during at least one sampling event; that is to say, the constituent was detected at a level that the laboratory was able to determine a numerical concentration. In comparison, 21 constituents were detected in the imported aqueduct water during at least one sampling event.

The six constituents detected in the purified water are: Bromochloromethane, used in fire-extinguishing fluid; Chromium (VI), formed by oxidation of chromium (III) in the advanced oxidation process; Strontium, a naturally occurring metal and dietary supplement; Acesulfame-K, a widely used artificial sweetener; Iohexal, a contrasting agent used in X-ray procedures; and

[3] The Unregulated Contaminant Monitoring Rule 3 (UCMR 3) was signed by EPA Administrator, Lisa P. Jackson on April 16, 2012. UCMR 3 will require public water systems to monitor for up to 30 potential drinking water contaminants. Additional information can be found at: http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/ucmr3/index.cfm

Triclosan, an antibacterial agent used in hand soap and toothpaste. Since these non-regulated constituents do not have regulatory limits, the best way to determine the significance of measured concentrations is to compare them to the constituent's Drinking Water Equivalent Level (DWEL) or the EPA indentified Health Reference Level. The DWEL and Health Reference Levels both represent an acceptable concentration in drinking water assuming an average person consumes two liters of water per day for 70 years. The measured concentration of these six constituents in the purified water were 10 million times to 18 times lower than associated DWELs and Health Reference Levels.

In general, water quality testing shows that the purified water is approaching distilled water purity. For example, TDS (a measure of salt content) in the purified water is about 15 mg/L, compared to TDS in San Diego's source water and drinking water of about 500 mg/L. As a second example, TOC (a measure of carbon that is bound in organic molecules) in the purified water is about 0.1 mg/L compared to a TOC of 3.0 mg/L in San Diego's source water and 2.5 mg/L in San Diego's drinking water (City of San Diego, 2012a, City of San Diego, 2012g).

For detailed information regarding water quality and other data collected and analyzed for the Demonstration Project, please refer to Quarterly Testing Report No. 4 for the AWP Facility, which is included in the References section of this Project Report.

Integrity Testing and Monitoring

Verifying the integrity and reliability of each water purification process was critical to assure that only the highest quality water is produced by the AWP Facility. Integrity testing uses both mechanical tests and routine water quality sampling to verify that equipment is functioning properly. Integrity monitoring consists of continuous and daily measurements at critical points in the treatment process. During the 12-month testing period, a critical control-point monitoring plan was implemented to identify any changes in performance of the treatment processes that could adversely impact final water quality. Examples of the techniques used to assure reliable performance are illustrated in Table B-2.

Integrity testing and water quality monitoring confirmed that the advanced water purification processes are functioning properly.

Integrity monitoring and critical control point monitoring showed that the AWP Facility equipment remained intact, met the intended treatment performance on a continuous basis, and was reliable throughout the operational period (CDM and MWH, 2013a). During the design phase of a full-scale AWP facility, the City would develop a similar online monitoring and response plan to provide sufficient features and assurances that any foreseeable malfunction could be promptly identified and appropriate responses promptly applied. Overall, the results of both integrity testing and monitoring verified that the purification processes met their intended treatment performance levels on a continuous basis.

Table B - 2: Summary of Advanced Water Purification Process Integrity Monitoring

Critical Control Point	Critical Limit Parameter	Monitoring Frequency	Results
Membrane Filtration	Pressure Decay[1]	Once per day	Results showed that both membrane filtration systems remained intact over the testing periods.
Reverse Osmosis (RO)	TOC[2], Conductivity[3]	Continuous[4]	Both RO systems achieved consistent conductivity rejection, and nearly six months of online TOC monitoring showed the combined RO permeate TOC was consistently below the maximum acceptable level of 0.1 mg/L.
UV Disinfection	Reactor Power Level	Continuous	When any of the 72 lamps or 36 ballasts failed, system alarms and power levels adjusted as programmed, and water quality was not affected.
UV Disinfection/ Advanced Oxidation	Hydrogen Peroxide Dose Rate/ Continuous Flow Confirmation	Once per day by draw down Continuous flow confirmation	

1. Pressure Decay: The operational integrity of membrane filtration systems can be tested by a pressure decay test, which measures the rate of pressure decay (drop) across a membrane over a specified period of time. A sharp drop in pressure can alert operators to a potential defect or leak in the membrane filtration system.
2. TOC is the amount of carbon present in the water, and includes all natural and man-made organic chemicals.
3. Conductivity is the ability to conduct or transmit electricity. Conductivity of water increases with the concentration of dissolved ions, so measuring conductivity provides a measure of the concentration of dissolved ions in water.
4. The term "continuous" may also apply to measurements that are taken frequently (example: every four minutes) and automatically whenever the process is in production.

Performance Indicator Monitoring

The AWP Facility testing also included performance indicator monitoring to determine if any constituents could be used to indicate the treatment efficiency of the reverse osmosis and UV/advanced oxidation processes. Many of the constituents monitored at the AWP Facility were removed by the reverse osmosis to levels at or below quantifiable limits, demonstrating strong performance of the reverse osmosis process. Therefore, identifying usable performance indicators to accurately measure advanced oxidation removal was a challenge.

Sixteen constituents were monitored as performance indicators, and removal generally exceeded 95 percent within the reverse osmosis process when sufficient quantities were present to calculate removals. In some cases, greater than 99.9 percent removal was observed.

Indicator compounds, such as TOC (a measure of carbon bound in organic molecules), conductivity (ability to conduct electricity which corresponds to salt content), monochloramines (a mild disinfectant used to prevent microbial growth in drinking water), and UV 254 (a measure of absorbance of light of a particular wave length as it passes through water), may prove to be more reliable as CEC removal performance indicators due to their ease of measurement and their reliable presence in the water downstream of both the reverse osmosis and advanced oxidation processes. For the reverse osmosis process, the average removal results were: TOC - 99.6 percent, conductivity - 99.0 percent, and UV254 - 88.8 percent. For the advanced oxidation process, the average removal results were: UV254 - 68.7 percent and monochloramines - 72.8 percent.

Operational Performance

The AWP Facility became fully operational on June 16, 2011. The operation and testing results were presented in quarterly reports over the operating period as summarized in Table B-3 (CDM and MWH, 2011b, CDM and MWH, 2012a, CDM and MWH, 2012b, CDM and MWH, 2013b).

Table B - 3: Operation and Testing Schedule

Testing Period	Testing Quarter	Operating Period		Report Date
		Test Period Start	Test Period End	
1	Quarter 1	6/16/2011	10/31/2011	December 2011
2	Quarter 2	11/1/2011	2/10/2012	March 2012
3	Quarter 3	5/11/2012	5/14/2012	June 2012
4	Quarter 4	5/15/2012	7/31/2012	September 2012

The following subsections summarize the operational specifics of the membrane filtration, reverse osmosis, and UV disinfection and advanced oxidation systems (CDM and MWH, 2013a).

Membrane Filtration

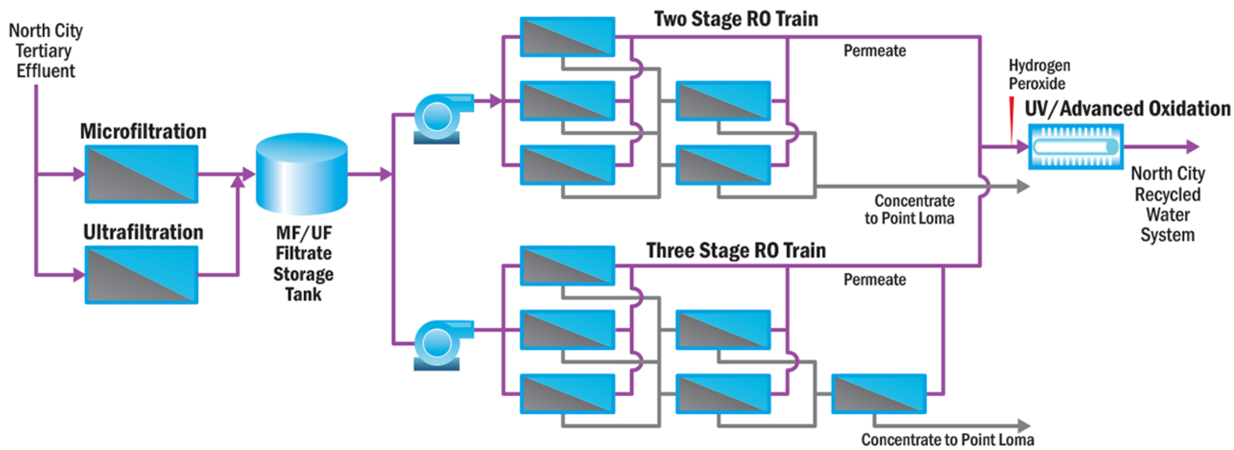
The membrane filtration equipment used at the AWP Facility included two parallel systems, each treating half of the recycled water entering the AWP Facility. One system used microfiltration membranes, while the second system used ultrafiltration membranes. Although both systems were expected to efficiently remove suspended solids, bacteria, and protozoa as the first step in the multiple barrier process, the smaller pore size of ultrafiltration membranes was expected to provide better removal, but with higher energy usage. Side-by-side testing was performed to determine the feasibility of using either microfiltration or ultrafiltration systems for the full-scale AWP facility. More membrane selection options will allow for more competitive bids on full-scale equipment.

Water quality data demonstrated that both systems consistently produced purified water that met water quality objectives for target constituents. Microbial monitoring confirmed that both membrane systems provide a substantial barrier to pathogenic organisms. Both membranes removed more than 99.9 percent of bacteria and more than 99 percent of viruses. The ultrafiltration membranes provided an increased level of protection against the smallest pathogenic organisms (viruses) due to its smaller pore size. The side-by-side testing showed that the smaller pore size on the ultrafiltration membrane did not result in higher pressure/energy requirements.

Reverse Osmosis

Two reverse osmosis configurations, a two-stage configuration and a three-stage configuration, were tested (shown in Figure B-2). The different configurations were tested to identify any operating advantages that one configuration may have over the other. The two-stage and three-stage configurations were tested at both an 80 percent and an 85 percent recovery rate, where recovery rate refers to the percentage of upstream flow that remains in the downstream flow after the reverse osmosis step. Existing AWP facilities in California typically operate at an 85 percent recovery rate, with approximately half of the plants using two-stage configurations and half using three-stage configurations. The testing showed that both the two-stage and three-stage reverse osmosis configurations could reliably operate at 85 percent recovery. The three-stage configuration did not offer the improved system hydraulics that were anticipated.

Figure B - 2: Reverse Osmosis Configurations Tested at the AWP Facility



Water quality testing of the reverse osmosis membranes focused primarily on expected differences in nitrogen, a nutrient of concern for San Vicente Reservoir. Both reverse osmosis configurations exhibited similar water quality performance. Specifically, both systems showed similar ability to remove salts and nitrates and produced purified water that would meet or exceed regulatory requirements.

The three-stage configuration required eight percent more energy than the two-stage configuration. Based on operational performance, the two-stage configuration provided the basis for a full-scale AWP facility layout and cost estimation conducted as part of the Demonstration Project.

Because reverse osmosis uses semi-permeable membranes that only let the smallest molecules pass through, it requires more pressure and energy than the other treatment processes. Both reverse osmosis configurations were equipped with energy recovery devices designed to optimize the overall energy use of the reverse osmosis system. Energy recovery devices are designed to recover energy between reverse osmosis stages, minimizing energy requirements. Specifically, these devices transfer pressure (and associated energy to create pressure) from one reverse osmosis stage to another, thereby reducing the amount of pressure and energy required for each stage. The energy recovery devices tested for the reverse osmosis process demonstrated that these devices performed successfully and resulted in an eight percent overall energy reduction for the two-stage configuration. The full-scale energy savings with energy recovery devices was assumed to be four to seven percent.

Concentrate produced by the reverse osmosis system would be discharged to Point Loma. Ocean discharges from Point Loma have decreased in recent years, and currently average approximately 150 mgd to 160 mgd. At a recovery rate of 85 percent, a reservoir augmentation project at San Vicente Reservoir producing 15 mgd (average production) of purified water would generate approximately 2.6 mgd of concentrate. This would constitute approximately 1.9 percent of the total Point Loma flow, increasing the TDS of the Point Loma ocean discharge by approximately 100 mg/L – which would not have any insignificant effect.

UV Disinfection and Advanced Oxidation

During the testing period, the UV disinfection and advanced oxidation system, which includes UV light and hydrogen peroxide, was operated to achieve specific removals of n-nitrosodimethylamine (NDMA) and 1,4-dioxane. These chemicals are used by CDPH as indicator compounds to assess the performance of advanced oxidation since both are difficult to remove and the ability of a process to achieve removal indicates that the process provides a robust barrier to a wide array of chemicals. Although NDMA concentrations are extremely low in North City recycled water as compared to other recycled water sources throughout California and nationwide, percent removal can still provide an indication of advanced oxidation system performance.

Performance results demonstrated that, with an adequate amount of hydrogen peroxide and power applied to the UV system, sufficient contaminant removal was achieved to meet regulatory requirements. Because the excellent disinfection capability of UV/advanced oxidation systems has been well established by other full-scale operations (such as the Orange County GWRS), there was no need to test this system's disinfection performance as part of the Demonstration Project. Specifically, deactivation of 99.9999 percent of viruses has been demonstrated for this process operating under similar conditions. Throughout the testing period, the UV/advanced oxidation process achieved the target NDMA and 1,4-dioxane removal rates defined by CDPH (CDPH, 2008; CDPH, 2011).

AWP Facility Findings

Key findings of the AWP Facility include the following.

- The water quality testing and monitoring program at the AWP Facility included more than 9,000 tests at various points in the treatment process and imported water aqueduct for 342 different water quality constituents and microbial parameters. Water quality of the purified water was compared to regulatory limits, verifying that purified water met all applicable water quality standards. Further, this comprehensive water quality testing shows that the purified water is pure, approaching distilled water purity.
- It was demonstrated that continuous and daily monitoring of each water purification process can assure the integrity of the process and that only the highest quality water is produced.

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Section C: San Vicente Reservoir Study

San Vicente Reservoir Study Findings

- The addition of purified water into San Vicente Reservoir would not affect natural hydrologic characteristics of the reservoir, seasonal stratification, or mixing. This finding demonstrates that the addition of purified water would not affect the natural blending and retention in the reservoir.
- Blending and retention of purified water in San Vicente Reservoir would constitute a substantial environmental barrier, sufficient to meet regulatory requirements.
- For all anticipated reservoir operating scenarios and purified water release locations, the reservoir would dilute the purified water by at least a factor of 200 to one at all times.
- The addition of purified water would not substantially affect water quality in San Vicente Reservoir. The dam raise and reservoir expansion, which is independent of the Demonstration Project, will improve overall water quality in the reservoir by reducing nutrients including nitrogen compounds that cause water quality issues, and the addition of purified water will not change these improvements. Addition of purified water would improve some aspects of reservoir water quality, such as reducing salt concentration.

Regulatory agencies require that a substantial environmental buffer, either a groundwater basin or a surface water reservoir, serve as a receptacle for purified water prior to blending into the drinking water system. As recommended as part of the Water Reuse Study, San Vicente Reservoir would provide that environmental buffer if the City were to implement a reservoir augmentation project at San Vicente Reservoir.

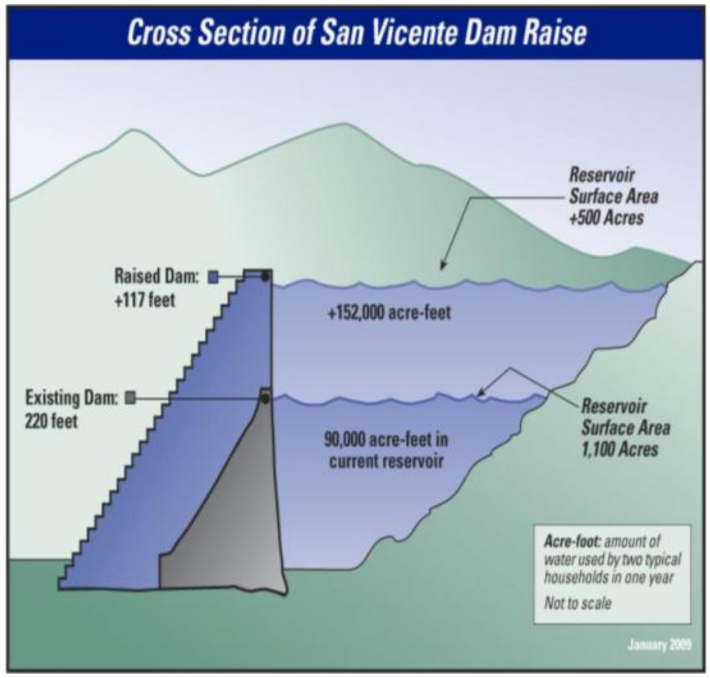
This section describes the San Vicente Reservoir setting, the regulatory considerations for reservoir operation, the reservoir analysis conducted as part of the Demonstration Project, and the results of the reservoir modeling.

The Demonstration Project included an in-depth study of San Vicente Reservoir.

San Vicente Reservoir: A Key Component of San Diego's Water Supply System

San Vicente Reservoir, located near Lakeside, was created by a dam built in

1945 that impounds San Vicente Creek. San Vicente Reservoir is owned and operated by the City's Public Utilities Department and is predominately used for municipal water supply purposes. The reservoir stores imported water, collects local runoff from a 75-square-mile watershed, and stores water transferred from Sutherland Reservoir. San Vicente Reservoir also supports limited recreational activities including boating, fishing, and water skiing.



Historically, San Vicente Reservoir has supplied water to the Alvarado Water Treatment Plant. As part of the Water Authority's Emergency Storage Project, San Vicente Dam is being raised, resulting in an increase in reservoir capacity from 90,000 AF to approximately 247,000 AF. The San Vicente Dam Raise Project will be complete by spring 2013, with refill of the reservoir expected to take three to five years, depending on the availability of imported water. As part of the Emergency Storage Project, new pipelines have been constructed to allow San Vicente Reservoir to receive imported water from the western leg of the regional aqueduct system. San Vicente Reservoir will continue to primarily supply the Alvarado Water Treatment Plant through the City's existing pipelines. The new conveyances of the Emergency Storage Project will also allow water to be sent to other water treatment plants serving all of the City and the entire southern two-thirds of the San Diego region.

San Vicente Reservoir has historically served as an integral component of the City's water supply system. These improvements further solidify the role of San Vicente Reservoir in the region's overall water supply operation, including the ability for the reservoir to play a role in a potential future reservoir augmentation project.

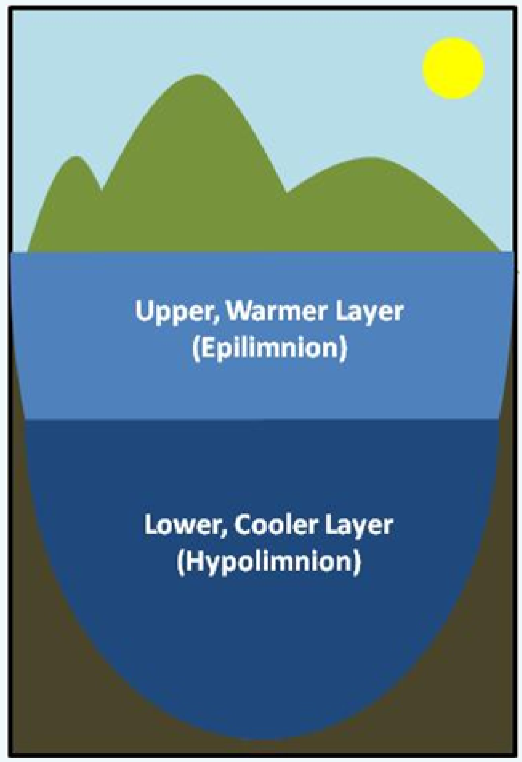
Why Consider San Vicente Reservoir for Reservoir Augmentation?

Purified water produced at the City's AWP Facility has been validated through robust testing as meeting applicable water quality requirements; however, regulatory agencies would require a reservoir augmentation project at San Vicente Reservoir to include an environmental buffer capable of providing adequate retention time and blending of purified water. As described in detail in Section D, Regulatory Coordination, retention time and blending criteria are part of what is known as a multiple barrier approach, which is required by regulatory agencies to ensure that adequate safeguards are in place to protect public health in the event of an unexpected issue with the purified water.

San Vicente Reservoir is an ideal feature for reservoir augmentation because, in addition to having sufficient storage available to accommodate purified water flows throughout the year, it has unique characteristics that assist in meeting regulatory requirements. Specifically, in addition to providing significant blending of purified water with other raw water sources, the reservoir's large capacity and stratification allow it to retain the purified water for a significant period of time before it is delivered for final treatment (refer to the stratification inset below for more information).

A Word About Reservoir Stratification

Reservoir stratification—the formation of "layers" of water within a reservoir—is a natural phenomenon that occurs in essentially all reservoirs in North America, including San Vicente Reservoir. Consistent and predictable stratification has been observed in more than 20 years of monitoring data collected from San Vicente Reservoir. During the period of stratification (approximately 10 months per year), warm water that is naturally heated by the sun is contained within the top-most layer of the reservoir (epilimnion), because warmer water is less dense than cooler water. The more dense, cooler water is contained within the lower layer of the reservoir (hypolimnion). When stratification occurs, the water and any dissolved or suspended constituents contained within the epilimnion do not readily mix with the water and constituents contained within the hypolimnion.



During winter months, the epilimnion cools in response to cooler air temperatures. This causes water temperature in the reservoir to equalize and the epilimnion and hypolimnion mix, causing the reservoir to lose its stratification (destratify). The fully destratified (mixed) condition lasts for a few weeks to a month and typically occurs in January, February, or March. The natural stratification and mixing of the reservoir is an important phenomenon, because it determines the extent and timing of mixing and retention provided by the reservoir.

Characteristics of San Vicente Reservoir that provide adequate retention time and blending features as required by regulatory agencies are described below.

- **Retention time.** The amount of time that purified water is retained in the reservoir, retention time, would provide time needed to monitor the purified water for water quality purposes—a step necessary to demonstrate that the purified water meets applicable water quality standards. San Vicente Reservoir's natural stratification, combined with a purified water release and withdrawal strategy that takes advantage of reservoir stratification (see stratification inset for more information), would provide purified water entering the reservoir with a substantial amount of retention time prior to withdrawal and final processing at a drinking water treatment plant and distribution to the City's drinking water system. Therefore, San Vicente Reservoir would be capable of providing adequate retention time as required by regulatory agencies as part of a multiple barrier approach that ensures the protection of public health.

- **Blending.** In addition to retention, the reservoir would provide significant blending, as a relatively small flow of purified water would be released into a large reservoir and blended with other reservoir water supplies prior to withdrawal. Once the San Vicente Reservoir expansion is complete, the reservoir volume will be 16 times greater than the projected annual purified water inflow of 15,000 AFY simulated.[4] This means that purified water would receive significant blending as it travels through the reservoir prior to being withdrawn and treated at a municipal drinking water treatment plant before flowing to the City's distribution system. Therefore, San Vicente Reservoir would be capable of providing adequate blending as required by regulatory agencies.

Under a reservoir augmentation project at San Vicente Reservoir, the City would augment San Vicente Reservoir with an annual average of 15 mgd of purified water. There would be seasonal variation in the amount of purified water produced at the full-scale AWP facility due to variations in the amount of recycled water available from North City, with winter monthly average inflows nearly twice as great as those seen in summer months. If the City were to implement a reservoir augmentation project at San Vicente Reservoir, the reservoir would continue to receive and store local runoff, water transferred from Sutherland Reservoir, and imported water. These water supplies would be blended with purified water, which is among the highest quality water available, prior to being treated at a drinking water treatment plant for delivery to the City's customers.

A reservoir augmentation project at San Vicente Reservoir would involve releasing purified water into the upper layer of San Vicente Reservoir. Because the purified water would be warm compared to the reservoir water and would flow into the reservoir at the surface, it would tend to remain in the upper layer of the reservoir. San Vicente Reservoir's outlet structure, located near the San Vicente Dam, has multiple ports to provide operators with flexibility when withdrawing water from the reservoir and sending it to a municipal drinking water treatment plant for treatment. Operators typically withdraw water for drinking water treatment and distribution from the deeper ports, where water quality is more consistent. Under stratified conditions, in which the upper and lower layers of the reservoir do not mix, purified water would be prevented from flowing directly to the outlet structure, providing a substantial retention time. During the relatively short period in which reservoir stratification would be lost, the reservoir would experience full and complete blending, so that any

[4] 15,000 AFY was selected as a representative yield for the purposes of reservoir modeling based on previous estimates of project yield, including the Water Reuse Study. This production capacity is approximate to the 15 mgd production capacity now assigned to a full-scale project, and reservoir modeling results obtained during the Demonstration Project are representative of the results expected from a full-scale project.

purified water that were to flow to the outlet would first undergo extensive blending with reservoir water.

San Vicente Reservoir's Role in Assuring Public Health Protection

A reservoir augmentation project at San Vicente Reservoir would protect public health by encompassing multiple barriers to prevent pathogens and chemicals from being introduced into the drinking water supply. While a full-scale AWP facility would provide substantial barriers, and no pathogens or chemicals are expected to be present in the purified water entering San Vicente Reservoir, the reservoir would provide absolute assurance that no target pathogens or chemicals would enter the drinking water supply. This multiple barrier concept is illustrated in Figure C-1.

Figure C - 1: Pathogen and Chemical Removal by Multiple Barriers

Advanced Water Purification Facility (Membrane Filtration, Reverse Osmosis, UV Disinfection/Advanced Oxidation)

Effectively Removes	Secondary/ Tertiary Treatment	Membrane Filtration	Reverse Osmosis	UV Disinfection/ Advanced Oxidation	Reservoir Blending and Retention	Treatment at Drinking Water Treatment Plant
Pathogens	●	●	●	●	●	●
Chemicals	●		●	●		●

Modeling San Vicente Reservoir

To evaluate the potential retention and dilution provided by San Vicente Reservoir, a three-dimensional hydrodynamic computer model of San Vicente Reservoir was set up in order to:

- Determine the effectiveness of San Vicente Reservoir as an environmental buffer capable of providing blending and retention as required by regulatory agencies
- Evaluate any hydrodynamic changes, or changes to movement of water within the reservoir, resulting from introduction of purified water
- Determine whether addition of purified water to San Vicente Reservoir would affect water quality within the reservoir

What is a Three-Dimensional Hydrodynamic Computer Model?

"Hydrodynamics" is the movement of water. The three-dimensional model of San Vicente Reservoir is a computer-based model that simulates and predicts the movement of water in all three directions within the reservoir: up and down, left to right, and forward and back.

The three-dimensional modeling of San Vicente Reservoir used a pair of coupled computer models: the Estuary Lake and Coastal Ocean Model [ELCOM] and the Computational Aquatic Ecosystem

Dynamics Model [CAEDYM]. These models were originally developed at the University of Western Australia. An expert team applied the models for use on the Limnology and Reservoir Detention Study of San Vicente Reservoir. The expert team has experience with similar modeling efforts for Lake Mead in Nevada and for Los Vaqueros Reservoir, Lake Perris, Lake Hodges, and Olivenhain Reservoir in California, plus three previous modeling projects for San Vicente Reservoir.

The computer model was set up, calibrated, and validated using real-world data collected through the Demonstration Project and previous efforts. San Vicente Reservoir modeling initially began in the 1990s when two tracer studies were conducted to establish the reservoir's retention and blending characteristics. During these tracer studies, an inert material (referred to as a tracer) was released into the reservoir, and its movement was monitored to simulate how water particles move and travel throughout San Vicente Reservoir. The three-dimensional hydrodynamic modeling was validated with data from the tracer studies to determine how well the model analyzed known conditions of San Vicente Reservoir. Three-dimensional hydrodynamic modeling was conducted for a variety of reservoir operation conditions and climatic cycles, including wet years, droughts, varying inflows and outflows, and other factors. By comparing data collected during the tracer studies to model predictions, the model was refined to accurately predict the movement of water through the reservoir.

The model was used to focus on hydrodynamic characteristics such as retention time and blending, but included a water quality component, or subroutine. The hydrodynamic modeling analysis consisted of the following steps:

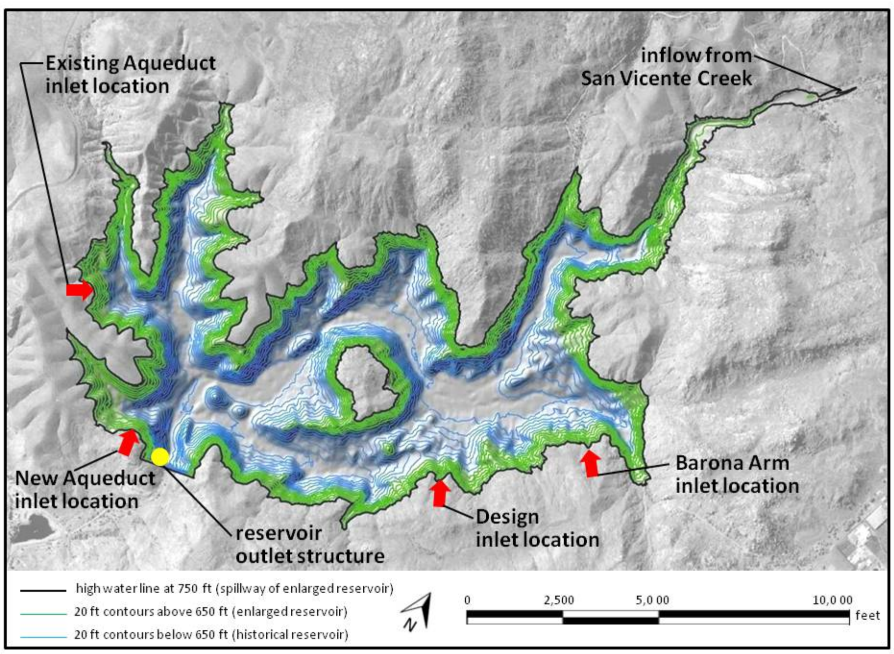
- Prepare a three-dimensional hydrodynamic model to simulate conditions in the old (90,000 AF-capacity) San Vicente Reservoir
- Use extensive historical reservoir water quality data and results from two tracer studies conducted in the late 1990s to calibrate and verify the accuracy of the three-dimensional hydrodynamic model
- Adjust the model to represent the expanded (247,000 AF-capacity) San Vicente Reservoir
- Conduct additional modeling to:
    - Assess the impact of adding purified water on the movement of water in the reservoir, including any potential implications on the formation and duration of the stratified layers
    - Assess the retention time and blending of purified water at various times of the year
    - Assess the impact of alternative purified water release locations on each of the above

The water quality component of the model was designed to simulate the potential effects of purified water on water quality in San Vicente Reservoir, specifically focusing on algae growth in the reservoir (Flow Science, 2010, Flow Science, 2012a, Flow Science, 2012b). Algal growth is the most important water quality factor affecting the use of the reservoir as a potable water supply, and also the most important water quality consideration for recreational uses. The water quality modeling analysis consisted of the following steps:

- Apply a water quality component to the three-dimensional hydrodynamic model
- Calibrate and verify the accuracy of the water quality component of the model using extensive historic reservoir water quality data
- Conduct model scenarios to compare water quality for three cases: 1) historic reservoir (90,000 AF), 2) expanded reservoir (247,000 AF), and 3) expanded reservoir with purified water added, compare physical parameters such as temperature and clarity, and nutrients for each case

Another key consideration in the reservoir modeling was the location where purified water would enter San Vicente Reservoir. The modeling effort involved testing four different potential locations to determine if the location of purified water entering the reservoir had an impact on water quality, retention, or blending. Figure C-2 illustrates these locations.

Figure C - 2: Potential Purified Water Inlet Locations



For the San Vicente Reservoir Study, Flow Science performed 18 separate runs of the three-dimensional hydrodynamic model. From these model runs, the project team–with input from the IAP–selected eight modeling scenarios for further assessment and analysis. Table C-1 summarizes the eight modeling scenarios. These modeling scenarios were selected because they represent the full range of purified water inlet locations and operational conditions that a reservoir augmentation project at San Vicente Reservoir could encounter. As such, the modeling effort captured the expected result of adding purified water to San Vicente Reservoir under all anticipated operating conditions. This modeling approach was a necessary step in the Demonstration Project to validate that San Vicente Reservoir will be able to meet regulatory requirements for retention time and blending under all conditions.

Table C- 1: Summary of Model Scenarios Completed

Model Scenario	Operating Scenario Simulated
1	**Base Case – Design Inlet Location:** reservoir under median expected storage and normal expected operations. Initial reservoir volume was 155,000 AF. Annual flow rates for Aqueduct inflow, runoff, purified water inflow, and dam withdrawal were 3,000, 4,500, 15,000, and 19,000 AFY, respectively. There were no water transfers from Sutherland Reservoir into San Vicente Reservoir. Purified water inlet was simulated at the Design Inlet Location, shown on Figure C-2.
2	**Base Case – Existing Aqueduct Inlet Location:** reservoir under median expected storage and normal expected operations. Initial reservoir volume was 155,000 AF. Annual flow rates for Aqueduct inflow, runoff, purified water inflow, and dam withdrawal were 3,000, 4,500, 15,000, and 19,000 AFY, respectively. There were no water transfers from Sutherland Reservoir into San Vicente Reservoir. Purified water inlet was simulated at the Existing Aqueduct Inlet Location, shown on Figure C-2.
3	**Base Case – New Aqueduct Inlet Location:** reservoir under median expected storage and normal expected operations. Initial reservoir volume was 155,000 AF. Annual flow rates for Aqueduct inflow, runoff, purified water inflow, and dam withdrawal were 3,000, 4,500, 15,000, and 19,000 AFY, respectively. There were no water transfers from Sutherland Reservoir into San Vicente Reservoir. Purified water inlet was simulated at the New Aqueduct Inlet Location, shown on Figure C-2.
4	**Base Case – Barona Arm Inlet Location:** reservoir under median expected storage and normal expected operations. Initial reservoir volume was 155,000 AF. Annual flow rates for Aqueduct inflow, runoff, purified water inflow, and dam withdrawal were 3,000, 4,500, 15,000, and 19,000 AFY, respectively. There were no water transfers from Sutherland Reservoir into San Vicente Reservoir. Purified water inlet was simulated at the Existing Barona Arm Inlet Location, shown on Figure C-2.
5	**No Purified Water Additions:** similar to Base Case, except there are no purified water additions and an equal reduction in reservoir outflow. Initial reservoir volume was 155,000 AF. Annual flow rates for Aqueduct inflow, runoff, and dam withdrawal were 3,000, 4,500, and 4,000 AFY, respectively. There were no water transfers from Sutherland Reservoir into San Vicente Reservoir.
6	**Extended Drought – Design Location:** hypothetical two-year drought where a large and constant volume of water is withdrawn monthly from the reservoir without importing additional water to refill the reservoir. Initial reservoir volume was 155,000 AF. Annual flow rates for Aqueduct inflow, runoff, purified water inflow, and dam withdrawal were 3,000, 4,500, 15,000, and 48,000 AFY, respectively. There were no water transfers from Sutherland Reservoir into San Vicente Reservoir. The volume of water stored in San Vicente Reservoir at the end of the simulation period was about 100,000 AF. Purified water inlet was simulated at the Design Inlet Location, shown on Figure C-2.
7	**Extended Drought – New Aqueduct Inlet Location:** hypothetical two-year drought

Model Scenario	Operating Scenario Simulated
	where a large and constant volume of water is withdrawn monthly from the reservoir without importing additional water to refill the reservoir. Initial reservoir volume was 155,000 AF. Annual flow rates for Aqueduct inflow, runoff, purified water inflow, and dam withdrawal were 3,000, 4,500, 15,000, and 48,000 AFY, respectively. There were no water transfers from Sutherland Reservoir into San Vicente Reservoir. The volume of water stored in San Vicente Reservoir at the end of the simulation period was about 100,000 AF. Purified water inlet was simulated at the New Aqueduct Inlet Location, shown on Figure C-2.
8	**Emergency Drawdown:** simulates a situation in which 66,000 AF of water is withdrawn from the reservoir in January and February of Year 2 and the reservoir is then refilled by adding 66,000 AF of water from the Aqueduct between March and July of Year 2. The rest of the flow rates are the same as the Base Case. Initial reservoir volume was 200,000 AF.

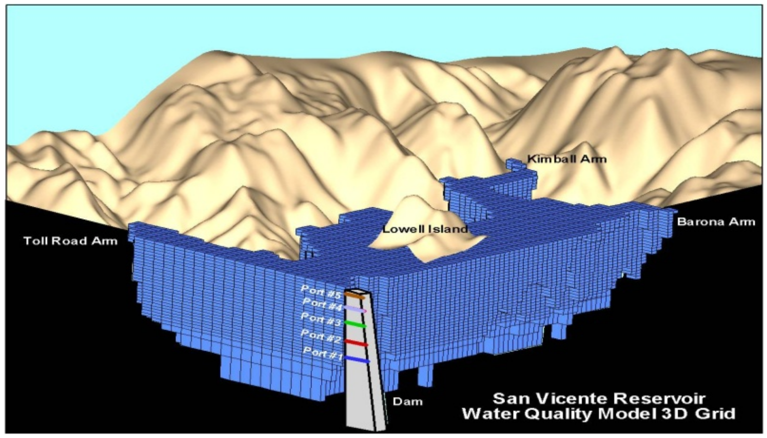
The reservoir model was set up in conjunction with regulatory entities including the Regional Board and CDPH, whose feedback was important to this process due to regulatory requirements for blending, retention, and water quality conditions. Model development and validation were also reviewed by the IAP. A dedicated subcommittee of the IAP was convened to review the model and associated data, and to provide comments to the City's reservoir modeling team throughout the reservoir modeling process. The IAP concluded that the model provides "an effective and robust tool" for assessing the effects of purified water on San Vicente Reservoir (NWRI 2010).

> ***"The Subcommittee (IAP Subcommittee for the San Vicente Reservoir Study) believes that the modeling is sufficiently predictive for purposes of evaluating the input of advanced treated recycled water (purified water)."***
>
> Findings and Recommendations of the Limnology and Reservoir Subcommittee (NWRI 2010)

San Vicente Reservoir Study Findings

Key findings of the San Vicente Reservoir modeling effort are:

- The addition of purified water into San Vicente Reservoir would not affect natural hydrologic characteristics of the reservoir, seasonal stratification, or mixing. This finding demonstrates that the addition of purified water would not affect the natural blending and retention in the reservoir.



The three-dimensional hydrodynamic model allowed the City to simulate potential effects of purified water on San Vicente Reservoir.

- Blending and retention of purified water in San Vicente Reservoir would constitute a substantial environmental barrier, sufficient to meet regulatory requirements.
- For all anticipated reservoir operating scenarios and purified water release locations, the reservoir would dilute the purified water by at least a factor of 200 to one at all times.
- As discussed in Section B: Advanced Water Purification Facility, the purified water produced at the AWP Facility was found to be very pure, approaching distilled water purity. The addition of purified water would not affect any aspect of water quality in San Vicente Reservoir. The dam raise and reservoir expansion, which is independent of the Demonstration Project, will improve overall water quality in the reservoir by reducing nutrients including nitrogen compounds that can stimulate algae growth and cause water quality issues, and the addition of purified water will not change these improvements. Addition of purified water would improve some aspects of reservoir water quality, such as reducing salt concentration.

Section D: Regulatory Coordination

Regulatory Coordination - Key Findings

- The combination of advanced water purification technology and San Vicente Reservoir conditions provide public health and environmental safeguards that make reservoir augmentation feasible from a regulatory perspective.
- Regulatory acceptance of the City's Demonstration Project was validated through a Concept Approval letter from the California Department of Public Health and a Resolution of Support and a letter confirming acceptability of the proposed regulatory pathway from the San Diego Regional Water Quality Control Board.

Prior to implementation, a reservoir augmentation project at San Vicente Reservoir would require approval by CDPH and the Regional Board. Neither CDPH nor the Regional Board has specific regulations in place for projects using purified water for reservoir augmentation, making the process for securing regulatory approval a challenge. A key objective of the Demonstration Project was to work closely with the regulatory agencies to identify appropriate requirements for a reservoir augmentation project at San Vicente Reservoir, and to determine whether a full-scale project incorporating water purification technologies and San Vicente Reservoir could meet these requirements.

Although reservoir augmentation at San Vicente Reservoir would use the same water purification processes as the Orange County GWRS, its regulatory pathway is less established. CDPH has established guidelines for groundwater augmentation projects such as the Orange County GWRS, but permits reservoir augmentation projects on a case-by-case basis.

This section describes regulatory conditions, including key considerations for each regulatory agency, the process used to identify regulatory requirements for a reservoir augmentation project at San Vicente Reservoir, and an assessment of the feasibility of a reservoir augmentation project at San Vicente Reservoir.

Regulatory Conditions

Projects in California that employ water purification processes are regulated by both CDPH and the State Board (administered by the local Regional Boards). To date, seven projects involving groundwater replenishment with purified water have been permitted in California, but no reservoir augmentation projects with purified water have been permitted or are operational statewide. Reservoir augmentation is practiced in other parts of the United States. For example, since 1978 the Upper Occoquan Service Authority has added recycled water into a stream above Occoquan Reservoir that supplies a drinking water treatment plant in Fairfax County, Virginia. The following sections discuss specific regulatory requirements for a reservoir augmentation project at San Vicente Reservoir.

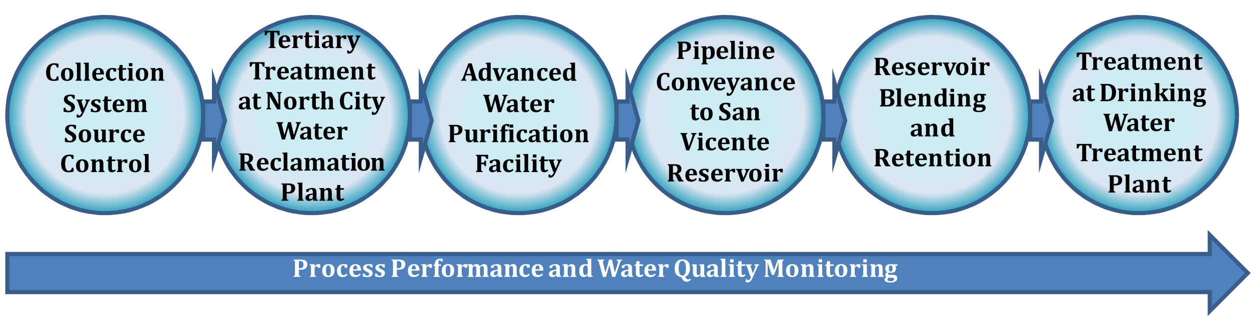
Protecting Public Health: California Department of Public Health

CDPH is responsible for developing and administering regulations to protect public health in California, including permitting public water supply projects. Because the City's reservoir augmentation project at San Vicente Reservoir would include augmentation of drinking water supplies, this project would require approval from CDPH (in the form of a permit) in order to operate.

State legislation passed in 2010 requires CDPH to finalize regulations by December 31, 2013 for projects using water purification for groundwater replenishment such as the Orange County GWRS. That same legislation requires CDPH to adopt regulations for reservoir augmentation projects by December 31, 2016. In advance of adopting regulations, CDPH can approve reservoir augmentation projects such as the City's potential reservoir augmentation project at San Vicente Reservoir on a case-by-case basis.

In order to ensure that public health is protected, CDPH requires that projects involving purified water incorporate a multiple barrier strategy. A multiple barrier strategy protects public health by incorporating safeguards into the process, which ensure that a failure or error at any given treatment step would not compromise public health. The public health safeguards that would be implemented in a reservoir augmentation project at San Vicente Reservoir are presented in Figure D-1, and described further in the following paragraphs.

Figure D - 1: Public Health Safeguards of the Potential Reservoir Augmentation Project at San Vicente Reservoir



Enhanced Source Control. The first step in the multiple barrier strategy for water purification is enhanced source control in the wastewater collection system, which refers to the prevention of contaminants from entering the wastewater stream. The City already operates a robust source control program focusing on controlling contaminants in industrial discharges upstream of North City (refer to Section F for more information). A reservoir augmentation project at San Vicente Reservoir would likely require the City to enhance that program by addressing commercial and residential discharges and focusing on preventing chemicals with potential public health implications from entering the collection system. Strategies to achieve this could include developing a Chemical Inventory Program and GIS Tracking System, implementing a Pollutant Prioritization Program, and performing an annual Local Limits Evaluation, as described in Section F.

Tertiary Treatment. This step would involve some or all of the processes that are already in place at North City to treat wastewater in accordance with Title 22 of the California Code of Regulations. Tertiary treatment produces what is commonly referred to as recycled water, suitable for irrigation and industrial purposes.

Advanced Water Purification Technology. CDPH requires that advanced water purification technology be incorporated into projects that augment the existing wastewater and recycled water treatment steps. Advanced water purification provides additional barriers to potential pathogens and chemical contaminants such as CECs. Advanced water purification technology produces purified water, which refers to recycled water that has been further purified so that it may be released into a groundwater basin or surface water reservoir that supplies water to a drinking water treatment plant (refer to Section B, Advanced Water Purification Facility for more information). A full-scale AWP facility associated with a reservoir augmentation project at San Vicente Reservoir would be located at North City.

Pipeline System Conveyance. Moving purified water from the advanced water purification facility, which would be located at North City, to the San Vicente Reservoir would require construction of a 22-mile extension to the City's existing recycled water system. At peak production capacity, it would take purified water at least 10 hours to travel to San Vicente Reservoir. In the unlikely event of a purification technology malfunction, this travel time would provide an opportunity to capture and divert purified water before it reached San Vicente Reservoir.

San Vicente Reservoir (Environmental Buffer). San Vicente Reservoir would serve as an "environmental buffer," or a natural water barrier that provides blending of purified water with other sources. San Vicente Reservoir would also provide substantial retention, meaning that it would retain purified water for an extended period of time prior to it entering the drinking water treatment plant. This would enable agencies to respond, should an unexpected problem occur in the upstream treatment processes (refer to Section C, San Vicente Reservoir Study for more information). CDPH requires that projects using water purification processes include an environmental buffer.

Drinking Water Treatment Plant. Purified water that is blended with other water sources in San Vicente Reservoir would be considered raw water, not yet suitable for drinking. Following retention in the reservoir, purified water would receive additional treatment at a drinking water treatment plant prior to public consumption. This would further protect public health by providing an additional barrier to potential pathogens or chemical contaminants. If the City were to implement a reservoir augmentation project at San Vicente Reservoir, this raw water would be treated at the Alvarado Water Treatment Plant or another municipal drinking water treatment plant.

Process Performance and Water Quality Monitoring. CDPH requires that a comprehensive and robust combination of water purification process performance monitoring, and monitoring of the purified water quality, be conducted to assure that all of the safeguards built into projects using water purification continuously function as planned.

CDPH would establish requirements for the City's potential reservoir augmentation project at San Vicente Reservoir through two permitting mechanisms.

- **Water Supply Permit:** The CDPH Water Supply Permit governing the existing drinking water system would need to be amended to include the additional source water (purified water) along with operating and water quality conditions specific to this new source.
- **National Pollutant Discharge Elimination System Permit:** CDPH would provide specific operating and water quality conditions to the Regional Board for inclusion in the NPDES permit discussed in the Regional Board section below.

Together, these operating permits would govern the advanced water purification technologies, operating features, resultant purified water quality requirements, and reservoir operating features providing redundant and reliable public health protections. Ultimately, a reservoir augmentation project at San Vicente Reservoir would need to meet not only drinking water quality standards applicable to all drinking water systems, but additional water quality standards intended to protect the health of aquatic organisms that may be present in the reservoir. Because some aquatic organisms may be more sensitive to certain water quality constituents than humans, some water purification standards are more stringent than conventional drinking water requirements.

Protecting Environmental Health: Regional Water Quality Control Board

The Regional Board is responsible for developing and enforcing water quality objectives for surface water and groundwater bodies within the San Diego region. Since the City's potential reservoir augmentation project at San Vicente Reservoir would involve releasing purified water into San Vicente Reservoir (the required environmental buffer), the project would fall under the jurisdiction of the Regional Board.

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

The Regional Board is responsible for enforcing water quality objectives in the San Diego Region.

The Regional Board's existing regulatory framework is designed to manage the discharge of waste to the environment. Water purification technology has been demonstrated to remove "wastes" from recycled water, and statewide legislation (Assembly Bill 2398) was introduced in 2012 to remove purified water from the purview of the Regional Board to reflect the position that purified water should not be considered waste due to its exceptional quality. This omnibus legislation has since been tabled, but a stakeholder group is continuing this discussion with the ultimate goal of removing purified water from Regional Board purview. In the meantime, a reservoir augmentation project at San Vicente Reservoir would need to abide by the Regional Board's regulatory framework.

Because groundwater replenishment projects release purified water to groundwater as opposed to surface water, these projects typically require only a WDR permit issued by the Regional Board. The City's reservoir augmentation project at San Vicente Reservoir would involve releasing purified water to a surface water body and would, therefore, require a full NPDES permit, which is more involved than a WDR and includes EPA approval. An NPDES permit for the City's potential reservoir augmentation project at San Vicente Reservoir would place limitations on the purified water released to San Vicente Reservoir in accordance with the Basin Plan, which is the primary source of water quality standards for San Vicente Reservoir. These water quality standards are based on specific uses designated for San Vicente Reservoir. The Regional Board also regulates surface water bodies via the California Toxics Rule, which establishes water quality criteria for 126 priority pollutants. Together, Basin Plan standards and California Toxics Rule criteria provide a comprehensive set of water quality standards designed to protect the integrity and purpose of San Vicente Reservoir.

Regulatory Coordination Activities

The City began working closely with both CDPH and the Regional Board regarding potential reservoir augmentation at San Vicente Reservoir long before the start of the Demonstration Project. The City's Water Repurification Project, initiated in 1994 and formally stopped in 1999, included a regulatory coordination effort that culminated in the conceptual approval of reservoir augmentation at San Vicente Reservoir. New state policies and water quality concerns that emerged following that Water Repurification effort prompted the City to initiate new discussions with CDPH and the Regional Board during the Water Reuse Study. The City first met with both the Regional Board and CDPH in 2004-2005 during development of the Water Reuse Study. The City then met with CDPH in December 2007 to receive an update on the potential regulatory framework for reservoir augmentation at San Vicente Reservoir. Two things were concluded from that meeting:

- The City would need to demonstrate the performance of water purification technologies that would be used in reservoir augmentation at San Vicente Reservoir
- An IAP would need to be formed to oversee technical studies and review the findings as required by CDPH to form the basis for concept approval of a reservoir augmentation project at San Vicente Reservoir

Based on initial CDPH input, the City formulated a preliminary plan for the Demonstration Project, and met again with CDPH in March 2008 to present a proposed work plan for the Demonstration Project. The objective of this meeting was to clarify Demonstration Project objectives and obtain input on the City's proposed Demonstration Project work plan that formed the basis for the project scope and costs that develop the rate case. The City also coordinated with the County of San Diego Department of Environmental Health (DEH) at the request of CDPH; County DEH was invited to all meetings held with the IAP.

Preliminary conversations were also held with the Regional Board. After an initial meeting with Regional Board staff in 2008 to introduce the Demonstration Project concept, subsequent meetings of the IAP and its subcommittees included both regulatory agencies. Table D-1 summarizes the IAP meetings held in support of the Demonstration Project.

Based on initial meetings with CDPH and the Regional Board, a plan to achieve regulatory conceptual approval was developed. This plan provided the framework for regulatory activities that would ultimately lead to preliminary regulatory approval for a reservoir augmentation project at San Vicente Reservoir. This plan identified key technical topics that would need to be addressed and a schedule of regulatory and IAP meetings to address these topics. Topical IAP subcommittees and working groups were convened to support the amount and complexity of technical considerations to be addressed and provide input on specific work products for the Demonstration Project.

The Independent Advisory Panel validated results and conclusions of the Demonstration Project.

The regulatory plan was structured around the following regulatory objectives:

1. Validate the ability of the AWP Facility to produce purified water meeting all regulatory requirements
2. Demonstrate the ability of San Vicente Reservoir to provide a substantial environmental buffer year-round
3. Validate that the addition of purified water would protect San Vicente Reservoir water quality

Technical activities and regulatory and IAP subcommittee meetings were held throughout the Demonstration Project consistent with the regulatory implementation plan. The timing of specific Demonstration Project activities necessary to achieve the regulatory objectives is presented in Table D-1 through D-5.

Table D - 1: Summary of IAP Meetings

Meeting No.	Date	Topic
1	May 11-12, 2009	Introductory meeting for the full IAP to discuss the Demonstration Project Scope
2	March 29-30, 2010	Limnology (reservoir-related) Subcommittee Meeting No. 1 to discuss set-up and calibration of the San Vicente Reservoir Model[1]
3	September 2, 2010	Limnology Working Group Meeting No. 1 to specify and discuss details pertaining to the San Vicente Reservoir Model[2]
4	October 21, 2010	AWP Facility Subcommittee Meeting No. 1 to discuss the draft Testing and Monitoring Plan[3]
5	March 17, 2011	Limnology Working Group Meeting No. 2 to review San Vicente Reservoir modeling scenarios, determine potential "worst case scenarios," and discuss pathogen removal[2]
6	June 6-7, 2011	Second meeting of the full IAP to update the group on the Limnology Subcommittee, Limnology Working Group, and AWP Facility Subcommittee activities, and tour the AWP Facility
7	December 6, 2011	Limnology Subcommittee Meeting No. 2 to review and receive comments on the draft San Vicente Reservoir modeling study, and receive input on proposed reservoir public health-related regulatory conditions[1]
8	December 19, 2011	AWP Facility Subcommittee Meeting No. 2 to review AWP Facility operational and water quality data[3]
9	March 9-21, 2012	Conference calls to review and discuss Draft CDPH Proposal[4]
10	March 13, 2012	Limnology Subcommittee Meeting No. 3 to review the San Vicente Reservoir Water Quality Report[1]
11	November 15-16, 2012	Third meeting of the full IAP to review and comment on the draft Demonstration Project Report, Quarterly Testing Report No. 4, and AWP Facility Study Report (CDM Smith and MWH 2013b)

Footnotes:

1. The Limnology Subcommittee was comprised of four IAP members focused on the Limnology Study.
2. The Limnology Working Group was comprised of two IAP members and project staff specifically assigned to vetting the details of the reservoir study.
3. The AWP Facility Subcommittee was comprised of four IAP members focused on the operation and results of the AWP Facility.
4. An ad-hoc subcommittee provided review and comment via a series of conference calls in lieu of face-to-face meetings.

Objective 1: *Validate the ability of the AWP Facility to produce purified water meeting all regulatory requirements*[5].

A series of actions were taken between October 2010 and December 2012 to assist in validating the ability of the AWP Facility to produce purified water meeting regulatory requirements. Construction of the AWP Facility began in September 2010 and ran through June 2011. During construction, a detailed Testing and Monitoring Plan was developed and revised in coordination with the IAP prior to being submitted to CDPH for approval. Following CDPH approval and completion of AWP Facility construction, the Testing and Monitoring Plan was implemented. The monitoring results were summarized in a Draft AWP Facility Report, which was reviewed with the IAP prior to being submitted to CDPH. Together, these actions have demonstrated that the AWP Facility produces purified water meeting all regulatory requirements. CDPH issued concept approval for the project in September 2012. CDPH's Concept Approval Letter is included as Appendix B to this report. Table D-2 provides an overview of the timeline of each action implemented in support of Objective 1.

Table D - 2: Timeline of Activities Completed in Support of Objective 1

Activity	Date
Procure and Fabricate AWP Facility equipment	October 2010
Prepare Testing and Monitoring Plan	September 2010
Conduct IAP AWP Facility Subcommittee meeting No. 1	October 2010
Submit Testing and Monitoring Plan for CDPH approval	December 2010
Perform AWP Facility Testing	August 2011 – July 2012
Conduct IAP AWP Facility Subcommittee meeting No. 2	December 2011
Submit Concept Proposal for Full-Scale Reservoir Augmentation Project at San Vicente Reservoir to CDPH	March 2012
CDPH issues Concept Approval for Full-Scale Reservoir Augmentation Project at San Vicente Reservoir to CDPH	September 2012
Submit Draft AWP Facility Report for IAP review	October 2012
Submit AWP Facility Draft Quarterly Testing Report No. 4 to CDPH	October 2012

5 For specific information regarding the AWP Facility, please refer to Section B of this report.

Objective 2: *Demonstrate ability of San Vicente Reservoir to maintain a substantial environmental buffer year-round.*[6]

Demonstrating that San Vicente Reservoir maintains a substantial environmental barrier involves providing evidence that purified water is either held in the reservoir for an acceptable period of time or substantially blended year-round.

Between late 2009 and December 2011, activities were undertaken to demonstrate that San Vicente Reservoir provides a substantial environmental buffer year-round. As described in Section C: San Vicente Reservoir Study, a three-dimensional hydrodynamic computer model was used to demonstrate that purified water would either be held in the reservoir for a period of time acceptable to regulatory agencies or substantially diluted year-round. The model was then reviewed with the IAP to ensure that it would provide an accurate representation of how purified water would move through the expanded reservoir.

Once the computer model was set up and validated by the IAP, modeling was performed to simulate the range of potential conditions for introducing purified water into San Vicente Reservoir under a reservoir augmentation project. A Limnology Working Group was convened to review these initial modeling results and recommend additional model scenarios. The Limnology Working Group was comprised of IAP members specifically assigned to vetting the details of all the reservoir work.

Additional modeling was performed to assess the worst-case conditions in San Vicente Reservoir to demonstrate that, even under these worst-case conditions, the reservoir would provide a substantial environmental buffer. Based on the modeling results, preliminary regulatory metrics for the reservoir were proposed. The results of the modeling efforts were summarized in a Reservoir Study ("Retention and Mixing Report"), which was reviewed with the IAP prior to being submitted to CDPH for consideration. Table D-3 provides an overview of the timeline of each action implemented in support of Objective 2.

The regulatory activities noted above focused primarily on CDPH requirements, because the environmental buffer regulatory standard is required by CDPH. In addition to these activities, the City has worked with Regional Board staff throughout the Demonstration Project, including holding project-specific meetings at the Regional Board office and inviting Regional Board staff to attend IAP meetings.

[6] For specific information regarding the San Vicente Reservoir Study and the San Vicente Reservoir Model, please refer to Section C of this report.

Table D - 3: Timeline of Activities Completed in Support of Objective 2

Activity	Date
Create a three-dimensional hydrodynamic computer model (San Vicente Reservoir Model)	Late 2009
Validate the San Vicente Reservoir Model using 1997 tracer study results	Late 2009
Adjust the San Vicente Reservoir Model to consider components of the expanded San Vicente Reservoir	Early 2010
Conduct IAP Limnology Subcommittee Meeting No. 1 to validate model calibration and applicability	March 2010
Finalize Reservoir Study - Model Development Report (San Vicente Reservoir Model development, validation, scalability)	June 2010
Perform initial modeling	June-October 2010
Conduct Limnology Working Group Meeting No. 1 to review initial model scenario results and recommend additional model scenarios	September 2010
Prepare and Submit draft San Vicente Reservoir Pathogen Removal Issues Paper	November 2010-February 2011
Conduct IAP Subcommittee Meeting No. 2 to assess initial modeling results and pathogen removal capacity of San Vicente Reservoir	March 2011
Assess worse-case San Vicente Reservoir retention scenario using results of second set of San Vicente Reservoir three-dimensional modeling results	April-June 2011
Prepare preliminary reservoir regulatory metrics	August–September 2011
Prepare Reservoir Study –Retention and Mixing Report	August-October 2011
Submit Reservoir Study – Retention and Mixing Report	November 2011
Conduct IAP Subcommittee Meeting No. 3 to review Retention and Mixing Report and preliminary reservoir regulatory metrics	December 2011
Submit Proposal to Augment San Vicente Reservoir with Purified Recycled Water	March 2012
Receive Concept Approval for San Vicente Reservoir Augmentation Project from CDPH	September 2012

Objective 3: *Demonstrate protection of San Vicente Reservoir water quality (specifically focusing on nutrients).*

Demonstrating that San Vicente Reservoir water quality would not be adversely impacted by a reservoir augmentation project at San Vicente Reservoir involved updating the computer model as described under Objective 2 to include a water quality component, or subroutine, so that the effects of purified water on reservoir water quality could be simulated. After meeting with the Regional Board, modeling was performed to demonstrate the negligible effect that adding purified water would have on San Vicente Reservoir water quality. Once the results of the modeling scenarios were presented to the Regional Board, the Regional Board adopted a resolution supporting the City's potential reservoir augmentation project at San Vicente Reservoir.

The modeling effort assessed potential effects of purified water on nitrogen loading into San Vicente Reservoir.

The Testing and Monitoring Plan for the AWP Facility was implemented during the period from August 2011 through July 2012. This involved collecting water quality data including parameters of interest to both CDPH and the Regional Board. These data were assessed to determine whether the quality of purified water produced at the AWP Facility would be suitable to meet Regional Board water quality standards, which – in some cases – are more stringent than CDPH standards. Because nutrient levels in purified water would be slightly higher than potentially required by the Basin Plan, additional model scenarios were performed to simulate the effects of adding purified water on nutrient loading to the reservoir.

Results of these simulations were summarized in a Reservoir Study - Water Quality Report, which was submitted to the IAP and the Regional Board. Nutrient loading was determined to be one area in which additional work would need to be completed to clarify regulatory requirements for a potential full-scale AWP facility. The City met with the Regional Board to discuss the results of the water quality evaluation and outline an approach for achieving regulatory compliance. This approach was summarized in a Proposed Regional Board Compliance Approach, which was submitted to the Regional Board for consideration. Table D-4 provides an overview of the timeline of each action implemented in support of Objective 3.

As described above, the City prepared submittals to both CDPH and the Regional Board to conclude the Demonstration Project regulatory coordination activities and elicit regulatory response. These submittals presented the regulatory framework for a potential reservoir augmentation project at San Vicente Reservoir as understood by the City. More detail on these submittals and the regulatory response is presented in the following sections.

Table D - 4: Timeline of Activities Completed in Support of Objective 3

Activity	Date
Meet with Regional Board to introduce the potential San Vicente Reservoir Augmentation Project	October 2008
Rerun initial San Vicente Reservoir model with water quality component	September 2011
Make presentation to Regional Board on Reservoir Augmentation Project at San Vicente Reservoir and Regional Board adopts resolution supporting the City's potential reservoir augmentation project at San Vicente Reservoir	October 2011
Assess AWP Facility monitoring data regarding Regional Board requirements	December 2011 – February 2012
Perform additional model scenarios to assess addition of purified water and reservoir expansion on nutrient loading	November – December 2011
Prepare Reservoir Study – Water Quality Report	January – February 2012
Submit Reservoir Study – Water Quality Report to Regional Board	March 2012
Conduct IAP Limnology Subcommittee meeting No. 3	March 2012
Meet with Regional Board to discuss San Vicente Reservoir 303(d) Listing and associated nutrient regulatory approach	June 2012
Prepare Proposed Regional Board Compliance Approach	June-August 2012
Submit Proposed Regional Board Compliance Approach to Regional Board	August 2012

CDPH Regulatory Acceptability

CDPH has the authority to approve reservoir augmentation projects on a case-by-case basis. One goal of the Demonstration Project was to receive concept approval from CDPH for a potential reservoir augmentation project at San Vicente Reservoir. The City submitted a proposal to CDPH in March 2012 that presented specific public health protections provided by a reservoir augmentation project at San Vicente Reservoir and summarized technical study results obtained throughout the Demonstration Project and validated by an IAP. The City's proposal, provided in Appendix A, articulated how a reservoir augmentation project at San Vicente Reservoir would provide a multiple barrier approach fundamental to public health protection by incorporating the following elements:

- Enhanced source control to prevent potential contaminants from entering the wastewater stream
- Pathogenic microorganism control through implementation of recycled water treatment and advanced water purification processes
- Control of nutrients including nitrogen compounds through implementation of advanced water purification processes
- Monitoring for regulated contaminants, additional chemicals, and other contaminants
- TOC control, achieved through implementation of an advanced water purification process and a monitoring plan focused on removal of these constituents

- Reliability and redundancy to meet regulatory requirements and prevent purified water from entering San Vicente Reservoir if necessary
- Monitoring and response plan designed to detect any unexpected operational issues at the AWP facility or source water contamination before the purified water reaches the reservoir

Based on the multiple barrier approach outlined in the City's proposal, CDPH issued a Concept Approval Letter to the City in September 2012, in which CDPH approved of the reservoir augmentation at San Vicente Reservoir concept proposed by the City (Appendix B).

Based on the body of technical work completed as part of the Demonstration Project and the successful operation of similar projects elsewhere in California, the program elements listed below were suggested to be implemented as part of the CDPH regulatory framework for the City's potential reservoir augmentation project at San Vicente Reservoir.

Table D - 5: Potential Reservoir Augmentation Project at San Vicente Reservoir Regulatory Program Elements - CDPH

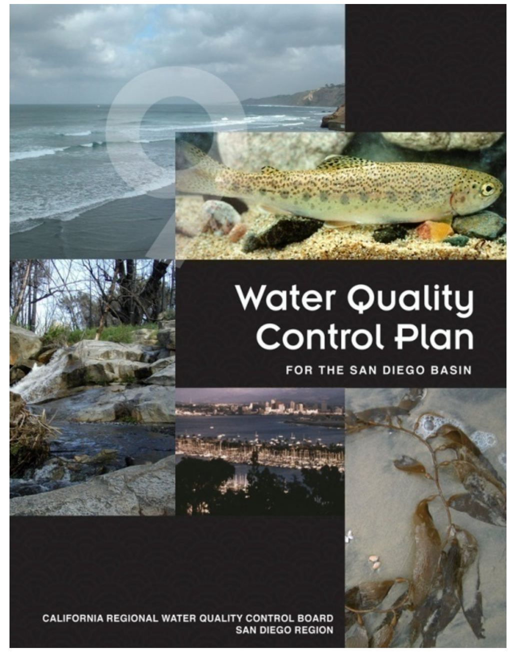
Control Point: Prior to Entering the Wastewater Collection System
• Establish enhanced source control program for the North City service area to prevent target contaminants from entering the wastewater stream.
Control Point: North City Water Reclamation Plant (source of recycled water for advanced water purification)
• Implement flow equalization to deliver a constant flow of recycled water from North City to the AWP Facility, simplifying process operation.
• Achieve full nitrification in the secondary aeration process to assist in reducing the amount of nitrogen in recycled water produced at North City.
• Operate with no return flows from biosolids processes (biosolids from North City are processed off-site) to produce the highest quality recycled water.
• Use tertiary-filtered water from North City as the source water for the AWP Facility.
Control Point: Advanced Water Purification Facility (AWP Facility)
• Treat the entire amount of water sent to the AWP Facility with membrane filtration and reverse osmosis meeting applicable CDPH specifications and performance measures to ensure the best quality of purified water possible.
• Treat the entire amount of water sent to the AWP Facility with advanced oxidation meeting applicable CDPH specifications and performance measures to ensure the best quality of purified water possible.
• Implement a Critical Control Point Monitoring Plan that includes surrogate indicators recommended by the industry at time of implementation. Surrogate indicators allow the City to quickly and easily detect any unexpected treatment process interruptions so that they may be addressed right away.
• Maintain a certified operator on-site at all times (24 hours/day) to ensure proper facility operation and oversight.

Control Point: San Vicente Reservoir
• Maintain an adequate combination of retention time and blending in the reservoir at all times to meet regulatory requirements and provide a barrier to potential pathogens.
• Locate the purified water inlet (where purified water enters the reservoir) and the reservoir outlet (where water leaves San Vicente Reservoir) such that purified water moves along a lengthy path from the inlet to the outlet, increasing the time that the water is held in the reservoir.
• Achieve a minimum blend of purified water with ambient reservoir water, at the outlet, of 100:1 at all times to achieve regulatory requirements to provide a substantial environmental buffer.
• Demonstrate criteria to ensure that purified water moves along a lengthy path from the inlet to the outlet and the criteria for blending of purified water at the outlet using a calibrated and validated hydrodynamic model. This allows the City to demonstrate that the requirements for a substantial environmental buffer would be achieved.
• Release purified water above the lower layer of water within San Vicente Reservoir, and withdraw water from the lower layer when layers are present (refer to Section C of this report for more information). This will allow the City to ensure that purified water remains in the reservoir for a longer period of time prior to being withdrawn.
• Treat water withdrawn from the reservoir at a drinking water treatment plant before distribution to the City's customers to provide an additional level of public health protection.
• Maintain the ability to take the reservoir offline as a source of supply to the drinking water system within 24 hours at all times to allow quick response time in the unlikely event that an unexpected process interruption requires the reservoir to be taken offline.

Regional Board Acceptability

Potential challenges associated with permitting a water purification project within the Regional Board regulatory framework were thoroughly discussed in meetings and correspondence conducted between the City and Regional Board throughout the Demonstration Project. Despite the exceptional quality of the purified water that would be released into San Vicente Reservoir, addressing the full array of applicable state and federal water quality standards, plans, and policies could require substantial time and effort. For example, although the nitrogen level in purified water would be comparable to that in imported water inflows to San Vicente Reservoir, purified water inflows would require a Regional Board permit and compliance with Basin Plan water quality objectives, whereas imported water inflows do not. Nitrogen loading associated with releasing purified water into the reservoir is an example of an issue that would require further Regional Board consideration before a reservoir augmentation project at San Vicente Reservoir could be implemented.

Based on coordination with the Regional Board, the City prepared a submittal to the Regional Board entitled “Proposed Regional Water Quality Control Board Compliance Approach” (Appendix D). This document, submitted to the Regional Board in August 2012, summarized the reservoir augmentation at San Vicente Reservoir concept and identified key permitting issues and Regional Board regulatory decisions and actions that would be required in order for the Regional Board to approve a project at San Vicente Reservoir. This document indicates that based upon the Regional Board’s interpretation of nitrogen limits within the Basin Plan, purified water flows to San Vicente Reservoir may be required to achieve a total nitrogen concentration limit of 0.25 mg/L to 1.0 mg/L. Water quality testing undertaken at the AWP facility indicates that the average concentration of total nitrogen in purified water is 0.8 mg/L, meaning that purified water could potentially exceed nitrogen concentration requirements established within the Basin Plan. Although purified water nitrogen concentrations could potentially exceed regulatory limits, total nitrogen concentrations in purified water are comparable to or lower than current water inflows to San Vicente Reservoir. Nitrogen concentrations in imported water inflows to San Vicente Reservoir range from 0.17 mg/L to 0.68 mg/L, and nitrogen concentrations in surface water runoff to San Vicente Reservoir range from 0.18 mg/L to 4.2 mg/L.



Although nitrogen levels in the purified water could potentially exceed Basin Plan requirements, total nitrogen levels in purified water are comparable to or lower than current nitrogen concentrations in San Vicente Reservoir.

The submittal noted the following:

- AWP Facility monitoring data indicate that the purified water supply would be equal or superior in quality to existing San Vicente Reservoir inflows for virtually all constituents. Nitrogen could be the only exception to this, as purified water nitrogen concentrations would be slightly higher than existing imported water inflows to San Vicente Reservoir, but superior in quality to the local runoff captured within the reservoir.
- Comprehensive reservoir modeling conducted as part of the Demonstration Project indicate that nitrogen concentrations under a reservoir augmentation project at the expanded San Vicente Reservoir are projected to be less than historic nitrogen concentrations in the reservoir.

On October 12, 2011, the Regional Board adopted Resolution No. R9-2011-0069, which documented the Regional Board's support for a reservoir augmentation project at San Vicente Reservoir. That resolution, included as Appendix C, also sets forth the Regional Board's proposed means of regulating the full-scale project.

The Regional Board noted that two key procedural questions will determine the pathway the City would need to take to proceed with applying for and receiving an NPDES permit for a full-scale project. These questions include:

- Prior to the Regional Board's consideration of an NPDES permit for reservoir augmentation at San Vicente Reservoir, would the Regional Board, State Board, and EPA need to take actions to modify the Clean Water Act Section 303(d) impaired water list for San Vicente Reservoir?
- Prior to the Regional Board's consideration of an NPDES permit for reservoir augmentation at San Vicente Reservoir, would the Regional Board, State Board, and EPA need to modify any requirements within the Regional Board's Basin Plan?

Excerpt from Regional Board Resolution No. R9-2011-0069

NOW THEREFORE, BE IT RESOLVED THAT, the San Diego Regional Water Quality Control Board:

- Supports the efforts to develop the Reservoir Augmentation Project at the San Vicente Reservoir as a means to reduce reliance on imported water, increase the use of recycled water, and to implement goals in California Water Code section 13510 and the 2008-2012 Strategic Plan Update for the Water Boards.
- In accordance with implementation provisions of the Basin Plan, the San Diego Water Board will regulate San Diego Region recycled water reservoir augmentation projects through the issuance of project-specific NPDES Permits.
- Reservoir augmentation NPDES permits issued by the San Diego Water Board will incorporate requirements established and the provisions recommended by California Department of Public Health.

The City's submittal provided a recommended pathway to address these procedural questions expeditiously, and noted that if the answer to both questions is "no", the pathway for approval would be straightforward. The City believes that this direct approval pathway (no Basin Plan modification or 303(d) list revisions) would be both feasible and appropriate. If the answer to either question is "yes", the project would remain feasible, but up to two years could be added to the project's implementation timeline.

.In response to the City's submittal, the Regional Board issued a letter concurring with the recommended regulatory pathway, acknowledging that neither the 303(d) impaired water listing nor the Basin Plan would need to be modified in order to permit a full-scale reservoir augmentation project at San Vicente Reservoir. This February 2013 Regional Board Letter of Concurrence (Appendix E) also reaffirmed that agency's strong support for the City's efforts in moving forward with a full-scale project, and noted that EPA concurs with this support and regulatory pathway.

Section E: Public Outreach and Education

Public Outreach and Education Findings

- According to tour participant feedback, comprehension of the water purification process increased following the completion of an AWP Facility tour.
- A series of public opinion polls shows a steady increase from 2004 (26 percent) to 2011 (68 percent) to 2012 (73 percent) of City residents who favor using advanced treated recycled water as an addition to the City's drinking water supply.

The public outreach and education program for the Demonstration Project continued from outreach efforts that started with the Water Reuse Study, the first phase of the City's Water Reuse Program. The outreach program for the Demonstration Project built on the foundation that had been laid during the Water Reuse Study.

The San Diego Assembly on Water Reuse

In 2005, the Water Reuse Study included a public outreach program that provided valuable input on how to best increase recycled water use as part of the City's plan for a reliable, long-term water supply. A key element of that public outreach program was the City of San Diego Assembly on Water Reuse, which brought together 59 individuals who resided in San Diego and were recommended by the Mayor and City Council to serve on this group. A non-technical group, these individuals represented a broad range of perspectives about San Diego. They reached agreement on a number of specific recommendations related to water reuse options for the City, including that "…technology and scientific studies support the safe implementation of non-potable and indirect potable use projects" (City of San Diego 2006). In addition to the American Assembly-style workshops, the City conducted several types of public opinion research including individual interviews, focus groups, and an online and telephone survey. To inform the public about the advanced water purification process, they also made presentations to groups, worked with the media, produced electronic newsletters, and established a website.

Because of a history of misinformation about water purification, City Council instructed that public outreach be included as a component of the Demonstration Project. Based on the City Council's directive, an outreach goal was adopted "…to inform and educate San Diego's local leaders, stakeholders and residents about the Demonstration Project."

In addition to the outreach goal, the following objectives were identified at the onset of the public outreach and education program:

- Foster a clear understanding of the Demonstration Project and its goals among all stakeholder groups
- Provide a description of the Demonstration Project and its results to the public
- Provide information on the opportunities and challenges of using reservoir augmentation as a component of diversifying the City's water supply

To accomplish the goal and objectives, a strategic outreach plan was developed to guide the comprehensive public outreach program envisioned for the Demonstration Project. A dedicated public outreach team was established to implement the program and to work closely at every step in the process with the technical team, which included the AWP Facility design and operating teams. The outreach team included the following staff:

- Project director
- Senior public information officer
- Two outreach practitioners dedicated full-time to the project
- Four multicultural consultants
- Media consultant

Throughout the duration of the Demonstration Project, the Public Utilities Department has sought to ensure that information about the Demonstration Project is presented in a clear, understandable, and accessible way to residents in all areas of the City. Information about the Demonstration Project has also been provided through a variety of formats including direct contact with individuals, written and electronic informational materials, traditional and social media, group presentations, community events, and tours of the AWP Facility. Starting in mid-2010, the following activities were completed during the first year of the project:

- Developed the outreach plan
- Conducted research, including one-on-one stakeholder interviews
- Produced informational materials
- Assembled a speakers bureau composed of project team members and Public Utilities Department staff
- Created a presentation about the project for community groups that was used for Speakers Bureau engagements

- Requested recommendations from City Council members to contact for presentation opportunities
- Conducted project presentations to community, planning groups, service clubs and business organizations, internal staff, and the City's IROC and NR&C
- Participated in industry conferences
- Developed an email list database of individuals interested in the project
- Distributed eUpdates and electronic newsletters to interested parties
- Participated in community events
- Provided project information to a broad group of media representatives and outlets
- Compiled quarterly metrics reports and analyzed them to guide future outreach activities

Beginning in mid-2011, the second year saw a continuation of the outreach activities initiated during the first year such as presenting to community, planning groups, service clubs and business organizations, and participating in community events, but added the following activities:

- Launched the Urban Water Cycle Tour program, which culminated in the AWP Facility tours
- Invited elected officials and project stakeholders to visit the AWP Facility when it began operation in mid-2011
- Developed additional informational materials, such as a virtual tour video, project white papers and a tour brochure
- Established a social media presence online using Facebook, Twitter, and YouTube
- Implemented continuous improvements in the AWP Facility tours based on feedback from tour guests
- Continuously enhanced Speaker Bureau presentations based on attendee feedback

All of the numerical data in this report reflects the activity from the commencement of the outreach program in spring 2010 through December 31, 2012. The outreach program is a continuing effort to educate San Diego residents about the potential for reservoir augmentation in the City. Although there is a "cutoff date" for reporting the statistics, the outreach efforts are ongoing. The Demonstration Project outreach program is described in more detail in the following sections. Supporting materials for Section E, Public Outreach and Education, are available on the Public Outreach and Education CD (Appendix H).

Planning, Research and Monitoring

The City's Public Utilities Department was committed to a comprehensive, transparent, and inclusive public outreach program that would inform residents of San Diego about the Demonstration Project. The first step to achieving this goal was to develop a plan to guide public outreach activities and ensure all activities were implemented throughout the City. As with the Water

Reuse Study, the City incorporated research findings to identify outreach activities to ensure all potential audiences had the opportunity to learn more about the Demonstration Project. Additionally, the City tracked its progress in reaching residents in all City Council Districts (using the eight-district map that reflected district boundaries from the beginning of the Demonstration Project until late 2012) through quarterly metrics reports.

Outreach Plan

The outreach plan, completed in May 2010, identified the variety of outreach activities and informational materials necessary to ensure prospective audiences knew about and were engaged in the Demonstration Project and its core element, the AWP Facility. The key points to be presented to City residents included:

- San Diego needs to develop local, reliable, and sustainable sources of water to lessen our dependence on imported water due to multiple factors affecting California's water supply.
- The Water Purification Demonstration Project is examining the use of water purification technology on recycled water to determine the feasibility of full-scale reservoir augmentation in the future.
- The water produced by the purification process goes through multiple steps of advanced treatment and will be tested to meet all water quality, safety, and regulatory requirements.
- No purified water will be added to the San Vicente Reservoir or San Diego's drinking water system during the Demonstration Project.

It was concluded that the most effective and efficient way to achieve the goal of informing San Diego residents about the water purification process was through focusing communication efforts on community leaders, stakeholder groups, and other local organizations. Audiences for the outreach program included local business; environmental, civic, and community leaders from all areas in the City of San Diego, including its vibrant multicultural communities; members of community planning groups and neighborhood councils; elected officials at all levels of government; media representatives; special interest groups such as seniors, the health community, science students, and religious leaders; Public Utilities Department staff; and water agencies throughout the county.

The core elements of the outreach activities were the speakers bureau, community events, and AWP Facility tours. The speakers bureau provided an opportunity for community groups and organizations of all types to learn more about the Demonstration Project through a presentation and opportunity to ask questions. Hosting informational booths at community events allowed for one-on-one discussions with a breadth of San Diegans. The AWP Facility tours provided an opportunity for individuals and groups to visit the facility to see firsthand the purification process and the quality of the water produced.

Research

The outreach plan recommended following previous research protocols to learn more about what residents and stakeholders knew about water reuse in general and water purification specifically. Information was obtained from three main sources: one-on-one stakeholder interviews, a telephone survey of City residents conducted in conjunction with the Water Authority's public opinion polls, and a San Diego State University student research study. Results from the research efforts guided the Demonstration Project's public outreach and information activities.

Stakeholder Interviews

The City recognized the importance of ensuring stakeholders from all communities in the City who had a vested interest in the Demonstration Project knew about it: what it was, what it was not ("Toilet to Tap"), and how they could learn about the Demonstration Project and provide input. This led to 105 one-on-one interviews with stakeholders throughout the City from mid-2010 to mid-2011. Stakeholders were identified through City Councilmember and Water Reliability Coalition member recommendations (see the *Stakeholder and Partner Communication* section) as well as by reviewing lists of stakeholders interviewed during the Water Reuse Study.

In addition to gauging their level of awareness about the Demonstration Project and the advanced water purification process, interviewers sought to learn the best way to provide information about the Demonstration Project to the community or group represented by each stakeholder and to determine what kind of information the stakeholder would need to more clearly understand the purification process. Water quality and public health and safety were the top concerns stakeholders mentioned about the concept of reservoir augmentation. This underscored the importance of providing information about the water purification process and the multiple barriers provided by the membrane filtration, reverse osmosis, and UV disinfection/advanced oxidation steps. It also emphasized the importance of the planned AWP Facility tour program and the need to provide information about how water quality will be monitored.

Public Opinion Polls

The Water Authority regularly conducts public opinion polls to garner information about attitudes toward water issues throughout the county. For the 2012 survey, as with the 2011 and 2004 surveys, the City requested that a statistically-significant sample of approximately 400 City residents be polled to provide a good base of knowledge about water attitudes in the City. According to the findings, nearly three-fourths of City residents favored using recycled water to help diversify the City's water supply (see Figure E-1) and 71 percent believed that recycled water used for irrigation could be further treated to make the water pure and of the highest quality for drinking (see Figure E-2). When the concept of the Demonstration Project was explained to them as part of the poll, over three-fourths of the respondents expressed strong support for it.

Figure E - 1: 2012 Public Opinion Poll – Opinion about Using Advanced Treated Recycled Water as an Addition to Drinking Water Supply

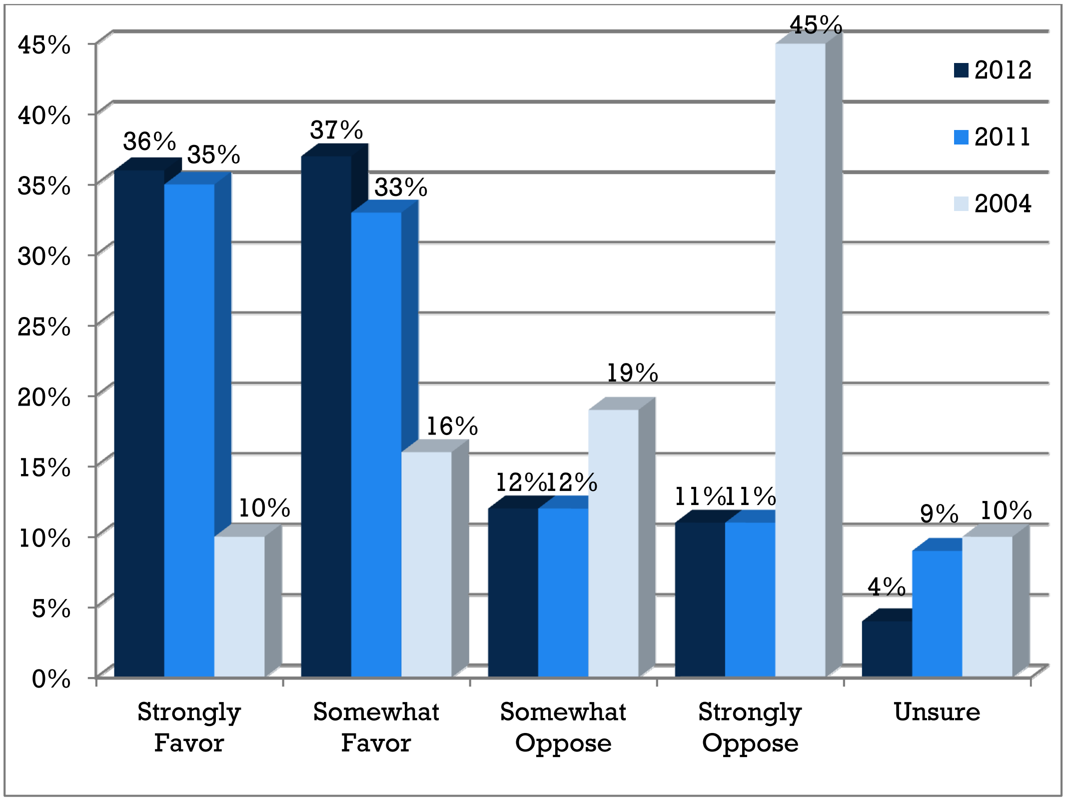
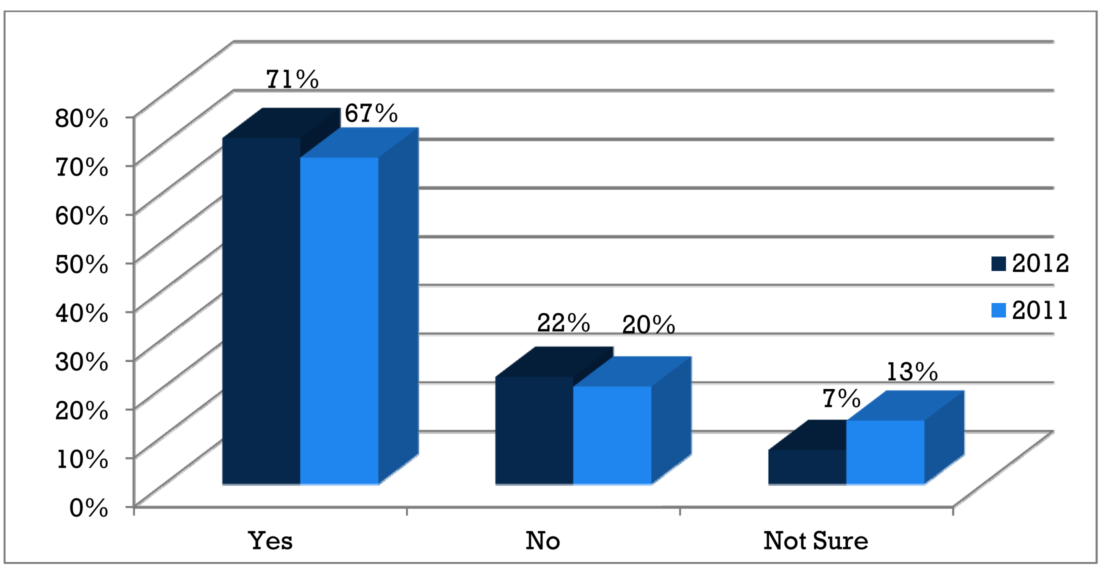


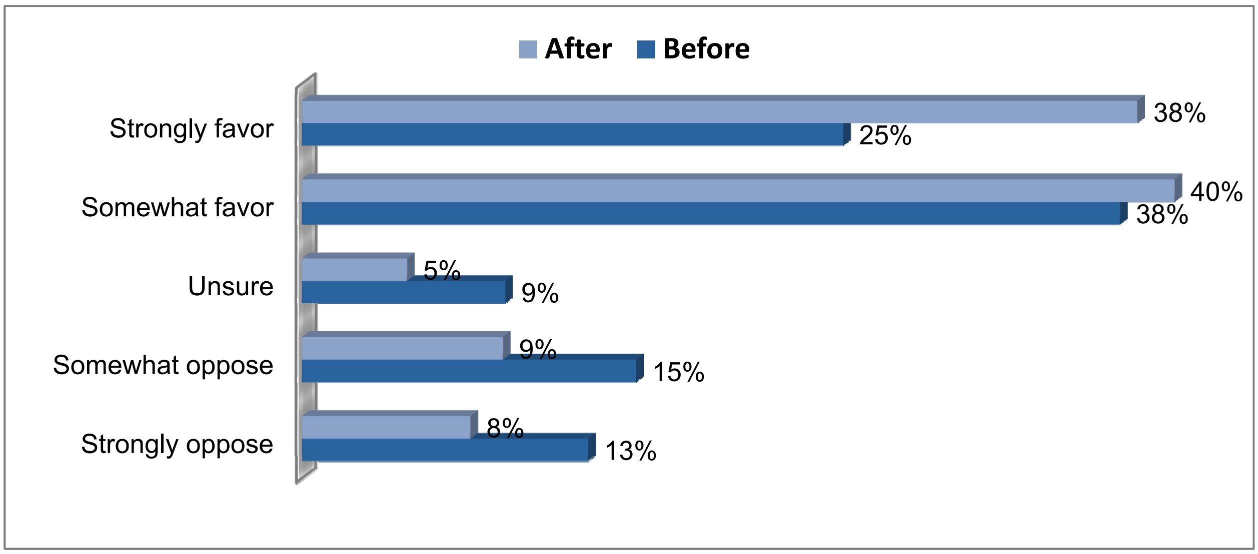
Figure E - 2: 2012 Public Opinion Poll – Is It Possible to Further Treat Recycled Water Used for Irrigation to Make It Pure and Safe for Drinking?



San Diego State University Research Study

A research study regarding the Demonstration Project was conducted in the fall of 2010 by a research methods class at San Diego State University (SDSU). The students conducted 63 in-depth interviews with City of San Diego residents. The information culled from these interviews was used to create a random digit dial telephone survey questionnaire. Students used the questionnaire to interview a statistically-significant sample of 626 San Diego residents by telephone in November 2010. After being read a description of the Demonstration Project, 63 percent of respondents said they supported it. The next step in the process was to provide more information about advanced water treatment to the respondents. This step validated the importance of informing people about the Demonstration Project, since 78 percent were supportive of the Demonstration Project once they learned more about it (see Figure E-3).

Figure E - 3: Impact of Additional Information on Support



Application of Findings

The research findings from the stakeholder interviews, public opinion polls, and the SDSU study helped determine which public outreach activities should be emphasized. For example, since the SDSU research found that people tended to trust scientists most for their water information, engineers and plant operators led AWP Facility tours and emphasized that the entire project is overseen by a team of experts from the IAP. Stakeholders also expressed concerns about water quality in the one-on-one interviews, so an extensive discussion of water quality is included in all project presentations. The purified water quality is also displayed visually at a sink that dispenses water produced at the AWP Facility at the end of the tour.

Outreach Metrics Report

The City's IROC serves as an official advisory body to the Mayor and City Council on policy issues relating to the oversight of the Public Utilities Department's operations. IROC's Outreach and Communication Subcommittee (formerly known as the Public Outreach, Education and Customer Service Subcommittee) noted the importance of measuring and evaluating the Demonstration

Project's outreach activities. The metrics reports that were developed in response to this request summarized completed outreach activities and provided direction for scheduling future activities. Outreach data were compiled into a comprehensive quarterly report that identified outreach activities completed to specific audiences during that reporting period. Included in the reports were the number of tour attendees, community presentations, eUpdates, new contacts, and more. The report also included additional details about each of these activities. A review of the metrics report guided the focus for future outreach activities. This ensured that every community in San Diego had the opportunity to learn about the project, whether through an article in a community newspaper, a water bill insert, attending a presentation, or touring the facility.

Education and Outreach Materials and Tools

Informational materials were developed as tools to explain and disseminate information about the Demonstration Project and the science behind water purification. These materials were tailored to the interests of multiple audiences and were made available in a variety of formats including both print and electronic versions. The materials were created to appeal to multicultural and age-specific audiences, and were translated into Spanish and Vietnamese. To ensure all aspects of the project were clearly understood, project informational materials were posted on the project's website, www.PureWaterSD.org, and distributed or available at presentations, tours, community events, and all other outreach activities.

Fact Sheet

An easy-to-understand fact sheet was developed early in the Demonstration Project to provide a description of the project, highlighting the need for a local, reliable source of water in San Diego and the components of the Demonstration Project. The fact sheet includes a schematic of the advanced water purification process, as well as the water treatment and distribution processes, to clarify any misconceptions about the Demonstration Project. It was written for lay audiences and translated into Spanish and Vietnamese for multicultural outreach opportunities. The fact sheet was distributed at stakeholder interviews, presentations, and community events, and available at AWP Facility tours, all City library branches, City Council offices, and the Mayor's office. It is also on the project website. The fact sheet was also condensed into a "quick facts" version with bullet points for use as reference.

Fact Sheet

Water Reuse Program

Water Purification Demonstration Project

The City of San Diego • Public Utilities Department

Water Purification | Demonstration Project

The City of San Diego has limited local water sources and relies on importing approximately 85 to 90 percent of its water supply. In the past, importing water from the Colorado River and Northern California has been a low-cost, reliable option, but environmental stresses and court-ordered pumping restrictions have continued to reduce the amount of water that can be delivered to San Diego. These circumstances and the threat of further limitations on our water supplies have intensified the need for new sources of water. As part of the City's effort to provide a local and sustainable water supply, the Water Purification Demonstration Project is examining the use of water purification technology to provide safe and reliable water for San Diego's future.

The Demonstration Project is the second phase of a process evaluating ways for the City to increase its use of recycled water. The first phase was the City's 2005 Water Reuse Study that identified reservoir augmentation as the preferred option for developing recycled water sources. The Demonstration Project will determine if reservoir augmentation is a feasible option for San Diego.

Recycled Water

Reservoir augmentation is a multi-step process that includes:

- Using water purification technology on recycled water
- Sending the purified water to a reservoir to blend with existing water supplies
- Treating the blended water again to be distributed as drinking water

The Demonstration Project is underway and will conclude in early 2013. During this time, the Advanced Water Purification Facility will operate for approximately one year and will produce 1 million gallons of purified water per day. A study of the San Vicente Reservoir is being conducted to test the key functions of reservoir augmentation and to determine the viability of a full-scale project. No purified water will be sent to the reservoir during the demonstration phase.

The City of San Diego's water resource strategy includes planning, conservation, recycled water, groundwater, water reuse, and watershed and resource protection to help meet future water needs.

An independent advisory panel of experts is providing oversight on project research to determine (1) if the purification process satisfies all water quality, safety and regulatory requirements of the California Department of Public Health, and (2) the behavior of the reservoir and what will happen if the purified water is added. A summary report detailing the results of the Demonstration Project will be provided to the Mayor and City Council. If deemed technically feasible, and following Mayoral and City Council authorization, a full-scale reservoir augmentation project would be implemented.

Potential benefits of implementing Reservoir Augmentation in San Diego:

- Provide a local and sustainable supply of purified drinking water for San Diego
- Improve the quality of water in the San Vicente Reservoir
- Decrease dependence on imported water
- Increase utilization of recycled water
- Provide a supply of water that uses less energy than imported water
- Have a positive impact on the environment by producing less discharge into the ocean and working toward lower carbon emissions

In an effort to keep San Diego citizens informed , the public outreach program is offering free tours of the Advanced Water Purification Facility and project presentations are being made to groups upon request. For more information, please call (619)533-7572 or email purewatersd@sandiego.gov. To register for a tour, please visit www.purewatersd.org.

City of San Diego Public Utilities Department • Long-Range Planning & Water Resources Division
600 B Street, Suite 600, San Diego, CA 92101 • (619)533-7572 www.purewatersd.org

Public Information Office 5/25/11

An easy-to-understand fact sheet was developed for distribution and for inclusion on the project website.

Frequently Asked Questions (FAQ)

The most frequently asked questions related to the Demonstration Project were answered in an FAQ to clarify misconceptions and further explain the components of the project. The FAQ was distributed at stakeholder interviews, presentations, and community events, and available at AWP Facility tours, all City library branches, City Council offices, Mayor's office, and on the project website. The questions were updated as needed according to public feedback.

Information Card

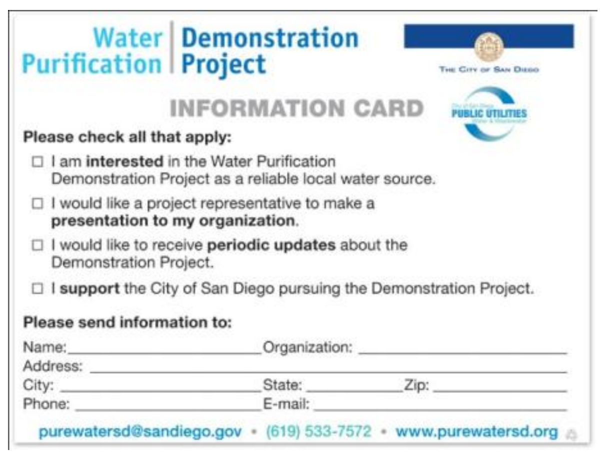
To ensure project information was presented clearly and understandably to all audiences, it was important that information be conveyed about project components in a consistent manner. This reduced confusion and fostered clarity about the Demonstration Project. A business card-sized informational piece was created as a portable, quick-reference item to carry as a reminder of key information points, or project messages, to provide to any audience. The card also included project contact information and the website address for easy reference.

Fact Card

The project fact card was a version of the information card produced for distribution at community events and AWP Facility tours to ensure consistency of project information and to provide contact information and the project website address.

Interest and Information Card

The interest and information card was used at all outreach activities and was designed to allow interested parties, community leaders, tour guests, and presentation participants to provide their contact information, level of interest, and any requests for additional information. A simplified version was created for use at events to gather names and email addresses. The extensive list was compiled and added to an email list to receive project updates, electronic copies of the project newsletter, eUpdates, and information about project involvement opportunities. The card also allowed members of the community to request group presentations or suggest additional groups to contact for a presentation. A total of 1,056 interest cards were collected from stakeholder interviews, community events, presentations, and facility tours. The interest cards included postage and a mailing address if interested parties preferred to complete and mail in the card at a later date.



Water Purification | Demonstration Project

THE CITY OF SAN DIEGO

PUBLIC UTILITIES

INFORMATION CARD

Please check all that apply:

- ☐ I am **interested** in the Water Purification Demonstration Project as a reliable local water source.
- ☐ I would like a project representative to make a **presentation to my organization.**
- ☐ I would like to receive **periodic updates** about the Demonstration Project.
- ☐ I **support** the City of San Diego pursuing the Demonstration Project.

Please send information to:

Name: ____ Organization: ____

Address: ____

City: ____ State: ____ Zip: ____

Phone: ____ E-mail: ____

purewatersd@sandiego.gov • (619) 533-7572 • www.purewatersd.org

An interest and information card allowed people to provide contact information, indicate level of interest, and request additional information.

Website

The official project website (with the domain name PureWaterSD.org) was designed and hosted on the City website. The site included all project materials, updates, related media, and up-to-date information about the project. For ease of use, a tour sign-up link was located on the home page. The project website was publicized on all informational materials and mementos to encourage an online following.

Content on PureWaterSD.org includes the following:

- AWP Facility tour registration
- Project history
- Email subscription registration system
- eUpdates
- IAP member list and activities
- Informational materials
- White papers
- Videos
- Project PowerPoint presentations
- WateReuse Association PowerPoint "Downstream"
- News coverage and related news clips
- Newsletters
- Completed speakers bureau presentation list
- Contact information
    - Links to project social media pages
    - Presentation request information
- Links to relevant resources or information about water reuse and water purification

Photography

Outreach efforts were documented with photographs, which were used in informational materials such as presentations, advertisements, newsletters and media outreach, and were placed on the project website and social media pages. Photographs were taken at most outreach activities, including community events, presentations, facility tours, and conferences.


Pure News

Water Reuse Program

Water Purification Demonstration Project

Water Purification | Demonstration Project

Summer 2012

The City of San Diego • Public Utilities Department

Pure News: Issue 6

Welcome to Pure News, a newsletter to keep you informed about the latest happenings with the City of San Diego's Water Purification Demonstration Project.

Moving Right Along

It's hard to believe it has been one year since the Advanced Water Purification (AWP) Facility began operation in June 2011. This demonstration facility purifies one million gallons of recycled water a day for testing and analysis before being diverted back to the City's recycled water system. The purification process uses microfiltration and ultrafiltration, reverse osmosis, and ultraviolet disinfection with advanced oxidation. The AWP Facility will continue to operate and offer tours through next year.

Although the AWP Facility is the centerpiece of the Demonstration Project, other behind-the-scenes work has been taking place as part of the project. For more than two years, staff have been conducting a study of the San Vicente Reservoir, working with California Department of Public Health and the San Diego Regional Water Quality Control Board to define regulatory requirements, and determining the cost of a full-scale project.

A final report compiling the results of the project's components is scheduled for completion at the year's end. The report will be available to the public following its release to the Mayor and City Council.

Pulling Out All the Stops for Purified Water

When it comes to water purification, many people refer to it as "toilet-to-tap." Although that is a catchy

Expanding Recycled Water Use

In 2009, the City of San Diego launched a Recycled Water

Pure News, a newsletter about the project, was published three times a year

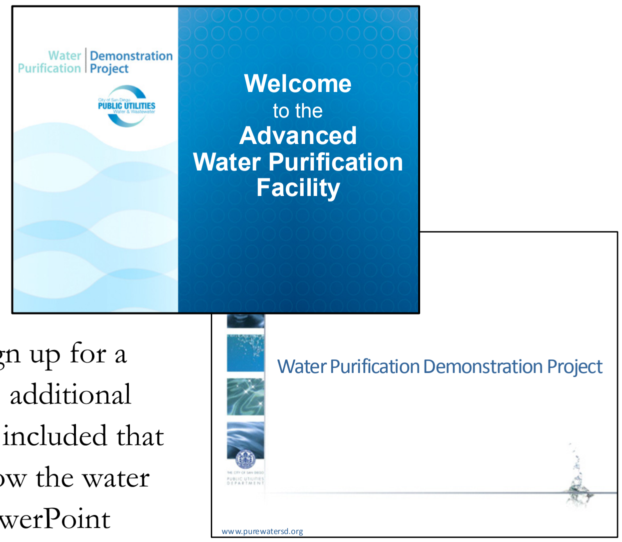
Electronic Updates ("eUpdates")

A series of electronic project updates (eUpdates) was designed and distributed by email as a way to provide project information updates as necessary to interested parties. Content included new information, recent media coverage, community involvement events, tour information, and photographs. These emails included brief updates about timely issues that may not be covered in the project newsletters.

Newsletter

A newsletter titled *Pure News* was published three times per year to provide updates on the project, highlight community outreach activities, call attention to project-related media stories, encourage readers to visit the AWP Facility, and share photographs. It was distributed electronically to a list of up to 3,890 interested parties compiled through project outreach activities (refer to the *Promoting the Demonstration Project* section for more information). Copies of the newsletter were printed for distribution at presentations and community events, and each issue has been made available on the project website.

PowerPoint Presentations



The speakers bureau and facility tour program incorporated PowerPoint presentations to explain the science behind water purification.

PowerPoint presentations were created for the speakers bureau and facility tour program. The presentations provided an overview of San Diego's water supply challenges and how the City is working to meet those challenges. The presentations provided the history of the project; explained its components; and encouraged public participation in the outreach program by letting audience members know how to sign up for a tour, request additional presentations, and easily access additional information about the project. A short video was also included that describes the multiple barrier treatment process and how the water purification equipment works. The objective of the PowerPoint presentations was to explain the science behind water purification. Presentation content was reviewed regularly to consider public feedback and new information. A long and short version of the project presentation was available to accommodate varying presentation timeframes. More information about the presentations and how they were used can be found in the *Business and Community Outreach and Speakers Bureau* sections.

Posters, Banners, and Mementos

Mementos were designed and distributed at community events and facility tours to serve an educational purpose.

Posters were created for display at the AWP Facility, presentations, and community events. The posters included images such as a schematic of the water distribution process, the multiple barrier treatment steps, and San Diego's imported water supply system. They provided a visual explanation of project components and referred interested parties to the project website and social media sites to continually build an online following. Banners featuring the project logo and website were also designed and produced to be used at community event exhibits.

Various mementos were distributed at community events and facility tours to serve an educational purpose. Useful and practical mementos featuring the project logo and website address were chosen based on the corresponding outreach activity. They appeal to a wide variety of audiences and remind them of how to get additional project information. Some mementos displayed the multiple barrier process in order to reinforce the science behind the technology.

White Papers

For those seeking in-depth information about the project, two white papers were created and posted online:

- The *City of San Diego Water Purification Demonstration Project, Advanced Water Purification*, which describes the multiple barrier processes and water quality testing in greater detail and addresses strategies that have been developed to manage potential risks from CECs
- *Potable Reuse Projects in the United States*, which includes details about other projects that use water purification processes and a timeline of their construction

Water Bill Inserts

A bilingual insert that announced the opening of the AWP Facility and tour opportunities was included in water bills and circulated for three months in 2011 and 2012. Water bills are delivered to approximately 275,000 ratepayers bimonthly. Based on findings gleaned from tour registration data, many AWP Facility tour participants found out about the tour program from the inserts.

A bilingual insert announcing the opening of the AWP Facility and tour opportunities was included in water bills.

Tour Guide Binder

As part of the tour program, a tour guide binder was developed to contain information relevant for those guiding tours of the AWP Facility. The binder included an in-depth tour script, key project information, and answers to frequently asked questions heard on previous tours. More information about the AWP Facility tours is included in the portion of this section titled *Business and Community Outreach*.

AWP Facility Brochure

To promote the project's tour program, a brochure was designed that highlights the AWP Facility. The brochure includes a brief project overview, a schematic and photos of the facility, an explanation of each of the three treatment barriers involved in the purification process, and information on how to register for a tour and follow the project online. The brochure, geared toward a general audience by using layperson's language, was intended for distribution as a take away at AWP Facility tours, community events, and presentations. It is also available on the project website.

Media Kit

A media kit was developed for distribution to local and national media representatives. The kit included the project fact sheet and FAQ, key information points, local and national news articles, the AWP Facility brochure, information about the Orange County GWRS, the white paper about related projects, a photo CD, and other relevant materials. The kit can be easily updated as needed. Project materials were provided for inclusion in media kits prepared for news conferences on related Public Utilities Department topics.

Tabletop Display Units

Two identical tabletop display units were created, one for display at the AWP Facility and the other to be used at community events. The collapsible and transportable units had Velcro panels, which allowed the display unit to be easily updated and changed as needed. The display units featured images and information about San Diego's water supply challenges, the components of the Demonstration Project, the purification process, and highlights of project media coverage locally and nationally.

The project tabletop display unit

Children's Activity Page

To incorporate children in the educational process, a worksheet was developed that introduced the concepts of water purification while engaging them in fun activities such as a maze, word search, and crossword puzzle. A solutions page was also developed for teachers and parents to check the children's work and to provide them with the correct answers. The activity page was distributed to children at tours and events.

AWP Facility Virtual Tour Video

A video was created that provides a virtual tour of the AWP Facility and the water purification process to ensure the AWP Facility tours were accessible to all San Diegans, including those who may not be able to physically tour the facility. The video includes footage of the equipment and explanations of the multiple barrier treatment process. The virtual tour is featured on the project website, YouTube page, and on DVD. DVDs were distributed to City public libraries for use in educational programs as well as to City Council offices, other elected officials, and other interested parties. The video has been viewed more than 880 times on YouTube.

Community Outreach and Tours

In order to reach a large and diverse segment of San Diego community members, various methods were used to connect with San Diegans. Through community outreach activities, these connections were used to share project information with a wide variety of audiences, such as grade school students, individuals from every community in San Diego, water industry professionals, and elected officials. The Demonstration Project established a presence throughout San Diego by hosting informational booths at community events, , welcoming guests to tour its AWP Facility, regular updates to decision makers and additional community outreach efforts.

Demonstration Project booth at the Sally Ride Science Festival

City Boards and Commissions

San Diego City Council requested that decision makers be kept informed about the status of the Demonstration Project. Therefore, the project director regularly presented to NR&C and IROC. Updates about the Demonstration Project components were provided at 19 NR&C meetings and five IROC meetings, including presentations to the IROC Environmental and Technical Subcommittee and the IROC Outreach and Communications Subcommittee.

Community Events

Hosting informational booths at community events was an important way to communicate directly with audiences from all over the City, including those who might not have been inclined to seek out water information. The Demonstration Project was featured at 42 community events in all San Diego council districts. These events varied from science expositions to festivals. At the informational booth, educational materials were distributed, project details were discussed, and contact information from booth visitors was collected to continually build a database of interested parties for future outreach. Members of the multicultural team staffed ethnic events to provide project information in a culturally appropriate manner to all San Diego residents.

Urban Water Cycle Tour Program

One of the Demonstration Project's most valuable outreach tools for explaining the science behind water purification technology was the Urban Water Cycle tour program. In the natural water cycle, water evaporates, forming clouds and then returning to earth as precipitation. The "urban water cycle" recognizes that used water from homes and businesses is treated at wastewater treatment plants and discharged to a water body from which it will evaporate. However, the natural process of evaporation and precipitation can be accelerated, as is done by the AWP Facility. Tours were given of water treatment, wastewater treatment, and water purification facilities to provide stakeholders with an up-close experience of the treatment process along with a better understanding of the "urban water cycle."

Tour pathway sign

Prior to the opening of the AWP Facility, stakeholders visited the Alvarado Water Treatment Plant and Point Loma Wastewater Treatment Plant to learn more about what treatment processes are used at each facility and the need each facility fills. Since its opening in June 2011, the AWP Facility remained the focus of the Urban Water Cycle tour program and was one of the primary outreach activities that provided project information. The tour provided San Diegans with a tangible experience of the Demonstration Project, increased the visibility of advanced water purification technology, corrected inaccurate perceptions about water purification processes, and solidified relationships with stakeholders.

AWP Facility Tour Publicity

The AWP Facility tours were publicized through email invitations, community event informational booths, newsletter articles, media coverage, email updates, social media posts, speakers bureau presentations, newspaper and online advertisements, and water bill insert announcements.

AWP Facility Tour Graphics

A variety of graphic materials were prepared to create an attractive and educational tour experience. The graphic approach reinforced the idea of the water cycle and used words and images that "connect" the viewer to the subject of water. A palette of colors was selected for the graphics to be representative of water. The backgrounds included graphics of waves and bubbles that implied technology and water purification in a simplified way. Icons were used to enhance and illustrate the AWP Facility process, such as H2O molecule decals.

Schoolchildren try to identify the purified water sample.

One of the main graphic elements used in the tour experience was a PowerPoint presentation featuring an animated video of the water purification process. Posters highlighting existing water purification projects, a San Diego County map for guests to identify where they live, banners displaying the urban water cycle, water-related maps, signposts featuring water-related quotations, signs explaining each step of the multiple barrier process, and a "photo-op" backdrop featuring San Vicente Reservoir were located throughout the facility to provide information and keep guests engaged during the entire tour. A blue pathway guided guests through the AWP Facility. Decals were placed along the pathway to illustrate the purification process. The decals early in the pathway showed water contaminated with a number of microorganisms. As the decals neared the end of the pathway following the three purification steps, they were clear and free of contaminants. All of these materials supplemented the messages expressed verbally by the guides throughout the tour.

AWP Facility Tour Logistics

The tour experience consisted of three main parts: an introduction, a facility tour and a closing. Each tour began with a presentation about the City's water supply situation and explanation of the various project components and treatment processes involved, followed by a tour of the facility with explanations of how the many pieces of equipment work together to create the multiple barrier process. At the conclusion, guests compared samples of recycled water, drinking water, and purified water produced at the facility.

AWP Facility Tour Attendees

Guests registered for the tours through an online registration system. Registrants provided contact information, including email addresses, and how they learned about the tour. Not only was the information collected useful for contacting guests prior to the tour, but it served a secondary purpose in expanding the project contact list. The email addresses collected were added to an interested parties email database for future communications.

San Diego Mayor Jerry Sanders toured the AWP Facility with his staff.

Tours were offered weekly with a Saturday and/or an evening tour offered at least once a month. Organizations also had opportunities to host meetings on site and take a tour of the facility. Since the facility opened, more than 3,200 guests have attended 243 tours. Tour attendees included many local elected officials and decision makers, such as San Diego Mayor Jerry Sanders, San Diego City Councilmembers, mayors of Del Mar and Solana Beach, councilmembers from Oceanside and Solana Beach, Assemblymembers Atkins and Fletcher, Congressman Filner, and staff from the offices of Senator Boxer, Representative Issa, State Senator Anderson, Assemblymembers Block and Jones, the EPA, the Bureau of Reclamation, Department of the Interior, Office of Management and Budget, and the Senate Appropriations Subcommittee for Energy & Water Development[7]. The Demonstration Project attracted City residents as well as international guests from Armenia, Australia, Azerbaijan, Brazil, China, Georgia, India, Iraq, Kyrgyz Republic, Mexico, Moldova, Spain, Tajikistan, Ukraine, the United Kingdom, and Vietnam.

Members of the 416th Civil Affairs Battalion (Airborne) following their AWP Facility tour

In order to further engage visitors following the tour, attendees received an email thank you note with a link to the project's Facebook page where guests could view the tour photographs. Tour participants were added to the database of interested parties to ensure they received periodic updates about the project.

Tour Feedback

Following tours of the AWP Facility, guests completed surveys to evaluate their tour experience and understanding of water purification. This tool is used to gauge the success of the information provided and identify areas of needed improvement for the tour. Based on the findings, nearly all of

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[7] Titles listed represent the office held at the time of tour. Some of these elected officials may no longer hold the office listed.

the respondents found the tour to be "very informative" (81.4 percent) or "informative" (18.2 percent), and more than 98 percent of respondents said the overall tour was "excellent" (74.6 percent) or "good" (23.7 percent).

The feedback has resulted in the tour program being adapted to meet visitors' needs and to incorporate suggested improvements. For example, respondents who toured early in the program often reported poor audio quality on the tour. After acquiring a better sound system, the audio quality comments dropped significantly. In addition, guests commented on the lack of accessibility for participants with limited mobility. Based on this feedback, a virtual tour video was created that could be viewed in the tour conference room or from a personal computer. Other feedback led to the development of more child-friendly materials, inclusion of additional props, and fine-tuning of other aspects of the tour.

Youth Outreach

Another facet of the outreach program is the cooperative work done with students throughout San Diego, most notably those at the Elementary Institute of Science. The Elementary Institute of Science Commission on Science that Matters is an innovative program that involves students from San Diego high schools in the study of a topic that will result in greater community sustainability. For the 2011/2012 school year, Elementary Institute of Science students created a video about the water purification process to make the project's technical aspects more understandable and appealing for children. Elementary Institute of Science posted the video on their YouTube page (youtube.com/eiscostm06), and the Demonstration Project social media pages linked to the video. The students presented the video and what they learned about the purification process to NR&C in May 2012.

Following their presentation to NR&C, EIS students pose with Project Director Marsi Steirer.

Outreach to young audiences was incorporated in many aspects of the outreach program. Elementary and high school classes, Boy Scout dens, Girl Scout troops, and home-schooled children toured the AWP Facility. Many higher education groups also toured the facility, including water treatment, engineering, law school, and medical school classes. In addition to the tours, the speakers bureau made presentations about the Demonstration Project to elementary and high school classes. Technical information was geared to a younger audience at youth-oriented events such as the Sally Ride Science Festival, the Girl Scouts World of Water Workshop, the San Diego Science & Engineering Expo, and the Greater San Diego Science & Engineering Fair.

Multicultural Organizations

With the help of multicultural experts, all aspects of project outreach were considered through a multicultural lens. Considerations included conducting one-on-one interviews with community leaders from ethnic or faith-based organizations, producing multilingual materials, distributing news releases and template articles to ethnic media, guiding tours of the AWP Facility for ethnic media representatives, participating in multicultural community events, providing Spanish and Portuguese translators for AWP Facility tours when necessary, and welcoming people of all backgrounds to tour the AWP Facility. This cross-dimensional approach to multicultural outreach ensured diverse audiences were taken into account for all outreach efforts.

Social Media, Conferences and Awards

To promote transparency and project visibility, the outreach program aimed to inform as many City residents as possible about the Demonstration Project. With this goal in mind, social media platforms, email distribution systems, and industry conferences were used to reach a wide variety of people.

Interested Parties

Interested parties who expressed a desire to learn more about the project, either when they visited the website or signed up at events or other outreach activities, were added to a database of email contacts. Other groups, such as stakeholders, media contacts, tour participants, and potential groups for speakers bureau presentations were also included in the database. Contacts were able to easily unsubscribe from email updates if they no longer were interested in the project. After continuously collecting contact information, the database eventually consisted of 3,890 email contacts. The contacts typically received project updates once a month, keeping them informed about the project without bombarding them with emails.

Social Media

Social media sites provided effective opportunities to reach new audiences and maintain contact with existing interested parties. An active social media presence was developed on Facebook, Twitter, and YouTube. The pages were updated and monitored on a daily basis, which included responding to public comments to keep followers engaged. A social media calendar was also developed and updated monthly such that interesting and relevant information could be posted frequently. Community members were encouraged to follow the social media pages at tours and events, on the website, and in newsletters, eUpdates, and other informational materials.

An active social media presence was developed on Facebook, Twitter, and YouTube.

Facebook (www.facebook.com/SanDiegoWPDP)

The latest project information, AWP Facility tour photos, and links to related articles and factoids were posted on the project's Facebook page, adding up to 379 wall posts. The page has received 123 page likes, 12 comments, and 93 likes on page items (e.g., photographs and wall posts).

Twitter (www.twitter.com/PureWaterSD)
Similar yet pithier posts and links were posted on Twitter compared to those posted to Facebook. On Twitter, dialogue about water issues and the Demonstration Project were more readily available, thanks to the social media site's structure. For example, a project mention by Council President Young on Twitter led to dialogue with a community member[8]. Eventually the community member attended the tour and later posted on Twitter about her positive tour experience and her support for the project. The Demonstration Project has 133 followers (i.e., subscribers) of its Twitter page. In addition to the project's own 537 tweets, posts were retweeted 54 times and the project's page was mentioned 75 times by others.

YouTube (www.youtube.com/PureWaterSD)
Project-related videos were posted on the YouTube page, including a virtual tour of the AWP Facility, an animated video explaining the water purification process, project testimonials, and a clip from *California's Gold* with the late Huell Howser that featured the Demonstration Project. The seven videos posted have received a total of 3,121 views. The YouTube page also linked to "favorite" videos posted by other YouTube channels including the video produced by Elementary Institute of Science students and a WateReuse Foundation video about the world's water supply titled *Downstream*.

Seven videos posted about the project on YouTube have received a total of 3,121 views.

Water Agency Collaboration

Although San Diego residents were the primary target audience for project outreach, all of the cities and agencies that receive or could potentially receive (such as in an emergency) drinking water from the San Vicente Reservoir have the potential to be affected by a reservoir augmentation project at San Vicente Reservoir. Water Authority member agencies were kept informed through presentations, meetings, and facility tours. They also received information suitable for sharing on their websites and in outreach materials. All Water Authority member agencies have received information through a presentation or tour.

In addition to providing project information, there was a collaborative effort between the Demonstration Project and the Water Authority. In early 2012, the Water Authority developed a brief video that explained the region's water needs and how full-scale reservoir augmentation could produce a reliable, local drinking water supply. An additional element of this collaboration was a cross-promotion where information was shared about the AWP Facility tours and the Water Authority's San Vicente Reservoir tours at the other's tour program.

[8] Title listed represents the office held at that time.

Trade Shows and Conferences

Since full-scale reservoir augmentation at San Vicente Reservoir would be the first project of its kind in California, the Demonstration Project drew interest from water industry professionals from across the state and the nation. There were 33 presentations made about the technical and outreach aspects of the project at local, national, and international water industry conferences. These presentations increased project visibility and encouraged connections with and learning from experiences of other water industry professionals.

Awards

The Demonstration Project has received recognition for its outreach efforts. In September 2011, the WateReuse Association honored the Demonstration Project as the Public Education Program of the Year for its outreach efforts since inception. The following year in September 2012, the WateReuse Association recognized the Demonstration Project once again, this time as the 2012 Small Project of the Year.

The Demonstration Project has received two awards from the WateReuse Association.

Media Outreach

Effective media outreach required that media representatives receive accurate and timely project information. Information was provided to reporters and editors of local, regional, and national publications, as well as multicultural print publications, online publications, and television and radio outlets at all project milestones. The project has been covered by many media outlets including the *San Diego Union-Tribune, North County Times, Los Angeles Times, USA Today, New York Times, National Public Radio*, and *National Geographic.*

Contact Lists

A comprehensive list of local and national media contacts was developed and information was provided at project milestones and to generate interest in the AWP Facility tour program. News releases and template articles were distributed to various publications: daily newspapers, online media, community newsletters, and trade publications. Members of the multicultural team provided contact information for local, ethnic media representatives and encouraged them to tour the AWP Facility. Stakeholders that have their own publications and newsletters were included in the list.

Media Outreach Activities

There were many components of the media outreach activities. Prior to the opening of the AWP Facility, science reporters were informed about the technical details of the project. This effort resulted in several publications writing about the multiple barrier process before the AWP Facility was operational.

Media representatives were invited to tour the AWP Facility once it became operational. On June 30, 2011, San Diego Mayor Jerry Sanders, Councilmember David Alvarez, Public Utilities Director Roger Bailey, and Demonstration Project Director Marsi Steirer announced the opening of the one-mgd AWP Facility at a news conference covered by reporters and camera crews from local television news stations and several daily print or online publications.[9]

Template articles were prepared to provide project information through community newspapers, stakeholder publications, and local websites and extend the reach throughout the City. The articles were customized as needed for a variety of outlets and updated articles were prepared as the project progressed. A well-publicized template article from early 2012 promoted the AWP Facility tour program, increasing participation in the tours while raising awareness about the project.

A news release highlighting a group's visit to the facility was submitted for consideration in the group's newsletter or appropriate publication. Tours were covered in several organizational newsletters and campus publications, such as Francis Parker School's online news and SOS Toastmasters' monthly newsletter, which may have otherwise not included a story on the Demonstration Project.

Advertisements

Advertisements announcing the AWP Facility opening and the availability of tours were placed in seven local, ethnic publications (*El Latino, Filipino Press, La Prensa, San Diego Monitor, Voice & Viewpoint, We Chinese in America* [weekend edition], and *Giving Back Magazine*) immediately following the facility opening in summer 2011.

Advertisements in local ethnic publications were used to reach out to multicultural

Depending on the publication, the advertisements ranged from one-eighth to one-quarter of a page in size. Spanish text was used for the advertisements placed in Spanish language publications. These advertisements were an important part of reaching out to multicultural audiences.

An animated advertisement featuring a Demonstration Project informational booth visitor dressed as Spiderman was placed on the Voice of San Diego website.

Additionally, the tour program was advertised in Voice *of San Diego* (VOSD) in June/July 2012 as part of an advertising package. Since the advertisement placement coincided with the release of the newest Spiderman movie and Comic-Con 2012, a three-frame animated advertisement that featured a Demonstration Project informational booth visitor dressed as Spiderman was placed on the *Voice of San Diego* website. The advertisement included phrases about the tour program that played on Spiderman terminology. Additionally, a static advertisement about the tour program appeared eight times

[9] Titles listed represent the office held at the time of the news conference.

in the VOSD Best of the Week and Member Report weekly email blasts. Lastly, a quarter-page tour program advertisement ran in the VOSD monthly magazine.

Media Coverage

As one of the first cities in California to pursue full-scale reservoir augmentation, San Diego has been front and center in media coverage for recycled water projects in the U.S. and around the world. The project was featured in local and national newspapers, online and trade publications, and local radio and television stations. The project and the tour program were also featured in community publications. Many affiliated websites provided links to the project website, informational materials or videos. Using established multicultural media contacts, project coverage was generated in African-American, Latino and Asian publications.

In October 2010, the *Union-Tribune* published an article describing water purification and included graphic diagram of the multiple barrier process. This emphasis on the science of water purification reflected what the Demonstration Project was all about. In January 2011, the *Union-Tribune* recalled its previous criticism of water purification as "toilet to tap" with an editorial piece titled "The Yuck Factor: Get Over It". On a national level, the *New York Times* followed suit with an article in February 2012 titled "As 'Yuck Factor' Subsides, Treated Wastewater Flows From Taps." From 2010 to 2012, information has been provided for many articles such as these that have recognized and contributed to the growing understanding of the scientific efficacy of water purification technology and San Diego's need for a local, reliable source of water. Overall, the project received media coverage from more than 100 publications and news outlets locally and nationally.


The New York Times

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As 'Yuck Factor' Subsides, Treated Wastewater Flows From Taps

By FELICITY BARRINGER

SAN DIEGO — Almost hidden in the northern hills, the pilot water treatment plant here does not seem a harbinger of revolution. It cost $13 million, uses long-established technologies and produces a million gallons a day.

But the plant's very existence is a triumph over one of the most stubborn problems facing the nation's water managers: if they make clean drinking water from wastewater, will the yuck factor keep people from accepting it?

With climate change threatening to diminish water supplies in the fast-growing Southwest, more cities are considering the potential of reclaimed water. A new report from the National Academy of Sciences said that if coastal communities used advanced treatment procedures on the effluent that is now sent out to sea, it could increase the amount of municipal water available by as much as 27 percent.

San Diego's success, 12 years after its City Council recoiled from the toilet-to-tap concept, offers a blueprint for other districts considering wastewater reuse.

For most of the four decades beginning in 1970, the arid West was the fastest-growing region in the country; the population of Nevada quintupled in that period while Arizona's nearly quadrupled. Continued population growth, unmatched by growth in water storage capacity, makes this a "new era in water management in the United States," the science group's report said.

"The pressures on water supplies are changing virtually every aspect of municipal, industrial, and agricultural water prac-

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EDITORIAL

THE YUCK FACTOR: GET OVER IT

As San Diego sprawls above 3.5 million people countywide in just 10 more years, and a projected 4.4 million by 2050, the greatest threat to our economic health and quality of life is an uncertain supply of water. This urban cul-de-sac at the bottom of California is at the tail end of the pipelines that deliver 80 percent or more of our water. That means we are heavily dependent on the mercy of others, and that is not comforting.

San Diegans have more than proved themselves willing to conserve; the city uses less water in real terms today than it did with a smaller population 20 years ago. That will continue to be a crucial part of the region's water strategy for decades. So, too, will be the development of new sources, such as desalination. And, of course, political battles to rescue the Sacramento-San Joaquin Delta from environmental collapse in order to keep Northern California water flowing south will be never-ending.

scaping and industrial processes, then purify and scrub it some more to nearly distilled water standards. The demonstration project is to produce 1 million gallons a day for a year, during which it will be continually monitored and studied, but not distributed for public consumption. If it proves safe and affordable, the city could then consider its expansion to a permanent plant that could produce up to 16 million gallons a day, which would be piped to San Vicente Reservoir.

Frankly, there is not that much to demonstrate, at least scientifically.

The project received media coverage from more than 100 publications and news outlets locally and nationally.

News coverage was continually monitored and compiled. Links to relevant news articles were posted on the project website and in eUpdates. A media tracking database noted project coverage by newspapers, radio, television, and blogs. Coverage of the Demonstration Project was generally accurate and discussed the technology to be employed to purify the recycled water.

The commitment to providing accurate, science-based information also resulted in more descriptive language being used by publications. Instead of sensational headlines relying on the inaccurate "toilet-to-tap" moniker, publications used more fact-based headlines. Some examples include *Union-Tribune* articles, such as "Water Recycling Key to U.S. Future" (Jan. 10, 2012), "Boosting Reservoirs with Purified Wastewater?" (May 22, 2012), and "Recycled Water Getting Another Look" (May 23, 2012).

Speakers Bureau

An active speakers bureau gave 132 presentations about the Demonstration Project throughout San Diego and proved to be a vital component of the outreach program. These presentations shared project information with community members and provided an opportunity to receive public feedback about the project and the presentation itself so public questions and perception about water purification in San Diego could be more clearly understood.

An active speakers bureau gave 132 presentations about the Demonstration Project throughout San Diego.

In order to ensure an inclusive, broad reach throughout San Diego, an extensive database of community groups with potential interest in the project was created. The list began with groups that received presentations about the Water Reuse Study in 2005 and 2006. Each City Council district office was contacted for recommendations of groups to contact. Presentation scheduling began with the groups recommended by council members, those groups that had been previously involved, and community planning groups throughout the City. Contacts were researched for environmental groups, business associations, religious groups, civic organizations, and other special interest groups. They were then contacted to schedule a presentation. The speakers bureau program provided an opportunity to explain the project components and for community members to ask questions, voice concerns, and obtain accurate information about it.

The speakers bureau members were tasked with presenting information about the project in community group presentation settings. A PowerPoint presentation was developed to explain San Diego's water supply situation, the components of the Demonstration Project, and how water purification technology works in layperson's terms. The speakers bureau team participated in two workshops to become familiar with the presentation and practiced delivering it and responding to questions. Regular meetings with speakers bureau members were held to discuss feedback from presentations, develop updated presentation slides, and identify questions that should be added to the project FAQ.

The speakers bureau was regularly publicized through all aspects of the outreach program including at community events, at facility tours, on all distributed informational materials, and on the project's website. Contacts in the speakers bureau database were contacted and offered a presentation, responses were provided to presentation inquiries, equipment and materials were prepared, and presenter feedback forms and group evaluations were collected. Any questions and concerns from the group were recorded in the database and follow-up was performed when necessary.

The speakers bureau successfully presented to groups citywide. The groups had various interests, and many group members followed up with a tour of the AWP Facility. Presentations were made to churches, classrooms, multicultural group meetings, water industry luncheons, community planning meetings, environmental symposia, and more. A broad range of groups proved to be interested in the discussion of San Diego's water supply and receptive to the options being explored by the City, particularly the Demonstration Project.

Stakeholder/Partner Communication

Sharing educational information about the project allowed relationships to be formed with stakeholders and a network of contacts to be developed. Once identified, stakeholders were contacted to participate in one-on-one stakeholder interviews, schedule group presentations, place project information in their relevant publications, and tour the AWP Facility. All of the stakeholders were added to the interested parties' database so they would receive regular email updates about the project.

American Assembly

As mentioned previously, in 2004 and 2005 a broad-based group of City residents participated in an American Assembly-style process to review the City's Water Reuse Study findings. The American Assembly members concluded that reservoir augmentation was the most viable use of highly treated recycled water for San Diego and that it could provide a local, reliable supply of water crucial to the City's future.

Because American Assembly participants played such an essential role in the eventual development of the Demonstration Project and were already invested in it, they were immediately identified as key stakeholders. Early in the project, members of the American Assembly were updated about the project status, informed about outreach opportunities, and encouraged to remain involved. In addition to being added to the email update contact list, the American Assembly participants were directly contacted in early 2012 to encourage them to tour the facility or register for a presentation if they had not done so already.

Water Reliability Coalition

Beginning in 2009, a unique union of diverse San Diego organizations came together to form the Water Reliability Coalition (WRC; formerly the IPR Coalition) in support of the Demonstration Project. This independent, broad-based coalition consisted of 23 environmental, technical, business, and ratepayer advocacy groups that promote the exploration of water purification in San Diego (see sidebar for list of organizations). The group was instrumental in maintaining momentum for the Demonstration Project by attending and providing testimony at City Council and other civic meetings. Additionally, they provided an independent voice about water purification and the need for a sustainable water supply for San Diego. In 2010, the San Diego Chapter of WateReuse California presented special recognition awards to each WRC organization in recognition of their support of water reuse, and in particular of water purification in San Diego.

As early supporters of the Demonstration Project, the WRC was updated about the project and invited to tour the AWP Facility. The Water Reliability Coalition's role was to provide their own opinion about the project as a non-governmental group. Additional information about the WRC can be found at www.sdwatersupply.com.

WRC
WATER RELIABILITY COALITION

Coalition Members:

- BIOCOM
- Building Industry Association of San Diego
- Building Owners and Managers Association, San Diego Chapter
- Citizens Coordinate for Century 3
- Coastal Environmental Rights Foundation
- Empower San Diego
- Endangered Habitats League
- Environmental Health Coalition
- Friends of Infrastructure
- Industrial Environmental Association
- National Association of Industrial and Office Properties, San Diego Chapter
- San Diego and Imperial Counties Labor Council
- San Diego Audubon Society
- San Diego Regional Economic Development Corporation
- San Diego Coastkeeper
- San Diego County Apartment Association
- San Diego County Taxpayers Association
- San Diego Regional Chamber of Commerce
- San Diego River Park Foundation
- Sierra Club, San Diego Chapter
- Surfrider Foundation, San Diego Chapter
- Sustainability Alliance of Southern California
- Utility Consumers' Action Network

Stakeholders

As mentioned previously, a number of community leaders were identified and interviewed in one-on-one meetings to gather their feedback on relevant water issues. A broad range of perspectives was sought from all sectors of the community since every industry, group, and individual is affected by the City's water supply. Stakeholder organizations were engaged, including construction, industrial, medical, education, business, and tourism sectors. To ensure the interests and concerns of all San Diego residents were captured, multicultural organizations and leaders in multicultural communities were sought to participate in the stakeholder interview process.

Following the interviews, the relationships with the community leaders and their organizations were reinforced in several ways: providing them with information requested during the interview, sharing template articles for inclusion in their organizational outreach materials, encouraging them to host a speakers bureau presentation, and inviting them to tour the AWP Facility.

Information Lines and Emails

To promote two-way communication, project telephone information lines and an email address were set up to allow community leaders to contact project staff easily. Three information lines were set up for overall project questions, speakers bureau registration, and tour information, respectively. Also, an email address (PureWaterSD@sandiego.gov) was promoted as the point of contact for all project-related questions and concerns.

The project received, responded to, and tracked 182 email and telephone inquiries from members of the public who inquired about it and requested presentations and tours, in addition to members of the public who requested tours by email. Each email and telephone inquiry was tracked on a form that recorded contact information and the information requested. The outreach hotlines were useful for providing a central contact point for the public. The goal was to respond to telephone and email inquiries within one business day. If a question required a more technical response, technical staff assisted in developing an accurate response that addressed the contact's concerns.

Internal Department Communications

The City of San Diego Public Utilities Department's 1,414 staff members were an important audience for the Demonstration Project since they could be asked about it while working in the field, responding to customer service inquiries, attending or staffing community events, or talking with their own friends and family. Therefore, internal audiences were kept informed about the project and provided with as much information as possible.

Internal Meetings

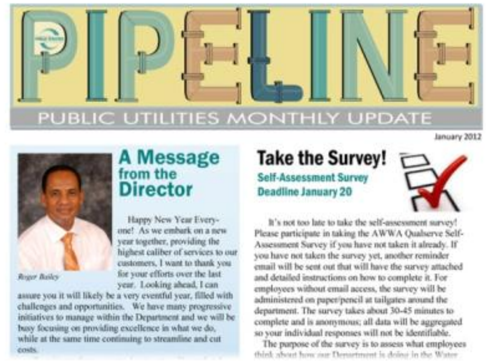
Information about the project was presented to Public Utilities staff at internal division meetings. Since all of the division staff were invited to and typically attended these meetings, many internal staff could be reached at once. The presentations explained project details and answered questions for an audience with unique interests that varied from those of the general public.

Project information was also shared at a series of three tailgate trainings, which are required classes for field personnel. Prior to the presentation, attendees were tested to determine their water purification knowledge. Following the presentation, the attendees were tested again to show what they learned through the presentations.

Intranet

The Public Utilities Department houses its own intranet site its staff. The site provides employee resources, department information, and related news. Information about AWP Facility tours and the virtual tour video are posted on the Intranet page. Also, the project's Pure News newsletters were posted on the intranet's page of Public Utilities Department newsletters.

Pipeline



PIPELINE

PUBLIC UTILITIES MONTHLY UPDATE

January 2012

A Message from the Director

Happy New Year Everyone! As we embark on a new year together, providing the highest caliber of services to our customers, I want to thank you for your efforts over the last year. Looking ahead, I can assure you it will likely be a very eventful year, filled with challenges and opportunities. We have many progressive initiatives to manage within the Department and we will be busy focusing on providing excellence in what we do, while at the same time continuing to streamline and cut costs.

Roger Bailey

Take the Survey!

Self-Assessment Survey Deadline January 20

It's not too late to take the self-assessment survey! Please participate in taking the AWWA Qualserve Self-Assessment Survey if you have not taken it already. If you have not taken the survey yet, another reminder email will be sent out that will have the survey attached and detailed instructions on how to complete it. For employees without email access, the survey will be administered on paper/pencil at tailgates around the department. The survey takes about 30-45 minutes to complete and is anonymous; all data will be aggregated so your individual responses will not be identifiable.

The purpose of the survey is to assess what employees

Information about the Demonstration Project was included in 14 issues of Pipeline, the Public Utilities Department's internal monthly newsletter.

Pipeline is the Public Utilities Department's internal monthly newsletter. It is emailed to Public Utilities staff, posted in break rooms, and available on the department's intranet page. Project updates, City staff tour invitations, and general information are submitted for inclusion in Pipeline, as necessary. Overall, information about the Demonstration Project was included in 14 issues of *Pipeline*.

City Staff Tours

To address the unique interests and concerns of Public Utilities Department staff, 16 AWP Facility tours were provided for City staff only. These tours were publicized through internal emails, Pipeline, and on the intranet. Public Utilities supervisors and supervisors in other City departments, such as Storm Water, requested additional tours to accommodate their staff members. These tours proved valuable in educating a large number of City staff about the project and providing in-depth information to them.

Public Utilities Department staff tour the AWP Facility.

Public Outreach and Education Findings

Key findings of the public outreach and education program are as follows:

- Feedback from individuals who have toured the AWP Facility shows that providing an opportunity to tour the facility increases understanding about water purification processes.
- Research shows a steady increase from 2004 (26 percent) to 2011 (68 percent) to 2012 (73 percent) in City residents who favor using advanced treated recycled water as an addition to the City's drinking water supply.

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Section F: Full-Scale Project Considerations

Full-Scale Reservoir Augmentation Considerations

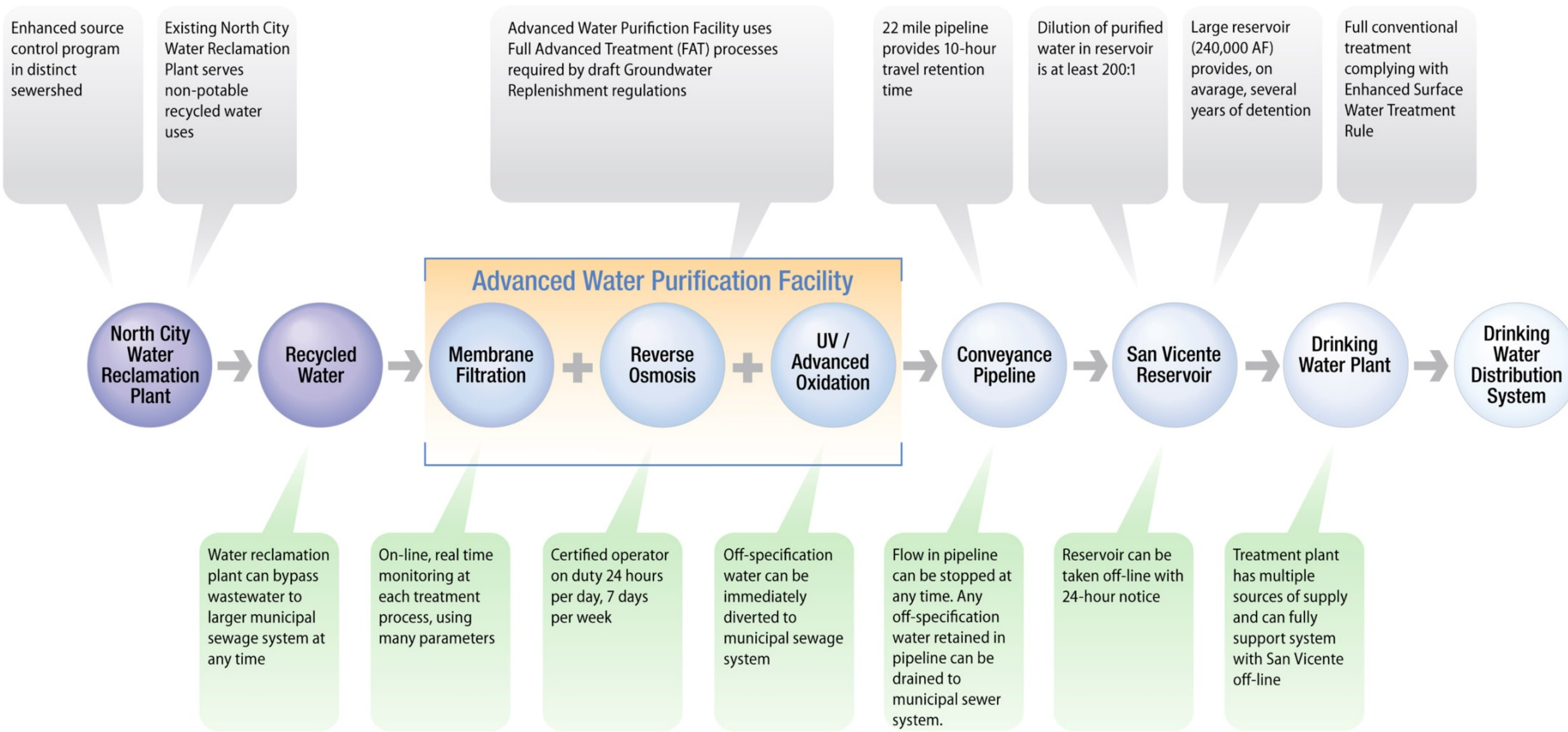
- Full-Scale Components of a Multiple Barrier Strategy
- Source Control Enhancement
- North City Water Reclamation Plant
- Advanced Water Purification Facility
- Pipeline System
- AWP Facility and Pipeline System Cost Estimates

The City must fully understand all potential implications of a reservoir augmentation project at San Vicente Reservoir prior to deciding whether or not to implement such a project. The Demonstration Project included an assessment of the full-scale project components that would be required, and an evaluation of potential operational requirements and other considerations associated with each component. The results of that assessment are summarized in this section.

Full-Scale Components of a Multiple Barrier Strategy

A reservoir augmentation project at San Vicente Reservoir would require a series of water purification components, focused on achieving a multiple barrier strategy, as required for regulatory approval. A multiple barrier strategy protects public health by incorporating safeguards to ensure that a failure or error at any given treatment step would not compromise public health. The components of a multiple barrier strategy that would be implemented for reservoir augmentation at San Vicente Reservoir are illustrated in Figure F-1 and described in further detail below. Please note that, although a full-scale project's multiple barrier strategy includes San Vicente Reservoir and a municipal drinking water treatment plant such as the Alvarado Water Treatment Plant, these facilities would not require modification. As such, those steps of the multiple barrier strategy are not addressed in this section.

Figure F - 1: Components of a Multiple Barrier Reservoir Augmentation Project at San Vicente Reservoir



Source Control Enhancement

The first step in the multiple barrier strategy for reservoir augmentation at San Vicente Reservoir would be source control, which refers to the prevention of contaminants from entering the wastewater stream. All wastewater systems have source control programs. The City's source control program, referred to as IWCP, was implemented in 1982 to regulate industrial discharges into the San Diego Metropolitan Sewage System (Metro System). The program was required as part of the NPDES permitting process for Point Loma, and the South Bay Water Reclamation Plant (SBWRP). The IWCP applies and enforces federal pretreatment regulations set forth by the EPA, and it satisfies the following objectives:

- To protect and improve receiving water quality;
- To prevent the discharge of toxic and potentially harmful pollutants in concentrations which would interfere with treatment plant operations or pass through the plant to the receiving waters;
- To protect system personnel and plant facilities by limiting discharges of potentially hazardous, harmful, or incompatible pollutants;
- To prevent contamination of treatment plant sludge in order to maximize beneficial reuse options for biosolids;
- To protect the quality of recycled water.

The City participates in the "No Drugs Down the Drain" program, which alerts California residents about problems associated with flushing medications down the drain. This program is an example of the City's existing source control efforts.

The City's IWCP is designed to support the existing discharge to the ocean via Point Loma, and goes beyond typical source control programs by implementing an EPA- and Regional Board-approved Urban Area Pretreatment Program (UAPP). The City has taken the following steps in implementing the UAPP that extend beyond typical source control programs:

- Developed local limits that comply with UAPP provisions of the Ocean Pollution Reduction Act; local limits are re-evaluated annually.
- Implemented Industrial Management Practices to minimize the discharge of toxic pollutants, such as Batch Discharge approvals, and solvent management plan requirements at all laboratories, including research and development, medical, and analytical laboratories.
- Include prohibitions on the discharge of pharmaceutically-active ingredients, including unused pharmaceuticals, expired pharmaceuticals, rejected batches or lots, and

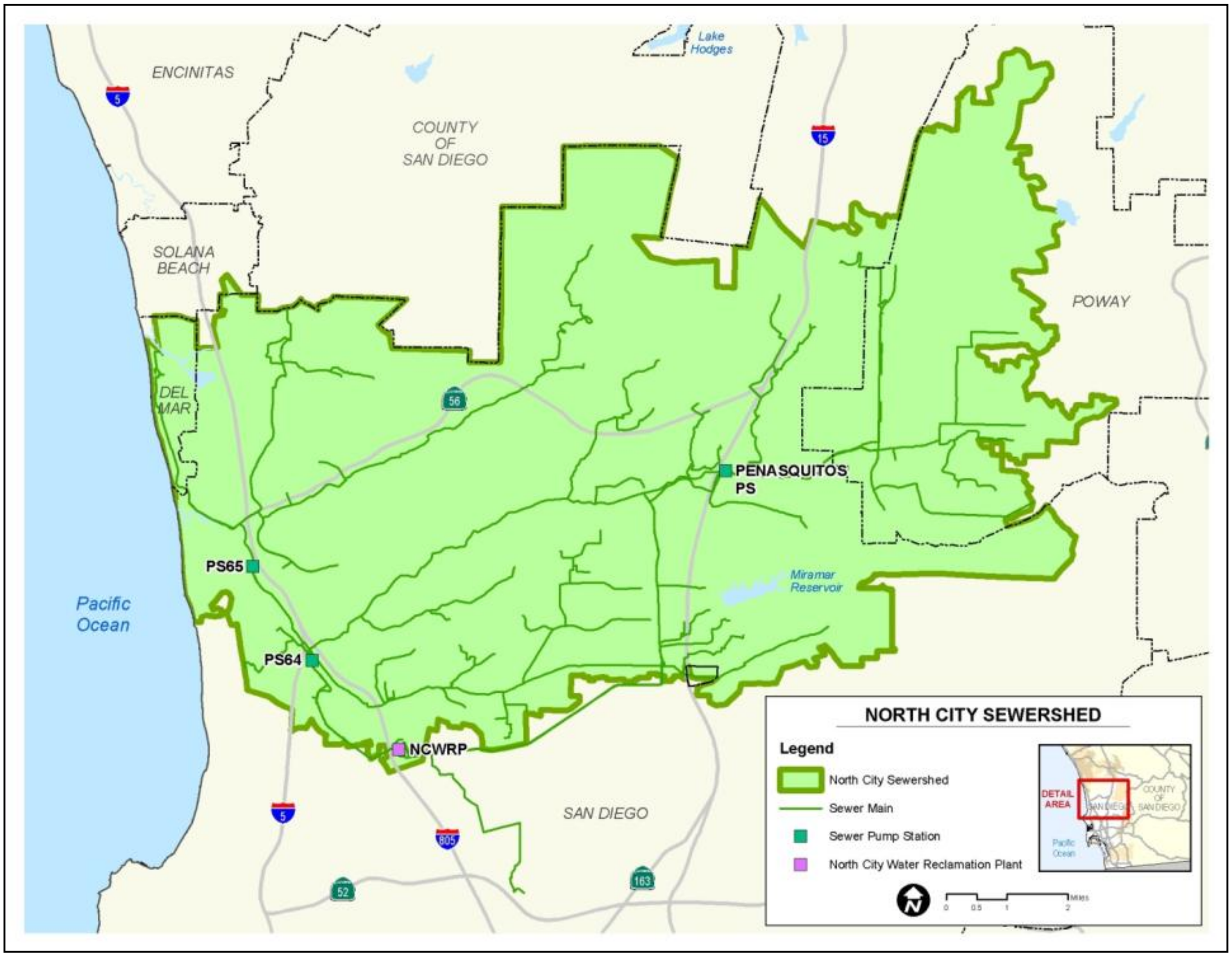
pharmaceuticals received in take-back programs in new and renewal permits for medical and biotech facilities tributary to North City.

- Require facilities that generate biohazardous waste to comply with the July 2005 California Medical Waste Management Act and revisions and amendments thereto, set forth in the California Health and Safety Code, Sections 117600 – 118360. Facilities must certify every six months as to compliance with the pharmaceutical discharge prohibition and biohazardous waste management requirements. The Program has procedures in place to evaluate the need for additional controls, and to develop and enforce new local limits and facility or sector-specific Industrial Management Practices as needed to ensure and maintain required effluent quality.

For projects where purified water would enter the drinking water system via groundwater or surface water augmentation, CDPH requires that source control programs be augmented to address residential and commercial discharges and consider an expanded set of contaminants that may have public health relevance, such as industrial chemicals, pharmaceuticals, and personal care product residuals sometimes found in wastewater.

Because the source of purified water for potential reservoir augmentation at San Vicente Reservoir is North City, that facility's service area would be the focus of an enhanced source control program. Figure F-2 depicts the North City service area.

Figure F - 2: North City Service Area



In order to identify potential supplements to the City's IWCP to address possible regulatory requirements associated with a potential reservoir augmentation project, the City reviewed the existing source control program being implemented by OCSD. OCSD's Source Control Program was enhanced to support the currently operational Orange County GWRS, which employs water purification processes similar to those that would be implemented for reservoir augmentation at San Vicente Reservoir. Comparison with OCSD's program illustrated that the City's existing program is robust and goes beyond applicable regulatory requirements for ocean discharges. However, based on that review and the heightened vigilance required to protect drinking water systems, it was concluded that the following components should be considered, should the City pursue reservoir augmentation at San Vicente Reservoir.

- **Chemical Inventory Program and GIS Tracking.** The City may need to implement an expanded industrial and commercial discharger chemical inventory database, which is linked to discharger locations that are tracked using GIS.
- **Pollutant Prioritization Program.** The City may be expected to develop a program to prioritize pollutants through sampling and characterization of CECs at the full-scale AWP

facility and determine if pollutants can be controlled through targeted source control for individual dischargers or commercial sectors.

- **Local Limits Evaluation.** To support a full-scale reservoir augmentation project at San Vicente Reservoir, a local limits evaluation may need to be performed for the North City service area, taking into consideration compliance criteria established by regulatory agencies. Local limits are wastewater limitations that apply to commercial and industrial facilities that discharge to a common treatment plant. They are developed to meet the source control program objectives and site-specific needs of the local treatment plant and its receiving waters. The evaluation would consider including additional pollutants of concern (POCs) on North City's list of local limits, and potentially lowering the limit of pollutants already on the list. An annual re-evaluation of the limits may be necessary to ensure compliance with new and evolving regulations for purified water. This evaluation could be done in conjunction with the annual local limits evaluation for Point Loma.

North City Water Reclamation Plant

North City would be a key component of a reservoir augmentation project at San Vicente Reservoir, providing conventional wastewater and tertiary water treatment technologies to water feeding the AWP facility. North City has been operating since 1997, and has a current design capacity of 30 mgd based on an annual average daily inflow rate; however, North City was master-planned for expansion to 45 mgd (City of San Diego 2012b). The IAP noted that North City already has complex reliability features, including conservative operating criteria and flow equalization, to support a reservoir augmentation project at San Vicente Reservoir.

North City is an existing facility that would serve as a key component of a full-scale reservoir augmentation project by providing recycled water to a full-scale AWP Facility.

No physical modification would be necessary for North City as part of a reservoir augmentation project at San Vicente Reservoir, although some operational adjustments could be made, including use of different chemicals and adjustment of certain operating procedures to complement the operation and performance of the full-scale AWP facility.

Full-Scale Advanced Water Purification Facility

As explained in Section B, Advanced Water Purification Facility, the City operated the AWP Facility for one year, producing one mgd of purified water using the same process components that would be used in a full-scale AWP facility. Operating the AWP Facility enabled the City to identify recommendations for design of a full-scale AWP facility (CDM Smith and MWH, 2013a). The full-scale components and design considerations identified as part of the Demonstration Project are summarized below.

Facility Components

The full-scale AWP facility would include the same general process components as the AWP Facility, as well as additional components necessary to address water quality and testing results from the AWP Facility. Table F-1 identifies the necessary full-scale AWP facility components and identifies which components were demonstrated at the one-mgd AWP Facility.

Production Capacity

An analysis was conducted to define an initial capacity for the full-scale AWP facility. That analysis evaluated the overall capacity of North City and recycled water availability considering existing irrigation and industrial users. Due to the seasonal variation in demand from existing recycled water users (more irrigation demand occurs in the summer months), more purified water would be available to augment San Vicente Reservoir during winter months. The initial full-scale AWP facility production capacity was determined to be 18 mgd. Average production (15 mgd) is expected to be slightly lower than maximum treatment capacity (18 mgd) because production will vary throughout the year due to seasonal fluctuations in recycled water demand and routine maintenance requirements. During periods of low recycled water demand, production would reach full production capacity, while in months of peak recycled water demand, it will be less than capacity, averaging approximately 15 mgd on a year-round basis.

Based on the full-scale capacity analysis, preliminary design criteria were developed for an 18-mgd capacity facility. The capital cost estimates presented later in this section are based on an 18-mgd maximum treatment capacity, because the infrastructure needs to be sized to be capable of delivering the maximum production of 18 mgd. The operations and maintenance (O&M) cost estimates are based on an annual average production of 15 mgd, because this is the average expected production for which annual, ongoing expenses will be incurred.

This production capacity analysis is summarized in the Full-Scale Reservoir Augmentation Capacity Analysis Technical Memorandum (RMC, 2011). The City updated this technical memorandum in January 2013.

Site Location and Layout

The full-scale AWP facility would be located on 10.3 acres of vacant City-owned property immediately north of North City. The site layout for the full-scale AWP facility was developed to locate the administrative building on the south side of the facility for visitor access. Process areas not enclosed in a building would be installed under canopies. A pipe gallery/access tunnel would be provided under Eastgate Mall Road, connecting North City to the full-scale AWP facility just west of the guard shack. Figure F-3 presents the preliminary site layout and location for the full-scale AWP facility.

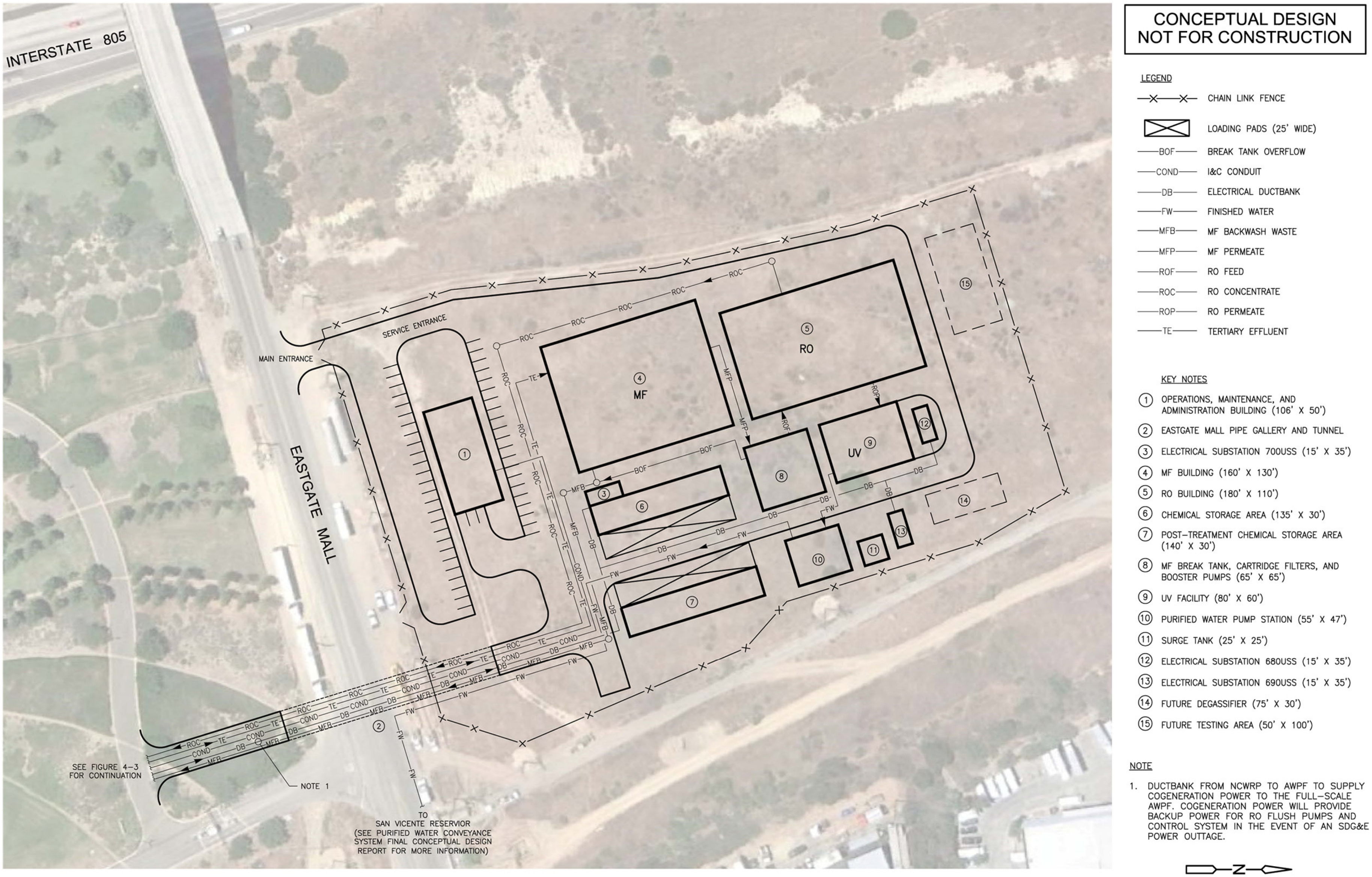
Table F - 1: Full-Scale AWP Facility Components

Full-Scale AWP Facility Component	Demonstrated at 1- mgd AWP Facility?	Purpose
Pump station to send North City water to the full-scale AWP facility	No	A new pump station would need to be constructed to pump water from North City to the full-scale AWP facility site.
Pre-treatment chemical addition	Yes	Pre-treatment would continue to be applied for the full-scale system to reduce contaminants that may harm the AWP Facility equipment.
Membrane filtration (either microfiltration or ultrafiltration)	Yes	Membrane filtration would continue to be the first stage in the water purification process for the full-scale AWP facility.
Membrane filtration break tank	Yes	A membrane filtration "break tank" would continue to be used to hold water before it is sent to the reverse osmosis system. This will help to stabilize flows.
Reverse osmosis booster pumps	Yes	"Booster pumps," pump stations used to move water from the membrane filtration to the reverse osmosis process, would continue to be used.
Reverse osmosis pre-treatment chemical addition	Yes	Pre-treatment before the reverse osmosis stage would continue to be applied to reduce contaminants that may harm the reverse osmosis membranes.
Cartridge filters	No	Cartridge filters would be added to help protect the reverse osmosis membranes.
Reverse osmosis feed pumps	Yes	"Feed pumps," send water into the reverse osmosis system would continue to be used to directly control the pressure of water entering the reverse osmosis system.
Reverse osmosis system	Yes	A reverse osmosis system would continue to be the secondary and main stage in the water purification process for the full-scale AWP facility.
UV disinfection/advanced oxidation using UV light with hydrogen peroxide	Yes	An UV disinfection/advanced oxidation system would continue to be the third and final stage in the water purification process for the full-scale AWP facility.
Post-treatment/ stabilization chemical addition	No	Post-treatment would be added for the full-scale AWP facility system. This step will include adding treatment chemicals to stabilize the purified water and ensure that it does not have corrosive properties that could potentially damage the conveyance pipeline to San Vicente Reservoir.
Purified water pump station	No	A purified water pump station would be added to transport purified water from the full-scale AWP facility to San Vicente Reservoir.
Operations Center	No	An operations center building would be added to conduct necessary operations and testing procedures for the full-scale AWP facility.

Footnotes:

1. Yes indicates the component was demonstrated by the AWP Facility. No indicates that, while not demonstrated by the AWP Facility, the component would be necessary for a full-scale facility.

Figure F - 3: Preliminary Layout and Location for the Full-Scale AWP Facility



System Controls, Reliability, and Redundancy

North City treats wastewater flows that would otherwise be treated at Point Loma. Flows to North City can be diverted to Point Loma, allowing North City to be shut down or taken "offline" any time. Point Loma can therefore serve as a back-up system, where flows can be sent from the North City service area when needed. The full-scale AWP facility would be able to be taken offline by halting delivery of recycled water from North City. Although the full-scale AWP facility would have the ability to be shut down at any time, facility design would need to include standard redundancy features that would allow the full-scale AWP facility to continue to operate at its optimal capacity when a particular process unit was offline for maintenance or cleaning.

Continuous monitoring and the ability to immediately shut down the full-scale AWP facility are critical components of the overall reliability of water purification processes. Instrumentation and automation would be provided to continuously verify that processes are operating as expected. The control system would include electronic monitoring that would automatically shut down the facility if a problem was detected. This would prevent water that does not meet the water quality requirements from being introduced into San Vicente Reservoir. Manual checks would also be performed on each system to identify operational trends and detect anomalies that require attention. These electronic systems controls and manual procedures, together with critical control point monitoring (see Section B, Advanced Water Purification Facility), would assure that only the highest quality water leaves the full-scale AWP facility.

Pipeline System Components

The City's Water Repurification Project efforts in the 1990s generated a conceptual pipeline (conveyance) system for a reservoir augmentation project that would convey purified water from North City to San Vicente Reservoir. However, because conditions have changed substantially since the Water Repurification Project was completed, a new conveyance study was required to analyze how water could be conveyed from the full-scale AWP facility (North City) to San Vicente Reservoir. In 2012, a conceptual design study was completed to update recommendations for the purified water conveyance system, including potential pipeline alignments and pump station specifications (RMC, 2012). The new conveyance study also comprehensively analyzed conditions that have changed since the Water Repurification Project was completed. In addition, the conceptual design provided estimates of the associated capital and operations and maintenance costs for the pipeline system components.

Components of the purified water pipeline system would include:

- Purified water pump station
- Purified water pipeline
- Reservoir inlet structure

An overview of the findings from the conceptual design study, including potential pipeline alignments and operational features of the pipeline and purified water pump station, are provided below.

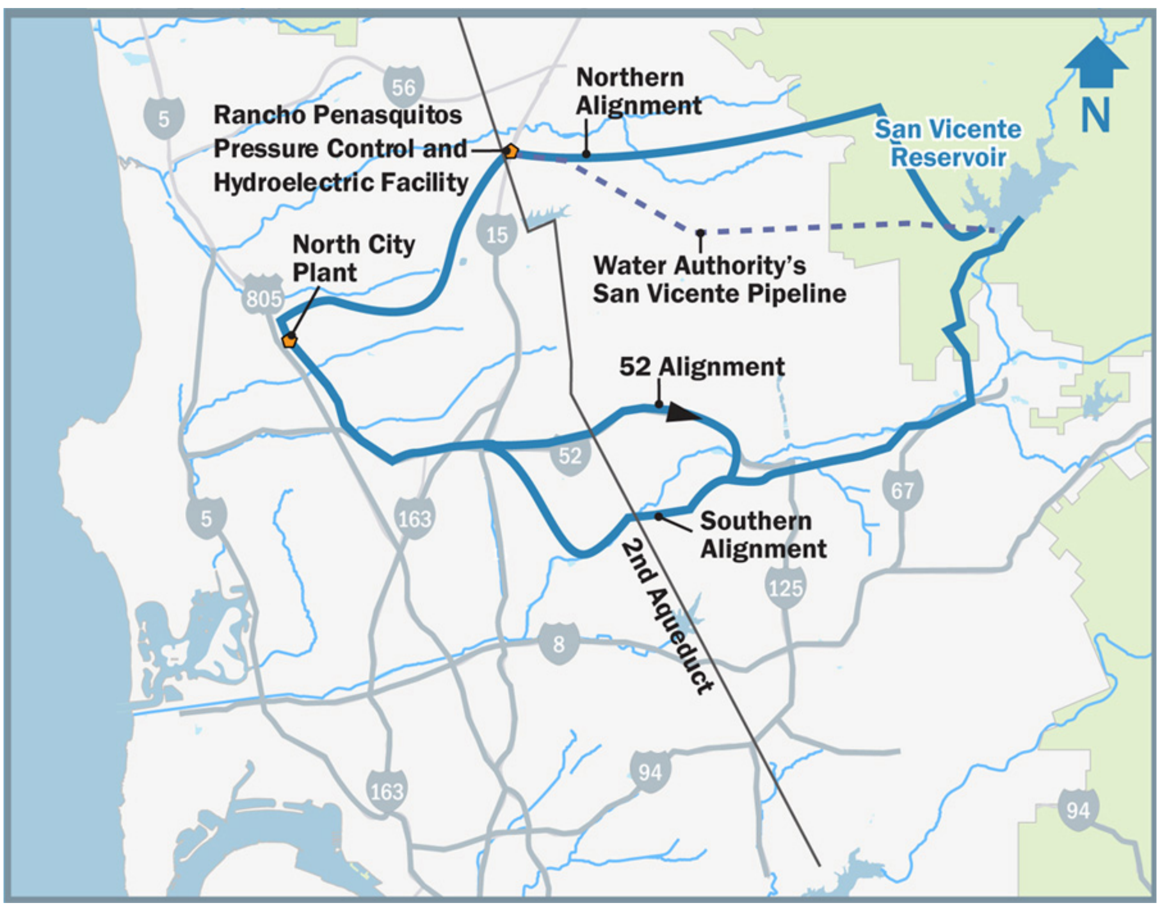
Purified Water Pump Station

A new pump station would be required at the full-scale AWP facility to transport purified water through the pipeline to San Vicente Reservoir. The capacity of this pump station would match the operating range of the AWP facility, with the potential to expand as necessary. Preliminary recommendations for pump types and clear well capacity (needed to counterbalance AWP facility production and pump station operation) were also provided in the conveyance conceptual design study.

Purified Water Pipeline

A series of alternative pipeline alignments to convey purified water from the full-scale AWP facility to San Vicente Reservoir were evaluated. These alignments are described below, and the potential location of these alignments is illustrated in Figure F-4.

Figure F - 4: Potential Purified Water Pipeline Alignments



Northerly Alignments

Two northerly alignments were considered to transport purified water to San Vicente Reservoir, referred to as the northern alignment and the San Vicente Pipeline alignment. The northern alignment, originally evaluated during the Water Repurification Project, is approximately 24 miles long, and follows city streets from North City to the Water Authority's Rancho Peñasquitos

Pressure Control and Hydroelectric facility, which is adjacent to the Second Aqueduct near Mercy Road and Black Mountain. From there, the alignment travels along Pomerado Road to Spring Canyon Road to Scripps Poway Parkway, then south along Highway 67, with a purified water inlet structure near the First Aqueduct inlet structure at San Vicente Reservoir. The close proximity of the purified water inlet to the First Aqueduct inlet structure could pose a challenge, as it would reduce reservoir retention time and blending, which are required to satisfy regulatory requirements. The alignment also traverses challenging terrain, and an encroachment permit would be required from Caltrans to place the pipe in the Highway 67 right-of-way. This alignment should be studied further in the preliminary design phase.

San Vicente Pipeline Alignment

The second northern alignment, the San Vicente Pipeline, is a connection to an existing pipeline that is operated by the Water Authority as part of the region's Emergency Storage Project. The Emergency Storage Project was implemented to connect a network of reservoirs, pipelines, and other facilities that can be used to store and move water throughout the San Diego region in the event of a natural disaster such as an earthquake or drought. The San Vicente Pipeline is 11 miles in length, and connects the Second Aqueduct, which supplies imported water to the west side of San Diego County, to San Vicente Reservoir. Due to the proximity of the San Vicente Pipeline to North City, the fact that it connects to San Vicente Reservoir, and the expected limited use of this pipeline (expected to be used primarily under emergency conditions), this pipeline was considered as a potential pipeline option for a reservoir augmentation project at San Vicente Reservoir. Approximately 10 miles of new pipeline would be needed to connect to the existing 11-mile San Vicente Pipeline.

Through meetings with the Water Authority, it was determined that the San Vicente Pipeline not only conveys water to San Vicente Reservoir, but is also used to convey water directly to the Morena Pipeline and Helix Water District Pipeline, both of which supply imported water directly to the Helix Water District's Levy Water Treatment Plant. Due to this direct connection to the Levy Water Treatment Plant (lacking an environmental buffer), use of the San Vicente Pipeline to convey purified water to San Vicente Reservoir could not be considered during the Demonstration Project.

It is recognized that, should the Water Authority and Helix Water District make other arrangements to transport water from the Second Aqueduct to the Levy Water Treatment Plant, a purified water conveyance strategy including the San Vicente Pipeline could be feasible from a regulatory standpoint. Should the City decide to proceed with a full-scale project, it is recommended that this option be further explored. Further, in the event that regulatory conditions change such that an environmental buffer is no longer required between a purified water source and a drinking water system, use of the San Vicente Pipeline could become feasible from a regulatory perspective.

Southerly Alignments

Purified water conveyance research conducted during the Water Repurification Project in the 1990s focused primarily on a southerly alignment. This alignment included use of the existing recycled water pipeline serving the Metropolitan Biosolids Center and other customers to the southeast of

North City. In addition, it relied on a longitudinal encroachment of a Caltrans right-of-way along State Route 52 (SR-52) and construction of a pipeline along Mast Boulevard in the Santee area. This alignment was re-evaluated as part of the Demonstration Project. Significant changes have occurred along this pipeline alignment since the 1990s. As a result of these changes, the City investigated two alternative southerly alignments for a purified water pipeline: the original approximately 22-mile alignment, including a SR-52 encroachment, and an approximately 23-mile alternative alignment through Mission Gorge that avoids SR-52. Based on the updated analysis conducted as part of the Demonstration Project, a southerly alignment appears to provide the best opportunity to convey purified water from North City to San Vicente Reservoir. Consequently, the cost estimate presented in the following section is representative of a southerly alignment. At the current level of planning and cost estimation, there is no appreciable difference in costs between the two southerly alignments.

Construction Impacts

Construction along any of the potential alignments would require stream crossings and analyses of adjacent native habitat and cultural resources. In addition, construction could potentially generate traffic, noise, and other environmental impacts, depending on its location and magnitude. Moving forward, additional environmental analyses will be required to determine specific features of each alignment such as potential impacts to biological, cultural, and other resources, which would make one alternative superior over the other from an environmental impact point of view.

Pipeline Draining

CDPH would require that purified water from a full-scale AWP facility be captured and prevented from entering San Vicente Reservoir in the unlikely event of a problem at the full-scale AWP facility. The pipeline transporting purified water to the reservoir would be generally on an uphill slope, facilitating the capture and diversion of flows away from San Vicente Reservoir if necessary. In a reservoir augmentation project at San Vicente Reservoir, drain lines would be included in the pipeline system design to enable off-specification flows to be diverted to local sewer systems. Along a southern alignment, this reliability feature would require the diversion of flows to both Santee and San Diego sewer systems.

Purified Water Inlet Structure

The purified water inlet structure would enable purified water to be released from the conveyance pipeline into San Vicente Reservoir. The inlet structure would be positioned at an elevation that would always remain above the surface of the water in the reservoir, and it would include a spillway. Engineering studies conducted in the 1990s provided a preliminary design for this inlet structure, which was reviewed as part of the Demonstration Project. This inlet structure is still feasible.

A series of purified water inlet locations were studied as part of the Reservoir Study conducted by Flow Science (refer to Section C, San Vicente Reservoir Study for more information). While all locations studied were determined to meet regulatory requirements for blending and travel time, a conservative location on the southeast edge of the reservoir (the Design Purified Water Inlet Location) was used as the basis for estimating conveyance pipeline costs.

AWP Facility and Pipeline System Costs

AWP facility and pipeline system costs were evaluated in terms of overall capital and O&M costs; unit costs, which reflect the capital and O&M costs spread over the project life and presented in terms of cost per AF of water produced; and effects on an average monthly household water bill. Avoided wastewater system costs were also quantified. These costs are described below.

Capital and O&M Costs

Capital and O&M costs for the AWP facility and purified water pipeline system are presented in Tables F-2 and F-3, respectively. These cost estimates were based on preliminary facility engineering, and would be updated during final design should the City decide to move forward with a full-scale project. Costs for the purified water pipeline system were developed as part of the Conveyance Conceptual Design Study, and costs for the full-scale AWP facility were developed as part of the Advanced Water Purification Facility Study (CDM Smith and MWH, 2013a). Total capital costs for a reservoir augmentation project at San Vicente Reservoir are estimated to be approximately $369 million, with O&M costs estimated to be $15.5 million per year.

Table F - 2: AWP Facility and Purified Water Pipeline System Preliminary Capital Cost Estimate

Parameter	Capital Cost[1]
AWP Facility Construction Costs	
AWP Facility Influent Pump Station	$2,800,000
Site Civil/Yard Piping	$5,800,000
Operations, Maintenance, and Administration Building	$1,600,000
Membrane Filtration Break Tank and Pump Station	$4,000,000
Chemical Storage Area #1 (Pre-Treatment Chemical Facility)	$2,400,000
Membrane Filtration Facility	$25,300,000
Reverse Osmosis Facility	$21,300,000
UV Disinfection and Advanced Oxidation System	$9,900,000
Chemical Storage Area #2 (Post-Treatment Chemical Facility)	$2,100,000
AWP Facility Construction Subtotal	**$75,200,000**
Contingency (30% of Construction Total)	$22,600,000
Insurance, Bonds, Overhead & Profit	$12,700,000
AWP Facility Construction Total	***$110,500,000***
AWP Facility Implementation Costs	
Engineering & Pre-Construction (20% of Total Construction Cost)[2]	$22,100,000
Environmental Documentation and Mitigation	$1,000,000
Construction Management (10% of Total Construction Cost)	$11,100,000
AWP Facility Implementation Total	***$34,200,000***
Total AWP Facility Capital Cost (Construction Total + Implementation Total)	**$144,700,000**
Purified Water Pipeline System Construction Costs	
Purified Water Pump Station	$8,000,000
Purified Water Pipeline	$114,200,000
Pipeline System Construction Total	***$122,200,000***
Pipeline System Implementation Costs	
Contingency (30% of Construction Total)	$36,700,000
Engineering & Construction Management (30% of Construction Total)[2]	$36,700,000
Environmental Documentation and Mitigation	$24,400,000
Land Acquisition	$4,500,000
Pipeline System Implementation Total	***$102,300,000***
Total Pipeline System Capital Cost (Construction & Implementation)	**$224,500,000**
Total Capital Cost (Construction + Implementation + Source Control)	**$369,200,000**

1. Costs for the purified water pipeline system were developed as part of the conveyance conceptual design study, and costs for the full-scale AWP facility were developed as part of the Advanced Water Purification Facility Study (CDM Smith and MWH, 2013a).
2. Includes costs associated with regulatory compliance and permitting.

Table F - 3: AWP Facility and Purified Water Pipeline System Preliminary O&M Cost Estimate

Parameter	Annual O&M Cost[1]
Power Costs	
AWP Facility Influent Pump Station	$306,000
Membrane Filtration System	$43,000
Reverse Osmosis System	$1,614,000
UV Disinfection and Advanced Oxidation System	$185,000
Miscellaneous Equipment	$7,000
Buildings	$481,000
Purified Water Pump Station	$1,657,000
Power Costs – Subtotal	***$4,293,000***
Chemical Costs	
Membrane Filtration Pretreatment	$223,000
Reverse Osmosis Pretreatment	$431,000
Hydrogen Peroxide for Advanced Oxidation	$216,000
Post Treatment	$358,000
Membrane Cleaning	$103,000
Chemical Costs – Subtotal	***$1,331,000***
Replacement of Consumables	
Membrane Filtration Membranes	$441,000
Reverse Osmosis Cartridge Filters and Reverse Osmosis Membranes	$319,000
UV Lamps and Ballasts	$281,000
Replacement of Consumables – Subtotal	***$1,041,000***
AWP Facility Maintenance Costs	***$1,409,000***
Treatment at North City to Support AWP Facility[2]	***$3,965,000***
Purified Water Pump Station Maintenance Costs	***$228,000***
Purified Water Pipeline Maintenance Costs	***$1,500,000***
Other Annual Costs (Compliance Testing and Security)	$310,000
Annual Labor Costs	$1,418,000
Total Annual O&M Cost	**$15,495,000**

1. Costs for the purified water pipeline system were developed as part of the conveyance conceptual design study, and costs for the full-scale AWP facility were developed as part of the Advanced Water Purification Facility Study (CDM Smith and MWH, 2013a).
2. Cost to increase North City tertiary water production above what is needed to meet non-potable recycled water demands.

Auxiliary Program Costs

Additional auxiliary program costs to support a full-scale project are presented in Table F-4. These cost estimates were based on preliminary cost estimates for a source control program and a public outreach program. Costs for the Source Control Program were developed as part of the Enhanced Source Control Plan for the Full-Scale Advanced Water Purification Facility Technical Memorandum (RMC, 2013).

Table F - 4: Auxiliary Program Cost Estimate

Parameter	Auxiliary Cost
Auxiliary Upfront Cost	
Source Control Program Upfront Cost[1]	$500,000
Auxiliary Annual Cost	
Source Control Program Annual Costs[2]	$50,000
Public Outreach Annual Program Costs[3]	$700,000

1. Source control upfront costs include a chemical inventory program and GIS tracking database (approximately $50,000), a pollutant prioritization program to be completed by existing City staff (approximately $50,000 for initial set-up work), and a local limits evaluation for North City (approximately $400,000). For additional information on source control program costs, refer to the Enhanced Source Control Plan for the Full-Scale Advanced Water Purification Facility Technical Memorandum (RMC, 2013).
2. Source control annual costs include $25,000/yr for annual updates to the chemical inventory program and GIS tracking database, an average of $10,000/yr for periodic updates to the pollutant prioritization program, and $15,000/yr, on average, for updates to the local limits analysis. For additional information on source control program costs, refer to the Enhanced Source Control Plan for the Full-Scale Advanced Water Purification Facility Technical Memorandum (RMC, 2013).
3. Public outreach annual costs include initial start-up of outreach efforts. Annual public outreach costs will be scaled back following full-scale reservoir augmentation project operations.

Unit Costs

A net present value analysis was performed on the capital and O&M costs presented above. Based on this analysis, the unit cost of a reservoir augmentation project as San Vicente Reservoir would be approximately $2,000/AF, as shown in Table F-5. Key assumptions of this analysis included:

- The project life is 50 years.
- Financing would be received through rates, revenue bonds, and State Revolving Funds.
- The Water Authority's Local Resource Program (LRP) credits would continue. The uncertain future of these credits was addressed by applying a credit that reflects a midpoint between favorable and unfavorable conditions. Under favorable conditions, the credit is expected to be $450/AF of water produced, while under unfavorable conditions it is expected to be $100/AF. The average of $275/AF was used in estimating the overall cost of reservoir augmentation.
- Grant funding in the amount of 20 percent of capital costs would be received. Such grants are typical for water recycling projects.

Table F - 5: Projected Unit Costs

Project Component	Projected Unit Cost[1]
AWP Facility	$1200/AF
Purified Water Pipeline System	$700/AF
Source Control	$50/AF
Public Outreach	$50/AF
Total	$2,000/AF

1. Assumes a project life of 50 years, financing through both revenue bonds and State Revolving Funds, LRP credits of $275 / AF, and grant funding in the amount of 20% of capital costs.

The projected unit cost of $2,000/AF is consistent with projections developed for the Indirect Potable Reuse - Phase I project evaluated in development of the 2012 LRWRP, which was estimated to cost approximately $2,100/AF, including initial capital and annual operating costs (including energy). A key difference between the costs developed for the LRWRP and the costs presented in this Project Report is that the LRWRP costs do not reflect any potential grant funding or low-interest loans. Neither the costs developed for this study nor the LRWRP costs reflect any cost savings from reduced wastewater treatment and disposal (see Avoided Wastewater Costs section, below).

Household Water Bill

The anticipated effect of a reservoir augmentation project at San Vicente Reservoir on an average monthly household water bill was also calculated. Assuming an average residential usage volume of 14 hundred cubic feet per month, an average untreated water supply cost to the City of approximately $962/AF, and an average total water use of approximately 194,000 AFY, a reservoir augmentation project at San Vicente Reservoir with an average flow of 15 mgd and a unit cost of $2,000/AF would result in an increase of approximately $6.87 per month on an average residential water bill. For comparison, the average residential water bill (fiscal year 2012-2013) was approximately $72.03 per monthly billing cycle (water charges only).

This projected increase does not take into consideration projected increases in monthly water bills expected as the result of increasing imported water supply costs that would occur with or without a reservoir augmentation project at San Vicente Reservoir. It should also be recognized that such a project would provide value to the customer in increased supply reliability and reduced reliance on imported water.

Avoided Costs

The implementation of a reservoir augmentation project at San Vicente Reservoir would result in avoided wastewater system costs, as well as savings related to reduced salinity in the City's water supplies. Avoided wastewater system costs result from the elimination of costly capital improvement needs and in reduced operations and maintenance costs. In order to determine what capital improvements could be avoided as a result of implementing full-scale reservoir augmentation, the

September 2011 Metro Wastewater Plan (Plan) was referenced. The facility requirements described in the Plan correspond to Point Loma remaining a chemically-enhanced primary treatment plant. There are several projects included in the Plan's long-term capital program. Among these projects is the construction of a seven-million-gallon wet weather storage facility that would be needed to attenuate flows to Point Loma. In the absence of full-scale reservoir augmentation, this facility would need to be operational by the year 2022. Its estimated capital and operating costs are \$123 million and \$6.2 million per year, respectively.

Implementation of a reservoir augmentation project at San Vicente Reservoir would also reduce the flows conveyed to and treated at Point Loma. Annual operations and maintenance savings related to reduced treatment and conveyance, respectively, are approximately \$2.2 million and \$450,000 per year.

The TDS (a measure of salt content) of purified water produced at the AWP Facility was approximately 15 mg/L. This is in contrast to imported water TDS, which is approximately 500 mg/L and has occasionally exceeded 600 mg/L (City of San Diego, 2012a, City of San Diego, 2012g). The estimated monetary savings to a drinking water system due to reduced salinity was evaluated by MWD and the Bureau of Reclamation in the late 1990s. They found that reduced salinity correlates with longer useful lives of downstream treatment facilities. Savings related to the extended lives of retail customers' plumbing fixtures would also be expected. The savings associated with reduced salinity were further evaluated in Water Reuse Study (City of San Diego, March 2006) specifically for the City's setting and determined to equal \$250/AF. The Recycled Water Study (City of San Diego, July 2012) re-evaluated the savings and conservatively applied \$100/AF in its financial analysis. While it is anticipated that salt reduction benefits would be observed as a result of a reservoir augmentation project at San Vicente Reservoir, this benefit has not been analyzed as part of the Demonstration Project, and has not been monetized.

These avoided costs, summarized in Table F-6, yield an associated net unit cost of \$1,000/AF.

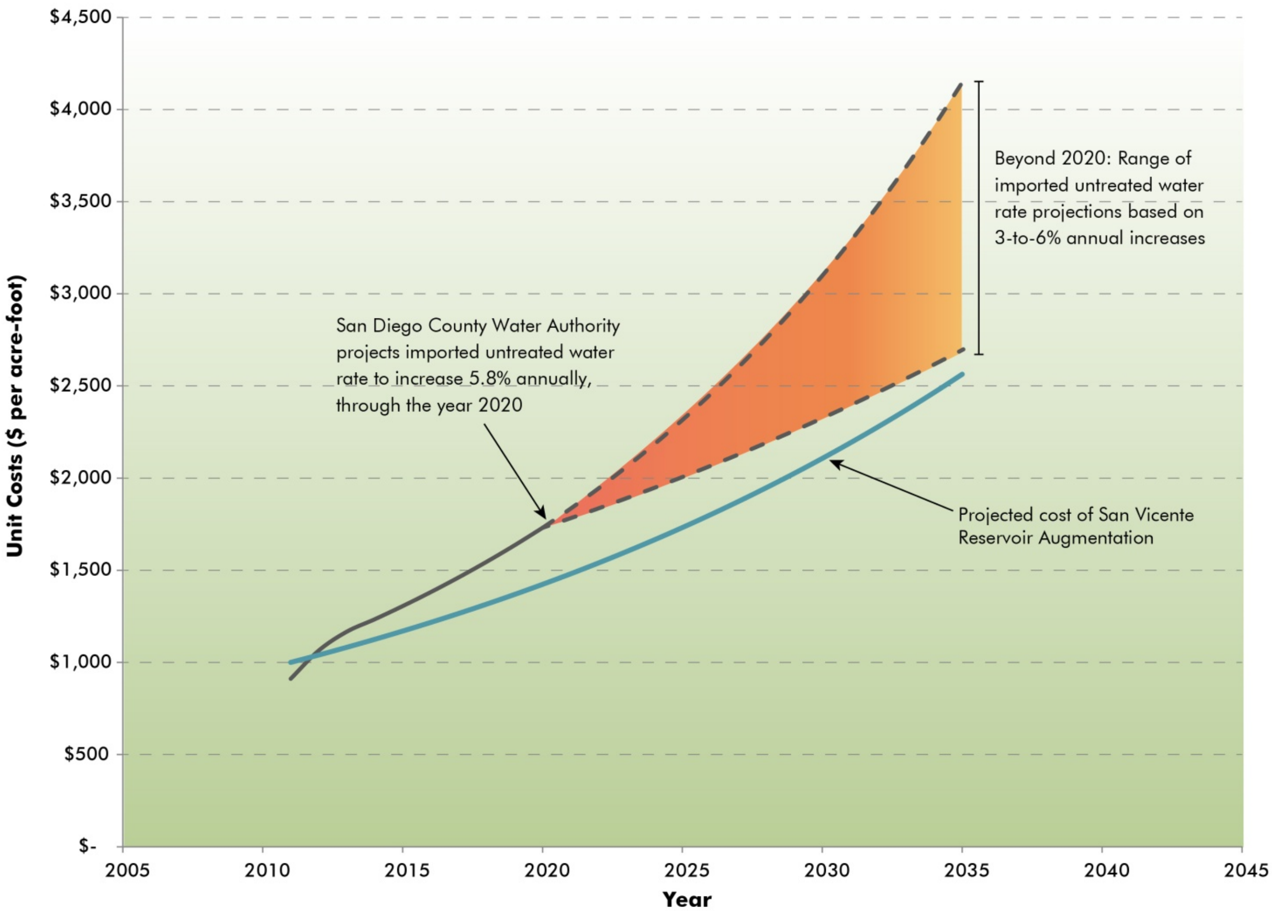
Table F - 6: Avoided System Costs

Benefit	Avoided Cost	Avoided Cost per AF
Point Loma Wet Weather Storage Facility	\$123,000,000 (Capital) \$6,150,000 (Annual O&M)	\$1,000
Reduced Treatment at Point Loma	\$2,200,000 (Annual O&M)	
Reduced Pumping at Pump Stations No. 2	\$450,000 (Annual O&M)	
Reduced Salinity in Water Supplies		Not monetized
Total Avoided Costs/Savings		\$1,000

The current cost of untreated imported water as of January 2013 is \$1,039/AF. Imported water costs are expected to increase at a rate of 5.8 percent per year through 2020, and between three and six percent per year after 2020. Figure F-5 presents the current and projected cost of imported water compared to the net cost of water from a reservoir augmentation project at San Vicente Reservoir.

As shown in this figure, the unit cost of imported water supplies exceeds the net unit cost of supplies from a reservoir augmentation project at San Vicente Reservoir.

Figure F - 5: Current and Projected Cost of Water Supplies



For additional cost information, please refer to Section 8.4 of the City of San Diego Recycled Water Study (City of San Diego, 2012b), provided in Appendix G.

Energy

An energy analysis requested by City Council for water supply options will be completed by the consultant preparing the City's 2012 LRWRP. The report is anticipated to be submitted for City Council review and acceptance in early 2013.

Because no single water supply option can meet all goals of the 2012 LRWRP, a range of options (including conservation, groundwater, non-potable reuse, reservoir augmentation, rainwater, gray water, ocean desalination, and imported water) was considered to form eight portfolios and diversify the approach to meet the objective of the plan. Over 20 performance measures were used to comprehensively evaluate each portfolio, which were ranked in terms of their cumulative performance.

Based on these rankings, and their climate change adaptation benefits, three portfolios consistently ranked highest. All three of these highest ranked portfolios included reservoir augmentation at San Vicente Reservoir as a common resource option. The inclusion of a full-scale (15-mgd average flow) reservoir augmentation project as a resource option in all three of the highest ranked portfolios is significant because, if approved by the public, City Council and CDPH, reservoir augmentation at San Vicente Reservoir would be validated based on cost, energy footprint, and other criteria as a recommended near term resource strategy.

One quantitative performance measure for "energy footprint" of the City's water sources is the cumulative carbon dioxide emissions. Energy use can be illustrated by kWh /AF or tons of carbon dioxide emissions per AF. Reporting of greenhouse gas emissions (of which carbon dioxide is considered the largest, or primary component) by major source is required by the California Global Warming Solutions Act (AB 32, 2006). The City's reliance on imported water that originates hundreds of miles away and requires energy-intensive pumping contributes significantly to greenhouse gas emissions.

Greenhouse gas emissions are calculated based on typical per unit energy requirements for each source of water supply, including energy requirements for distribution and wastewater treatment if applicable. The energy (kWh/AF) of each water supply option in the 2012 LRWRP was converted to carbon dioxide equivalents (San Diego, 2012c). Carbon dioxide emissions are a reflection of the energy required to produce water, not the type of energy used, for each water resource. While imported water sources have different sources of energy than local water resources, it is assumed that all water resources use the same energy resource for simplicity.

The 15-mgd reservoir augmentation project at San Vicente Reservoir (estimated to require 2,500 kWh of energy per AF) would produce approximately 1.0 metric tons of greenhouse gases/AF. By comparison, imported water requires a range of 2,000 kWh/AF to 3,300 kWh/AF of energy, depending on the blend of water from the Colorado River or the Bay-Delta in Northern California, respectively. This corresponds to a range of 0.8 to 1.3 metric tons of greenhouse gases/AF (City of San Diego, 2012c). Since 2003, the blend delivered to the Water Authority has averaged approximately two-thirds Colorado River and one-third water from the Bay-Delta. Future imported water energy consumption will vary depending on actual blend. However, for practical purposes, the reservoir augmentation project at San Vicente Reservoir energy consumption is equivalent to that of imported water.

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Section G: Summary and Conclusions

In an average year, approximately 85 to 90 percent of the City of San Diego's water supplies are imported water (City of San Diego, 2011a). Imported water reliability issues, coupled with recurring droughts in the San Diego region, have placed considerable strain on the City's ability to meet water demands. The City has taken a variety of actions to maximize water resources and improve water supply reliability, including moving forward with a three-phased Water Reuse Program designed to maximize the use of recycled water throughout the City. The Water Reuse Program is an integral component of the City's plan to improve water supply reliability by developing local, drought-tolerant water supplies.

The City's 2006 Water Reuse Study (Phase 1 of the Water Reuse Program) included a comprehensive evaluation of all viable options to maximize the use of recycled water produced by the City's two water reclamation plants. Based on this study, a stakeholder group determined that the preferred option for maximizing use of the City's recycled water supply would be to augment existing supplies in the City's San Vicente Reservoir with purified water (reservoir augmentation at San Vicente Reservoir).

The City recently completed Phase 2 of the Water Reuse Program, the Water Purification Demonstration Project. This three-year project assessed the feasibility of supplementing San Diego's San Vicente Reservoir with purified water produced at an advanced water purification facility located at North City. The Demonstration Project involved constructing and operating a small-scale advanced water purification facility, studying San Vicente Reservoir, implementing a public outreach and education program, coordinating with regulatory agencies, and developing conceptual design criteria and costs for a full-scale AWP facility and purified water conveyance facilities. The concept of using purified water to augment San Vicente Reservoir has been determined to be feasible, and the Mayor and City Council may consider implementing a full-scale reservoir augmentation project at San Vicente Reservoir, which would be Phase 3 of the Water Reuse Program.

The Demonstration Project consisted of the following components:

1. Convene an Independent Advisory Panel
2. Design, install, and operate a demonstration-scale advanced water purification facility at the North City Water Reclamation Plant
3. Conduct a study of San Vicente Reservoir to establish residence time and water quality parameters and conditions of purified water in the reservoir
4. Perform an energy and economic analysis

5. Define the state's regulatory requirements for a full-scale reservoir augmentation project at San Vicente Reservoir
6. Perform a pipeline alignment study
7. Conduct a public outreach and education program

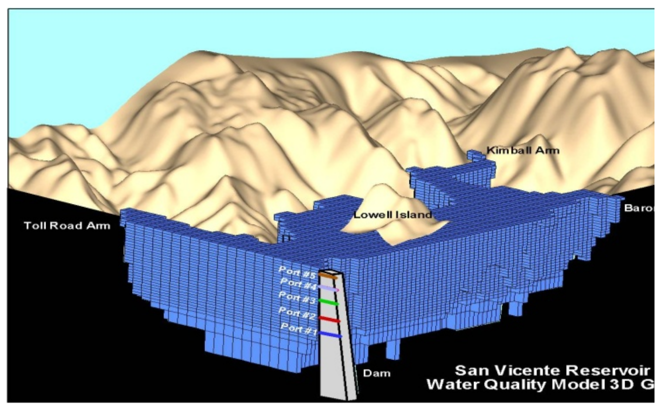
The Demonstration Project generated a significant body of data related to the expected performance of a full-scale reservoir augmentation project at San Vicente Reservoir. Each Demonstration Project component was designed to generate evidence and findings to assess the feasibility of such a project. Each of these components is summarized below.

- ***Component: Convene an Independent Advisory Panel.*** An IAP organized and managed by NWRI was convened in 2009 to oversee the Demonstration Project. The IAP consisted of ten academics and professionals with extensive expertise in the science of water reuse, including water and wastewater technology, public health, epidemiology, toxicology, water quality, environmental science, limnology, public utilities, and industry regulations. The IAP unanimously concluded that the project will "…be a landmark development in the acceptance and furtherance of indirect potable reuse and will contribute to the City of San Diego's water portfolio. The proposed project will supplement existing sources and provide a greater degree of independence, thus improving the reliability of the existing water supply." The IAP findings can be found in Appendix F.
- ***Component: Design, construct, and operate a demonstration-scale advanced water purification facility at the North City Water Reclamation Plant.*** The AWP Facility was designed, installed, operated, and tested between 2010 and 2012. The ability to produce purified water meeting all regulatory standards was evaluated by performing water quality testing on 12 months of purified water samples produced by the AWP Facility. The AWP Facility produced purified water that reliably met applicable water quality standards, and on-line monitoring confirmed the continuous acceptable performance of water purification technologies. Although the testing period is complete, the AWP Facility has continued to operate for public tours and to gather additional equipment performance data.
- ***Component: Conduct a study of San Vicente Reservoir to establish residence time and water quality effects of purified water in the reservoir.*** A detailed study of San Vicente Reservoir was conducted to establish residence time and water quality effects of purified water in the reservoir. Blending, retention time, and water quality in the reservoir were evaluated by using a robust computer model. The model was set up and applied by an expert team and validated by the IAP. It was

Water quality monitoring showed that purified water met all applicable regulatory standards.

determined that blending and retention of purified water in San Vicente Reservoir would constitute a substantial environmental barrier, sufficient to meet regulatory requirements, and that the addition of purified water would not adversely affect natural reservoir conditions and mixing. The modeling showed that the enlargement of the reservoir will improve nutrient-related water quality issues compared to the historical reservoir, and that adding purified to the enlarged reservoir will not substantially affect these improvements.

- ***Component: Perform an energy and economic analysis.*** Costs were developed based on concept-level facility plans prepared as part of the Demonstration Project and validated based on existing operating projects. Full-scale project implementation costs were estimated to be $2,000/AF, with net costs reduced to approximately $1,000/AF when considering wastewater system avoided costs. A full-scale reservoir augmentation project at San Vicente Reservoir would require approximately the same amount of energy and generate green house gas emissions comparable to imported water, based on an energy analysis conducted as part of the LRWRP.
- ***Component: Define the state's regulatory requirements for a full-scale reservoir augmentation project at San Vicente Reservoir.*** Regulators participated in all IAP meetings and working groups addressing all technical aspects of reservoir augmentation conducted throughout the Demonstration Project. This technical background enabled the regulators to establish specific guidelines and regulatory pathways to permitting a reservoir augmentation project at San Vicente Reservoir. A Concept Approval Letter was issued for the project by CDPH, and the Regional Board issued a Resolution of Support for the reservoir augmentation at San Vicente Reservoir, and a Letter of Concurrence confirming the preferred pathway to permit a full-scale project.



The three-dimensional Water Quality Model Output demonstrated that the addition of purified water would improve nutrient-related water quality issues in San Vicente Reservoir.

- ***Component: Perform a pipeline alignment study.*** In 2012, a conceptual design study was completed to update recommendations for the purified water conveyance system, including potential pipeline alignments and pump station specifications (RMC, 2012). The new conveyance study also comprehensively analyzed conditions that have changed since the Water Repurification Project was completed.
- ***Component: Conduct a public outreach and education program.*** Comprehensive City-wide outreach enabled key stakeholders and interested members of the public to gain an understanding of how purified water offers a technically feasible and reliable supplemental water supply. Recent survey research showed that when provided with information about

the water purification process, respondents strongly or somewhat favor adding recycled water to the local drinking water supply. Feedback from individuals that toured the AWP Facility showed that providing an opportunity to tour the facility increases understanding about water purification.

Overall, the AWP Project achieved its stated objectives, and demonstrated that water purification technology may be feasibly used to produce water that could be sent to San Vicente Reservoir to be available to drinking water treatment plants for distribution as drinking water.

Table G-1 provides the summaries and findings generated throughout the course of the Demonstration Project.

Targeted presentations proved to be a vital component of the outreach program, increasing the public's understanding about water purification and the Demonstration Project.

Table G - 1: Demonstration Project Findings and Conclusions

Component	Summary	Findings
Convene an Independent Advisory Panel	The IAP provided expert peer review of the technical, scientific, and regulatory aspects of the Demonstration Project. The IAP met ten times over the course of the Demonstration Project.	The IAP found that purified water would meet or exceed all drinking water requirements and provide multiple barriers for public health protection; reservoir modeling verified that the reservoir will provide 100-fold dilution of purified water, CDPH and the Regional Board have indicated support for the project, and City staff has implemented an effective public outreach program. The IAP found the AWP Facility produced water of a higher quality than any source available to the City of San Diego and unanimously concluded that a reservoir augmentation project at San Vicente Reservoir would be a landmark project in the acceptance and furtherance of indirect potable reuse and would improve the reliability of the City of San Diego's water supply portfolio. See IAP reference letter in Appendix F.
Design, install, and operate a demonstration-scale advanced water purification facility at the North City Water Reclamation Plant	The Demonstration AWP Facility has been in operation since June, 2011. The 12-month testing period took place from August 2011 to July 2012. Comprehensive water quality testing included measurements for 342 constituents and parameters before and after each treatment step, and in the imported aqueduct water. A total of more than 9,000 water quality tests were performed.	Water quality of the purified water was compared to regulatory limits, verifying that purified water met all applicable water quality standards. This comprehensive water quality testing showed that the purified water produced at the AWP Facility is pure, approaching distilled water purity. Continuous and daily monitoring of each water purification process can assure the integrity of each treatment step and that only high quality water is produced.

Component	Summary	Findings
Perform a study of San Vicente Reservoir to establish residence time and water quality parameters and conditions of purified water in the reservoir	A detailed Limnology and Reservoir Detention Study of San Vicente Reservoir was conducted to establish residence time and water quality effects of purified water in the reservoir. Blending, retention time, and water quality in the reservoir were evaluated by using a three-dimensional hydrodynamic model.	The addition of purified water into San Vicente Reservoir would not affect natural hydrologic characteristics of the reservoir, seasonal stratification, or mixing. Blending and retention of purified water in the reservoir would constitute a substantial environmental barrier, sufficient to meet regulatory requirements. For all anticipated reservoir operating scenarios and purified water release locations, the reservoir would dilute the purified water by at least a factor of 200 to one. The addition of purified water would not substantially affect water quality in San Vicente Reservoir. The dam raise will improve overall water quality and the addition of purified water will not change these improvements.
Perform an energy and economic analysis	Cost were evaluated for a full-scale reservoir augmentation project at San Vicente Reservoir in terms of overall capital and operational and maintenance costs; unit costs, which reflect the capital and O&M costs spread over the project life and presented in terms of cost per AF of water produced.	The estimated capital and annual operational and maintenance costs for a full-scale reservoir augmentation project at San Vicente Reservoir are $369 million and $15.5 million per year, respectively. This capital and annual costs for a full-scale project yielded an estimated unit cost of $2,000/AF. This unit cost is comparable to the $2,100/AF unit cost estimated in the LRWRP for a full-scale (15 mgd average production) reservoir augmentation project at San Vicente Reservoir.

Component	Summary	Findings
Perform energy and economic analysis, cont'd	As part of the 2012 Long-Range Water Resources Plan, an energy analysis for a reservoir augmentation project at San Vicente Reservoir was performed.	Accounting for wastewater system avoided costs, the estimated net unit cost of a reservoir augmentation project at San Vicente Reservoir is $1,000/AF, which is comparable to the current imported water cost. A full-scale reservoir augmentation project at San Vicente Reservoir was estimated to require 2,500 kWh/AF of energy and would produce approximately 1.0 metric tons of greenhouse gases/AF. A full-scale project would consume energy and produce green house gas emissions that are equivalent to imported water and less than ocean desalination.
Define the state's regulatory requirements for a full-scale reservoir augmentation project at San Vicente Reservoir	Throughout the Demonstration Project the City engaged separately with the California Department of Public Health and the San Diego Regional Water Quality Control Board. In addition, both agencies actively participated in ten IAP meetings.	The California Department of Public Health issued a concept approval of the City's San Vicente Reservoir Augmentation Project. The San Diego Regional Water Quality Control Board, with concurrence from the United States Environmental Protection Agency issued concept approval as well.
Perform a pipeline alignment study	A conceptual design study was completed to update recommendations for the purified water conveyance system, including potential pipeline alignments and pump station specifications.	The estimated capital and annual operational and maintenance costs for the conveyance system are $225 million and $3.4 million, respectively. Updated analysis of the pipeline alignment confirmed that a southerly alignment appears to be the most feasible.

Component	Summary	Findings
Conduct a public outreach and education program	A comprehensive public outreach and education program was conducted throughout the city to educate San Diego's local leaders, stakeholders and residents about the Demonstration Project	Recent research showed that when provided with information about the water purification process, respondents favor use of purified water to supplement local water supply via reservoir augmentation at San Vicente Reservoir. Feedback from individuals that toured the Advanced Water Purification Facility showed that providing an opportunity to tour the facility increases understanding about water purification.

References

Supporting Documents Referenced in this Report

In addition to this Project Report, many technical studies, testing reports, and outreach documents were produced as part of the Demonstration Project. Those documents, which were used as the basis for the Project Report, are listed below for reference. The public may schedule an appointment with the Public Utilities Department for viewing of these documents as well as other project related documents that are not posted on the project website. Due to the size of these documents, the distribution was limited.

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