City of Daly City
Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Studies

EXECUTIVE SUMMARY

FINAL
October 2009

2700 YGNACIO VALLEY ROAD • SUITE 300 • WALNUT CREEK, CALIFORNIA 94598 • (925) 932-1710 • FAX (925) 930-0208

City of Daly City
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Delivery System Expansion Feasibility Studies

EXECUTIVE SUMMARY

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1.0 INTRODUCTION

This report presents the findings and recommendations for the Recycled Water Transmission Main Corridor Study (Corridor Study) and the Feasibility Study for Tertiary Treatment Expansion at the Daly City Wastewater Treatment Plant (Feasibility Study). The corridor study, consisting of three technical memoranda (Appendix A), presents the basis of design for expanding the Daly City recycled water delivery system to serve customers in the Town of Colma and the San Francisco Lake Merced area. In addition to the corridor study, Carollo prepared a treatment feasibility study in 2008 (Appendix B). The feasibility study identified the required treatment facilities to expand the Daly City tertiary treatment capacity to serve the same customers, and concluded that an additional 3.4 mgd of tertiary treatment capacity could be developed at the existing treatment plant site.

2.0 BACKGROUND

The San Francisco Public Utilities Commission (SFPUC), under its Water System Improvement Program (WSIP), is evaluating the feasibility of developing recycled water projects to offset demands on its water supply system. Daly City is also interested in expanding its current recycled water system to maximize available opportunities within the City to reduce potable water demands. The SFPUC serves the San Francisco and Daly City area with surface water from the Hetch-Hetchy system. Daly City operates its own water system in which well water is blended with surface water supplied by the SFPUC. Wells in the Daly City system draw from the Westside Groundwater Basin. The Westside Basin is also being examined by the SFPUC as an emergency water supply during drought conditions. Because of common interests in reducing reliance on the Westside Basin, the SFPUC and Daly City have jointly commissioned this study.

This project would expand the Daly City recycled water system to supply irrigation water to the Town of Colma and to three properties just north of Daly City in San Francisco, on the east side of Lake Merced Boulevard (referred to in this study as the San Francisco Lake Merced area). A schematic of the existing and planned expansion of the recycled water transmission system is presented in Figure ES.1. A preliminary layout of the system is shown in Figure ES.2. Recycled water would be used in Colma to irrigate turf and landscaping at cemeteries, parks, schools, and a golf course. Many of the cemeteries use private wells for their water source. In the San Francisco Lake Merced Area, recycled water would be used to irrigate turf and landscaping at San Francisco State University (SFSU) and for two housing developments: Parkmerced and Lake Merced Hill. The Parkmerced development and SFSU are also interested in year-round use of recycled water for non-

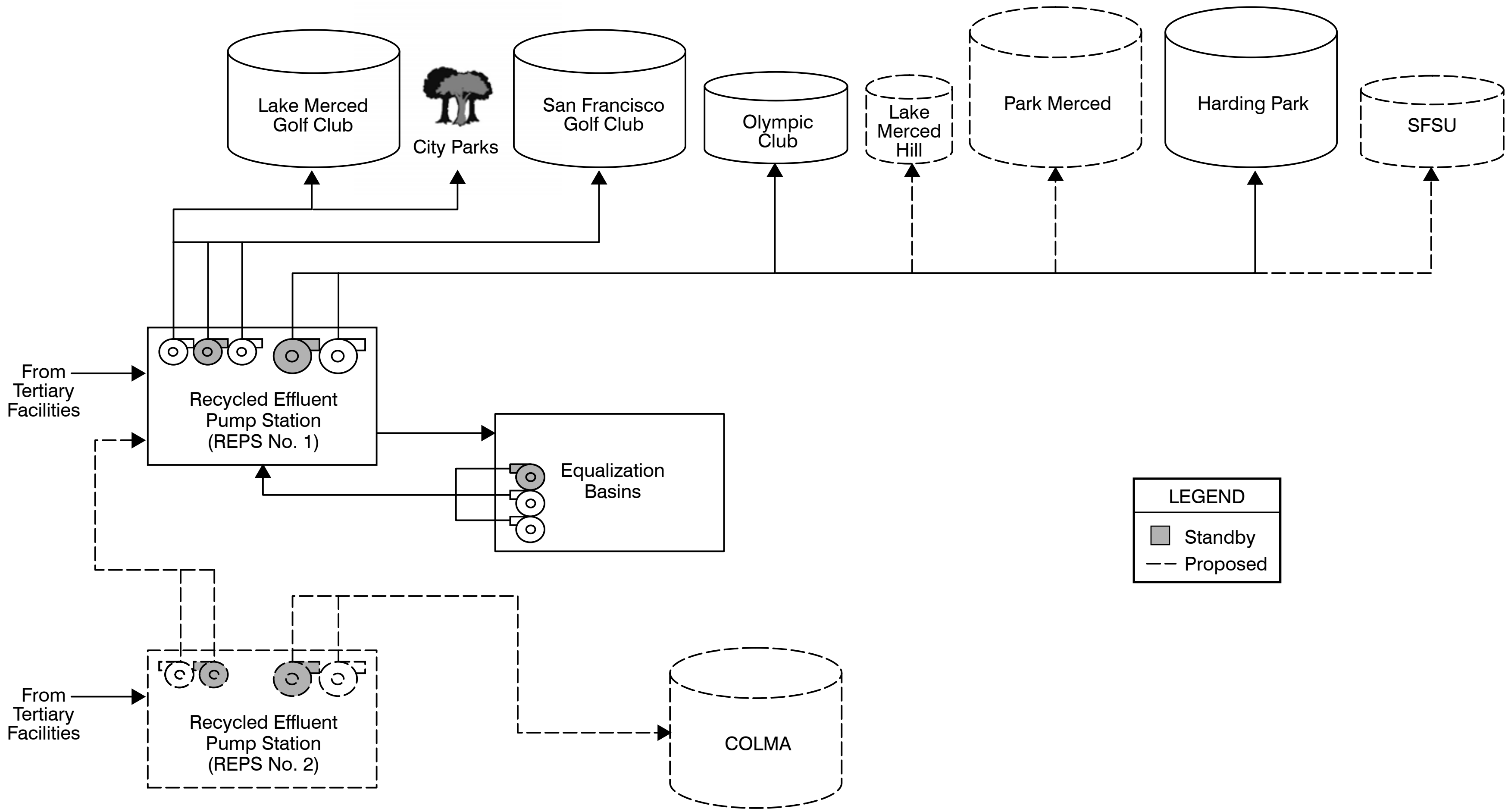

Figure ES.1
REUSE SYSTEM SCHEMATIC
CITY OF DALY CITY
COMBINED RESULTS OF THE RECYCLED WATER TREATMENT AND DELIVERY SYSTEM EXPANSION FEASIBILITY STUDIES

Note:
(1) Harding Park recycled water transmission main is currently in final design.

Figure ES.2
DALY CITY WWTP NSMCSD
RECYCLED WATER DISTRIBUTION
CITY OF DALY CITY
COMBINED RESULTS OF THE RECYCLED WATER TREATMENT AND DELIVERY SYSTEM EXPANSION FEASIBILITY STUDIES

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potable uses (primarily toilet flushing). All three properties currently use treated surface water from the SFPUC.

Daly City currently supplies recycled water to three nearby golf clubs (San Francisco Golf Club, Olympic Club, and Lake Merced Golf Club) as well as city parks and median strips. Recycled water is produced at Daly City's tertiary treatment facility at the permitted rate of up to 2.77 million gallons per day (mgd). The SFPUC and Daly City anticipates extending the Olympic Club transmission main to serve Harding Park Golf Course in San Francisco; construction is scheduled for 2010. The Harding Park project will utilize the remaining capacity of Daly City's recycled water treatment and delivery system. Preliminary estimates indicate that the new customers in Colma and the San Francisco Lake Merced area would require a combined average flow of 2.85 mgd during the irrigation season, and as much as 3.7 mgd during peak demand day. The City's tertiary treatment and recycled water delivery system would need to be expanded to accommodate these additional demands.

3.0 RECYCLED WATER DEMANDS

Recycled water demands were estimated to determine the flow capacity requirements for the treatment system and transmission mains.

3.1 Colma Customers

Potential customers in the Town of Colma include city parks, schools, a golf course, and cemeteries (all are seasonal irrigation demands). As presented in Table ES.1, the collective peak day demand for the Colma customers is 3 mgd. The average demand is estimated to be 1,056 acre-feet per year or 2.3 mgd if spread over an assumed 7-month irrigation period at a constant rate. Storage and distribution infrastructure needs within the Town of Colma were previously identified in the South San Francisco Recycled Water Facility Plan (2009), which was prepared under a separate project by Carollo for the City of South San Francisco.

3.2 San Francisco Lake Merced Area

The recycled water demands for the San Francisco Lake Merced area are presented in Table ES.2. Site constraints would limit the maximum production of the expanded tertiary treatment facilities to 3.4 mgd (peak flow). Colma customers have an average day demand of 2.3 mgd. If Colma customers take priority, the remaining capacity available for the San Francisco Lake Merced area customers would amount to about 1.1 mgd. However, on peak days the demand for Colma customers in estimated to be as high as 3 mgd. Under these infrequent conditions, there would only be 0.4 mgd available for the San Francisco Lake Merced area customers.

**Table ES.1 Colma Customer Recycled Water Demands
Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Studies
City of Daly City**

Name	Current Water Supplier	Total Irrigated Acreage	Average Annual Demand (ac-ft/yr)	Average Day Demand (mgd) (1)	Peak Day Demand (mgd) (2)
Alta Loma Park	Cal Water	5.4	9	0.02	0.03
El Camino High School	Cal Water	8.2	36	0.08	0.10
Alta Loma Middle School	Cal Water	5.0	14	0.03	0.04
Sunshine Gardens Elementary	Cal Water	3.4	6	0.01	0.02
Holy Cross Cemetery	Private Well	150	255	0.55	0.72
Cypress Lawn Memorial Park	Private Well	146	248	0.54	0.70
Cypress Hills Golf Course	Cal Water	30	62	0.13	0.17
Woodlawn Cemetery	Private Well	49.5	84	0.18	0.24
Olivet Memorial Park	Private Well	56.7	96	0.21	0.27
Salem Cemetery	Private Well	11.7	20	0.04	0.06
Hills of Eternity and Home of Peace	Private Well	31.5	54	0.12	0.15
Greenlawn Memorial Park	Cal Water	27	46	0.10	0.13
Golden Hill Memorial Park	Cal Water	2	16	0.04	0.05
Eternal Home	Cal Water	12.6	21	0.05	0.06
Winston Manor Park	Cal Water	1.44	2	0.01	0.01
Hoy Sun Cemetery	Cal Water	7.2	16	0.03	0.04
Serbian Cemetery	Cal Water	13.5	23	0.05	0.06
Italian Cemetery	Private Well/Cal Water	28	48	0.10	0.13
Total		**589.1**	**1,056**	**2.29**	**2.98**

Notes:
(1) Average day demand is based on the max month demand averaged over 30 days.
(2) Peak day demand includes a peaking factor of 1.3 over average day demand.

The combined peak day demand for the three San Francisco customers is estimated at 0.72 mgd, almost twice the available peak day capacity. Therefore, under extremely hot and dry conditions, the San Francisco Lake Merced area customers would need to augment their supply with SFPUC water.

Table ES.2	San Francisco Customer Recycled Water Demands Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Studies City of Daly City		
Name		**Average Day Demand (mgd)**	**Peak Day Demand (mgd)**
Irrigation Demand			
Lake Merced Hill	Irrigation	0.02	0.02
Parkmerced Development	Irrigation	0.22	0.28
San Francisco State University	Irrigation	0.17	0.22
Irrigation Demand Subtotal		**0.41**	**0.52**
Year-Round Use Demand			
Lake Merced Hill	Year-Round Use	n/a	n/a
Parkmerced Development	Year-Round Use	0.14	0.18
San Francisco State University	Year-Round Use	0.01	0.01
Year-Round Use Demand Subtotal		**0.15**	**0.19**
Total Demand		**0.56**	**0.72**

An analysis was performed to estimate the number of days in a year when SFPUC water augmentation would be required. Figure ES.3 shows the predicted recycled water use for the Colma and San Francisco Lake Merced area customers. The prediction was generated using historical production records from existing Daly City recycled water customers. The analysis indicates that fresh water augmentation would be required for about 30 days per year. The numbers of days per month are presented in Table ES.3.

Table ES.3	Fresh Water Augmentation Predictions Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Studies City of Daly City
Month	**Number of Days Requiring Fresh Water Augmentation**
May	5
June	9
July	7
August	7
September	2
Total	**30 days**

Notes:
(1) Months not shown have 0 days requiring fresh water augmentation.

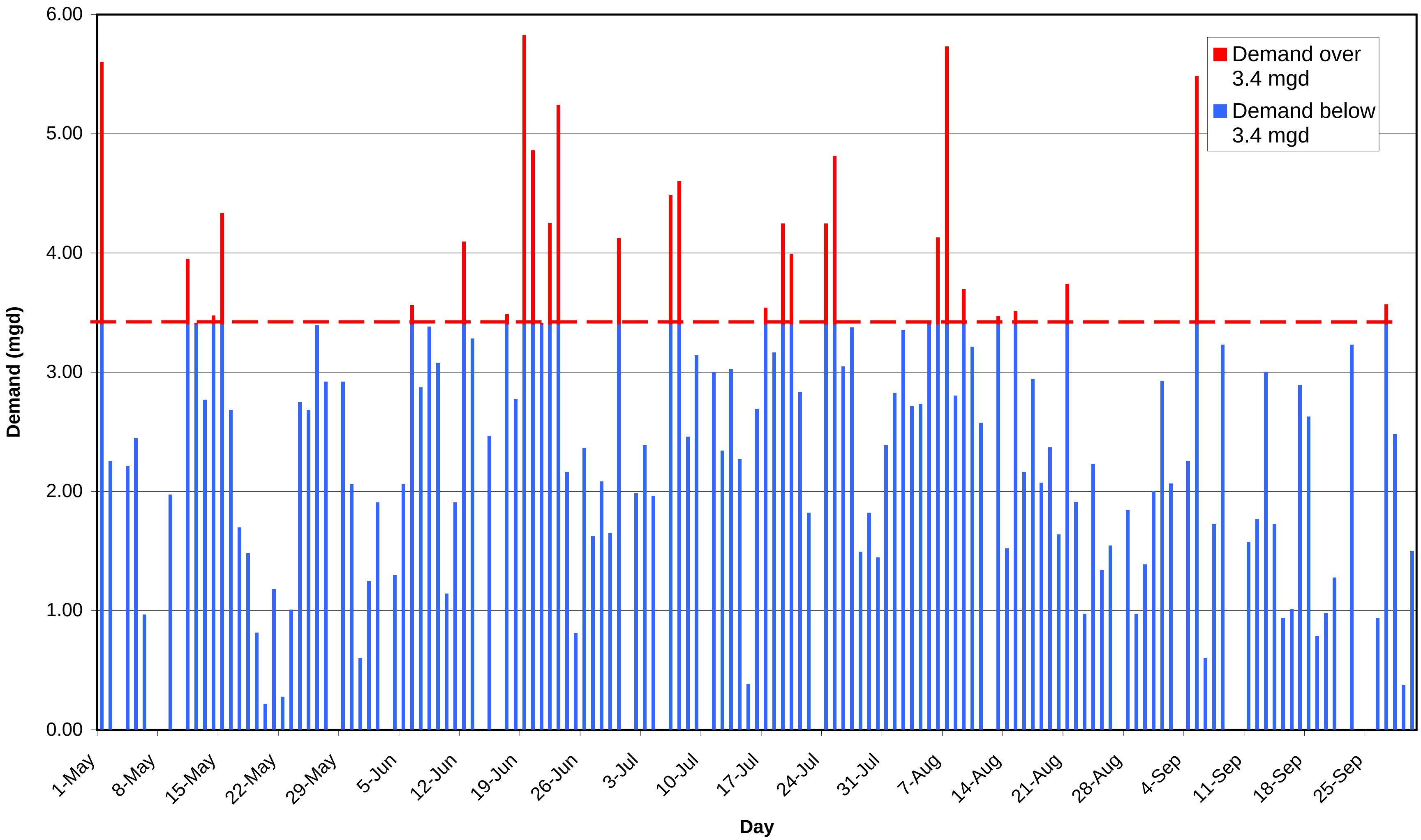

Figure ES.3
STATISTICAL RECYCLED WATER DISTRIBUTION
CITY OF DALY CITY
COMBINED RESULTS OF THE RECYCLED
WATER TREATMENT AND DELIVERY SYSTEM
EXPANSION FEASIBILITY STUDIES

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4.0 RECYCLED WATER TREATMENT FACILITIES EXPANSION

4.1 Tertiary Treatment Expansion

Current influent flows to the Daly City wastewater treatment plant average about 6.2 mgd. The existing Daly City tertiary facilities have a permitted production capacity of 2.77 mgd. As discussed previously, the maximum expansion of the tertiary treatment system that can be provided within the available space on site is 3.4 mgd. The preferred tertiary treatment scheme for the small site is pressure membrane filtration followed by ozone disinfection. The following components would be included in the tertiary treatment expansion:

- New secondary effluent pump station
- Microfiltration membranes located on the second floor
- HiPOx™ disinfection system (ozone) on the first floor
- New recycled effluent pump station

The proposed treatment process schematic is presented in Figure ES.4. A preliminary layout of the proposed facilities is shown in Figure ES.5.

4.2 Recycled Effluent Pump Station Upgrades

A new 3 mgd recycled effluent pump station (REPS) would be required to deliver recycled water to the Colma storage tank. The supply for the San Francisco Lake Merced area (0.4 mgd) would be pumped by the existing pump station through the existing Olympic Club/Harding Park recycled water pipeline. However, the pumps would need to be replaced with higher capacity pumps to deliver the additional flow to the San Francisco Lake Merced area. By pumping at a higher flow rate, all customers would be served within a 24-hour period. Pumping requirements will need to be refined when the customers and their final recycled water storage and distribution requirements are confirmed.

4.3 Operational Costs and Implications for Year-Round Use

Currently, Daly City supplies recycled water seasonally, for turf and landscape irrigation. As described previously, SFSU and Parkmerced are interested in the year-round, non-irrigation use of recycled water. The combined demand for the two customers is estimated at 0.2 mgd. If the City were to supply recycled water for these customers during the non-irrigation season, the new 3.4 tertiary facilities would need to operate at about 0.2 mgd. This could be accomplished

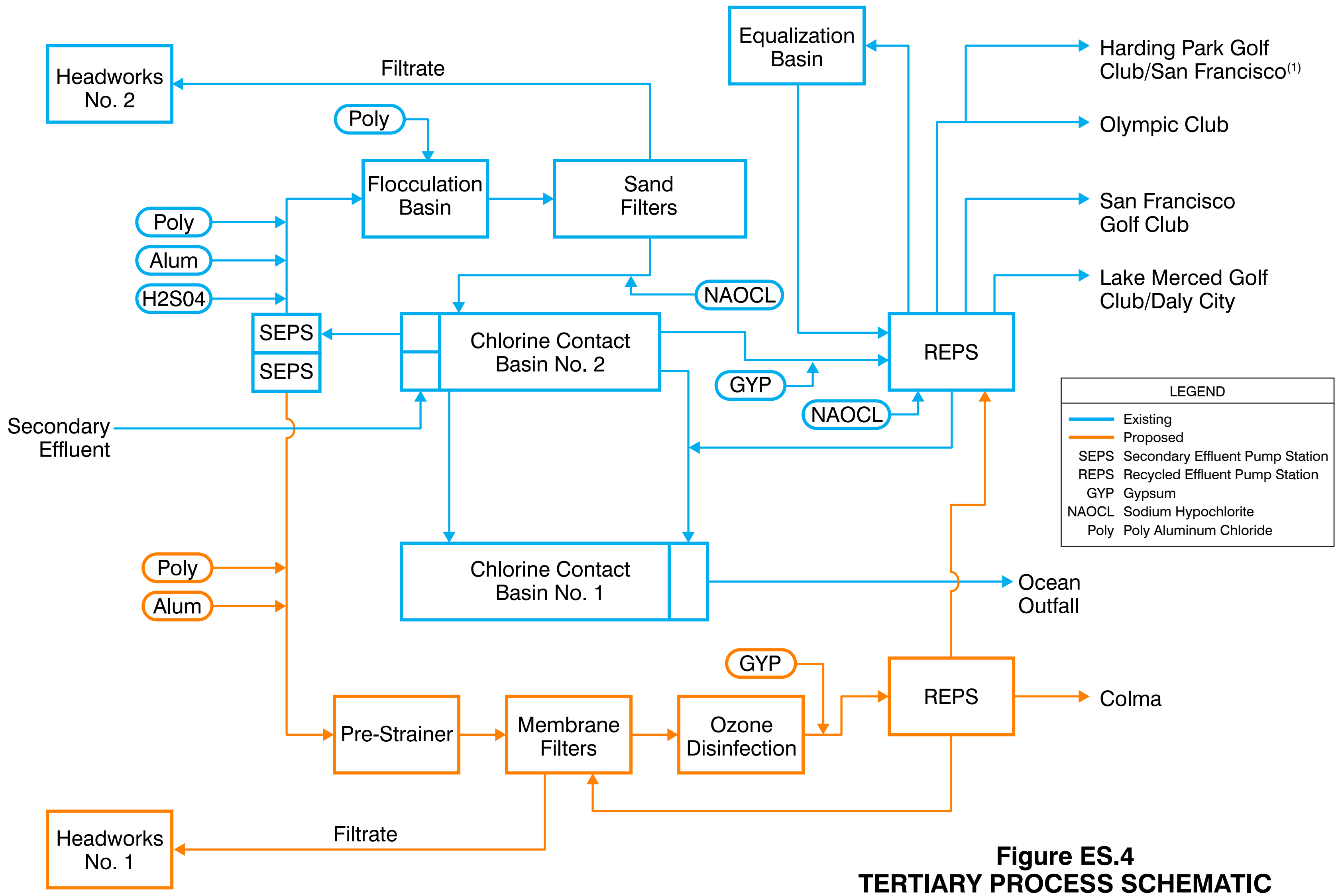

Figure ES.4
TERTIARY PROCESS SCHEMATIC
CITY OF DALY CITY
COMBINED RESULTS OF THE RECYCLED WATER TREATMENT AND DELIVERY SYSTEM EXPANSION FEASIBILITY STUDIES

Note:
(1) Harding Park recycled water transmission main currently in final design.

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Figure ES.5
PROPOSED LAYOUT FOR TERTIARY EXPANSION
CITY OF DALY CITY
COMBINED RESULTS OF THE RECYCLED
WATER TREATMENT AND DELIVERY SYSTEM
EXPANSION FEASIBILITY STUDIES

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as a batch operation by operating one membrane train (1.7 mgd capacity) for approximately 3 hours per day and pumping the recycled water to the storage tanks at the customer sites.

Additional operational constraints and monitoring would need to be evaluated during preliminary design to determine any further requirements for non-turf uses of recycled water.

5.0 RECYCLED WATER DELIVERY SYSTEMS

5.1 Delivery System for Colma Customers

The delivery system from Daly City to Colma would consist of the previously described REPS and transmission main, and a centralized storage tank in Colma. The distribution system for Colma customers would include irrigation booster pumps and pipelines to customers.

The selected route for the transmission main is shown in Figure ES.6. The transmission main would be an 18-inch diameter pipeline, with a flow capacity of 3 mgd. The length of the transmission main, from the Daily City treatment plant to the Colma storage tank, would be approximately 15,600 feet. To supply recycled water to Colma, the transmission main must cross I-280. An existing16-inch pipeline on a utility bridge spanning I-280 was previously installed by Daly City to accommodate future recycled water needs. This pipeline is currently not in service and can be utilized for the Colma transmission main for the freeway crossing.

Storage of recycled water is required locally at Colma to supply recycled water for the daily irrigation period. Because irrigation normally occurs at night over an 8-hour period, the distribution system downstream of the storage tank would be sized to deliver 3 times the daily production rate. An estimated volume of 3 million gallons (MG) would be required if all identified Colma customers were to participate, and assuming none of the existing storage facilities for individual users would be used. The actual required volume may be less depending on the extent that the existing storage facilities could be utilized. To minimize visual impacts on the neighborhood, the storage tank would be buried. The tank would be rectangular, constructed of reinforced concrete. The proposed site for the storage tank is an empty lot owned by the Italian Cemetery located at the corner of El Camino Real and F Street in the Town of Colma. The recycled water storage and distribution system is shown in Figure ES.7. A schematic of the delivery system is shown in Figure ES.8.

The potential Colma customers are grouped into two pressure zones - customers at 150 to 200 feet in elevation, and customers at elevations ranging from 250 to 300 feet. Each pressure zone would be supplied by a separate set of booster pumps.

Table ES.4 summarizes the Colma distribution system design criteria.

Figure ES.6
COLMA TRANSMISSION MAIN CORRIDOR
CITY OF DALY CITY
COMBINED RESULTS OF THE RECYCLED
WATER TREATMENT AND DELIVERY SYSTEM
EXPANSION FEASIBILITY STUDIES

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LEGEND

- Potential Customer
- El Camino Real Distribution System
- Hillside Blvd. Distribution System
- New Storage Tank
- Pump Station(s)

Figure ES.7
COLMA RECYCLED WATER INFRASTRUCTURE
CITY OF DALY CITY
COMBINED RESULTS OF THE RECYCLED WATER TREATMENT AND DELIVERY SYSTEM EXPANSION FEASIBILITY STUDIES

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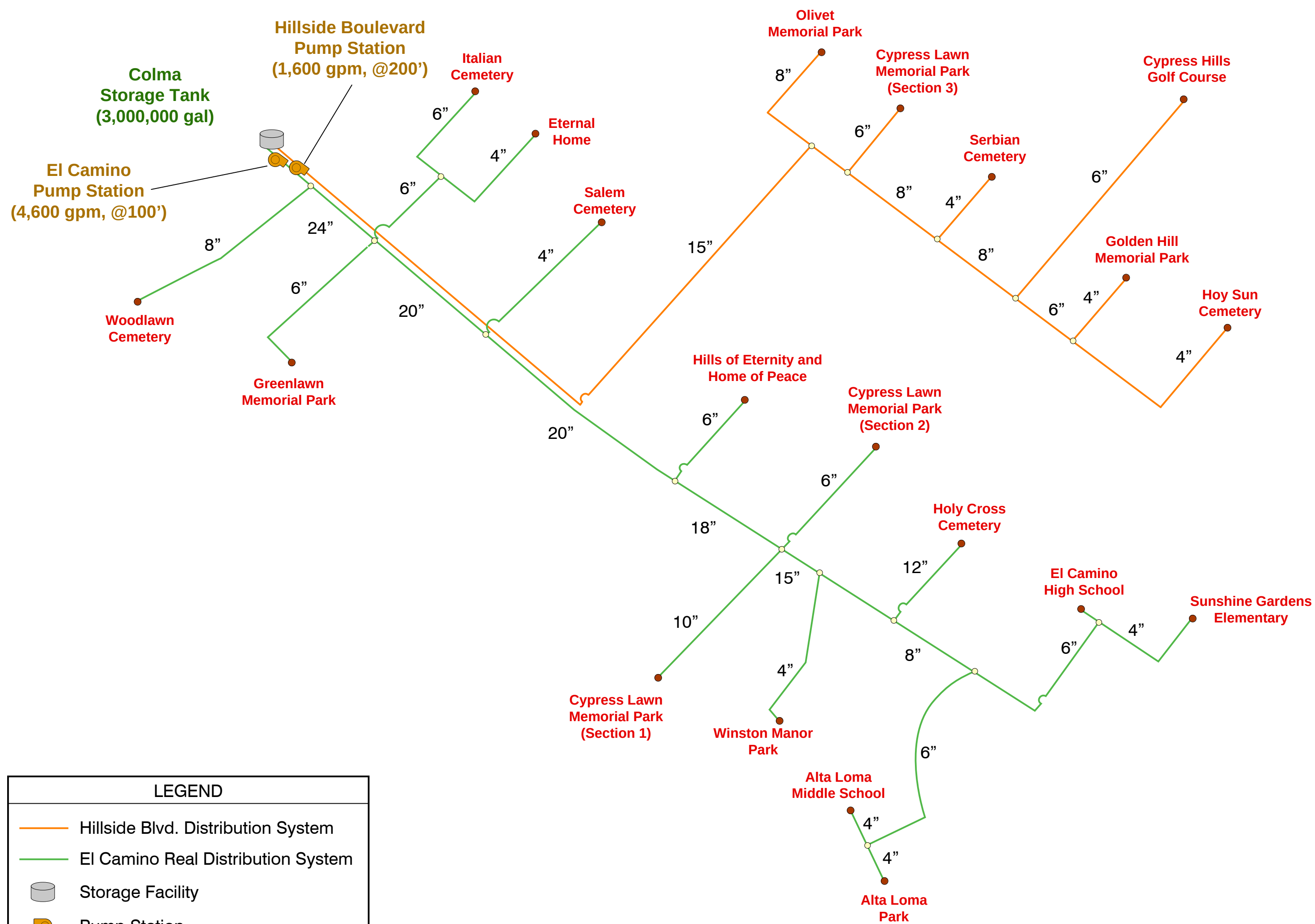

LEGEND

- Hillside Blvd. Distribution System
- El Camino Real Distribution System
- Storage Facility
- Pump Station

Figure ES.8
COLMA DELIVERY SYSTEM SCHEMATIC
CITY OF DALY CITY
COMBINED RESULTS OF THE RECYCLED WATER TREATMENT AND DELIVERY SYSTEM EXPANSION FEASIBILITY STUDIES

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Table ES.4 Colma Delivery System Elements Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Studies City of Daly City	
Description	**Value**
Transmission Main (18-inch diameter)	2.6 miles
Storage Tank - buried concrete	3 MG
Hillside Pump Station	1,620 gpm
Hillside Distribution Network (3-inch to 16-inch diameter)	2.2 miles
El Camino Pump Station	4,610 gpm
El Camino Distribution System (3-inch to 24-inch diameter)	3.6 miles

5.2 Delivery System for San Francisco Lake Merced Area

The three properties to be served in San Francisco (Lake Merced Hill, Parkmerced and SFSU) have differing demands and supply requirements, so each delivery system should be configured as a separate system. However, the delivery systems would share some common features. Each property would require a supply line (extending from the 18-inch diameter recycled water pipeline serving Harding Park), a storage tank, and a distribution pump station. Figure ES.9 shows the delivery system requirements for the San Francisco Lake Merced area customers. The design criteria are presented in Table ES.5.

6.0 PLANNING LEVEL COST ESTIMATE

Table ES.6 summarizes the planning level project costs for the recycled water treatment and delivery system.

7.0 SUMMARY AND CONCLUSIONS

In summary, it appears technically feasible to expand Daly City’s tertiary treatment system by approximately 3.4 mgd and to supply that water to Colma and San Francisco Lake Merced area customers. The size and character of the facilities would need to be refined during design according to the actual customers that commit to accepting recycled water, and their confirmed storage needs and recycled water demands.

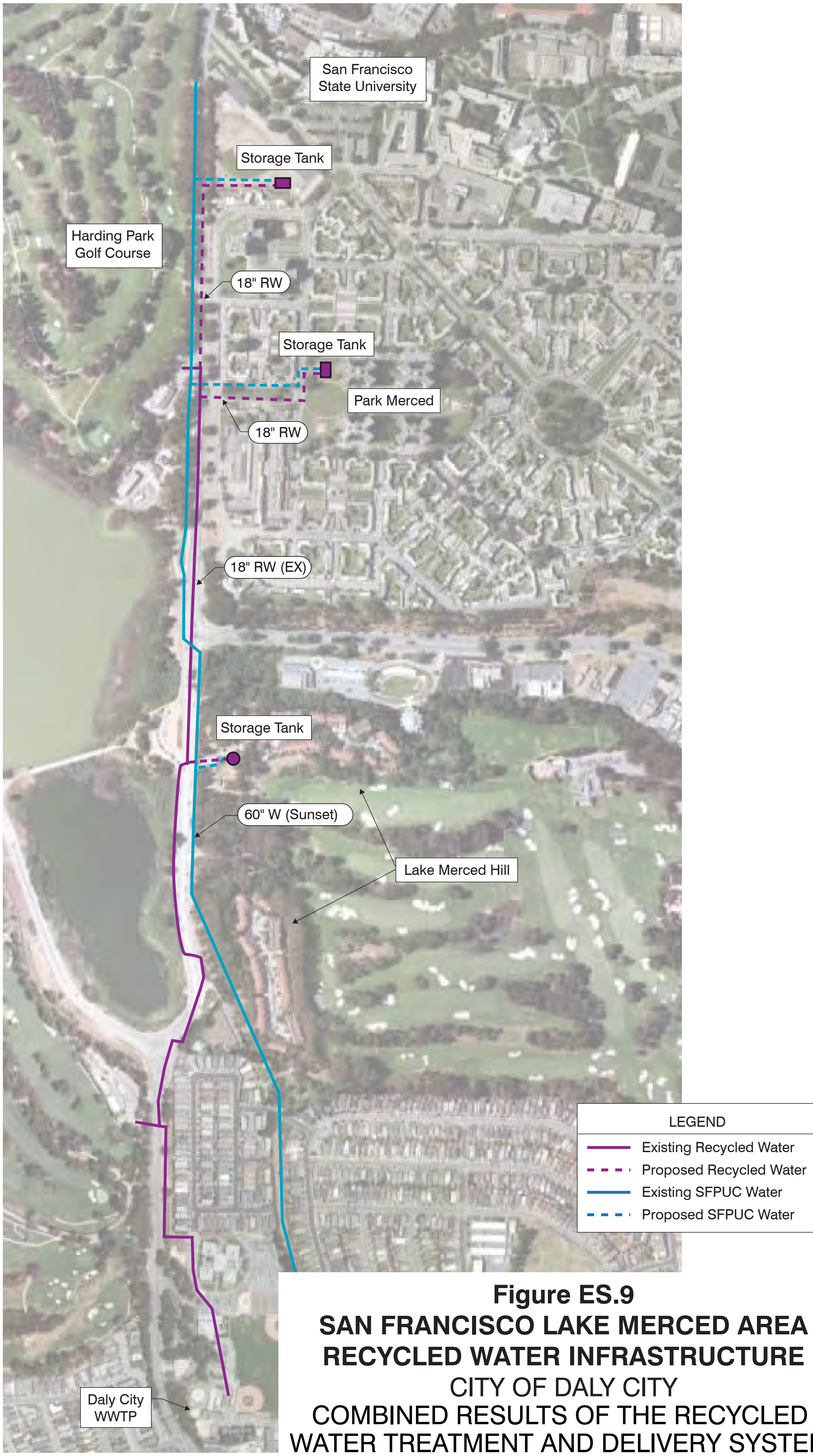

Figure ES.9
SAN FRANCISCO LAKE MERCED AREA RECYCLED WATER INFRASTRUCTURE
CITY OF DALY CITY
COMBINED RESULTS OF THE RECYCLED WATER TREATMENT AND DELIVERY SYSTEM EXPANSION FEASIBILITY STUDIES

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Table ES.5	**San Francisco Lake Merced Area Delivery System Requirements Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Studies City of Daly City**
Description	**Value**
Lake Merced Hill	
Transmission Main (18-inch diameter)	210 feet
Storage Tank - above grade cylindrical	21,000 gallons
Irrigation Pump Station	45 gpm
Connection to irrigation (12-inch diameter)	350 feet
Parkmerced	
Transmission Main (18-inch diameter)	850 feet
Storage Tank - above grade cylindrical	467,000 gallons
Hydropnuematic System	250 gpm
Irrigation Pump Station	600 gpm
Connection to irrigation (12-inch diameter)	1,000 feet
San Francisco State University	
Transmission Main (18-inch diameter)	1,550 feet
Storage Tank - above grade cylindrical	234,000 gallons
Hydropnuematic System	20 gpm
Irrigation Pump Station	475 gpm
Connection to irrigation (12-inch diameter)	1,000 feet

Table ES.6 Recycled Water Treatment and Delivery System Preliminary Cost Estimate
Combined Results of the Recycled Water Treatment and Delivery System Expansion Feasibility Studies
City of Daly City

Cost Item		Total
Tertiary Treatment Expansion		
Secondary Effluent Pump Station		$340,000
Microfiltration Membranes		$3,064,000
HiPOx™ Disinfection		$1,115,000
Tertiary Building		$869,000
Recycled Effluent Pump Station		$295,000
Site Work & Yard Piping		$818,000
E&IC		$2,178,000
Outfall Modification Allowance		$200,000
Colma Delivery System		
Transmission Main		$3,055,000
Storage Tank		$3,441,000
Distribution Systems (Pump Stations and Pipelines)		$5,604,000
San Francisco Delivery System		
Upgrades at existing REPS		$300,000
Transmission Mains		$623,000
Storage Tanks		$2,054,000
Distribution Systems (Pump Stations and Pipelines)		$929,000
	Total Direct Cost	**$24,885,000**
Estimating Contingency	30%	$7,466,000
Contractor Overhead and Profit	12%	$3,882,000
Escalation to Midpoint [1]	(5%/yr)	$5,711,000
Sales Tax [2]	8.25%	$1,027,000
General Conditions	12%	$5,157,000
	Total Estimated Construction Cost	**$48,128,000**
Engineering, Legal, and Administrative Fees	20%	$9,626,000
Owner's Change Order Reserve	5%	$2,406,000
	Total Estimated Project Cost	**$60,160,000**

Notes:
(1) 5% escalation to mid-point of construction added per year. Assumed 3 years to midpoint.
(2) Sales tax applied to 50% of total direct cost to estimate tax on materials.

The cost estimate herein is based on our professional opinion of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

APPENDIX A - RECYCLED WATER TRANSMISSION MAIN CORRIDOR STUDY

City of Daly City
Recycled Water Transmission Main Corridor Study

TECHNICAL MEMORANDUM NO. 1

PRELIMINARY INFRASTRUCTURE ANALYSIS

FINAL
July 2009

City of Daly City
Recycled Water Transmission Main Corridor Study

TECHNICAL MEMORANDUM
NO. 1
PRELIMINARY INFRASTRUCTURE ANALYSIS

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PRELIMINARY INFRASTRUCTURE ANALYSIS

1.0 PURPOSE

The purpose of this technical memorandum (TM) is to present preliminary findings for the Recycled Water Transmission Main Corridor Study and to identify the preferred pipeline routes for two recycled water pipelines: for customers in the Town of Colma and for customers in San Francisco, just north of Daly City. This TM serves as a reference document for participants in the upcoming Workshop No. 1. Final conclusions and recommendations will be published in the project report.

2.0 INTRODUCTION

Since 2004, the City of Daly City has been supplying recycled water for the San Francisco Golf Club, Olympic Club, and the Lake Merced Golf Club. The City also uses recycled water for irrigation of its Westlake Park and landscaping at the traffic medians along John Daly Boulevard. Building on Daly City's successful use of recycled water to off-set potable water demands, the San Francisco Public Utilities Commission (SFPUC) is partnering with Daly City to expand the recycled water system to serve additional customers within the SFPUC service area.

The first phase is an expansion of recycled water service to the Harding Park Golf Club (Harding Park) in San Francisco. The project will extend the pipeline that currently serves the Olympic Club by approximately 4,200 feet north to Harding Park. A 700,000 underground storage tank will also be included. The project is currently under design, and construction is scheduled to be complete by 2011.

As part of its Water System Improvement Program (WSIP), the SFPUC is considering the possibility of implementing a second phase of expansion using Daly City recycled water. This phase would serve SFPUC customers just north of Daly City along Merced Boulevard and the cemeteries in the Town of Colma to the south. In 2008 Carollo completed the Recycled Water Feasibility Study for South San Francisco, which included an evaluation of the feasibility of serving the Town of Colma with recycled water. The SFPUC will be comparing the two options -- whether to supply recycled water to Colma from South San Francisco or from Daly City.

Figure 1.1 presents an overview map of the wastewater treatment plant (WWTP) and the existing and proposed recycled water customers. The project would require the following components:

- An expansion of the tertiary treatment facilities at Daly City.
- An extension of the pipeline that will serve Harding Park for customers to the north.

LEGEND

- Existing Pipeline
- Existing Customer
- Potential Customer

Note:
(1) Harding Park recycled water transmission main is currently in final design.

Figure 1.1
NSMCSD RECYCLED WATER DISTRIBUTION
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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- A new pipeline to supply Colma Customers.
- Recycled water storage facilities for the Colma customers.

Planning for the second phase of the recycled water expansion includes two feasibility studies. The first study, completed by Carollo in 2008, evaluated the feasibility of expanding the Daly City tertiary treatment facilities. Results from the study indicate that the existing treatment system can be expanded by an additional 3.4 million gallons per day (mgd). The second study, the subject of this memorandum, is to evaluate the feasibility of adding new recycled water transmission main and associated facilities.

3.0 CUSTOMER RECYCLED WATER DEMANDS

3.1 Colma Customer Demands

The Recycled Water Feasibility Study (RWFS) for South San Francisco, completed by Carollo Engineers in 2008, included an evaluation of the feasibility of serving potential customers within the Town of Colma. The RWFS calculated expected landscape requirements for potential customers in the Town of Colma based on evapotranspiration and rainfall data. Calculated irrigation requirements, in conjunction with existing available water usage data, were used to estimate peak month demand, peak day demand, and peak hour demand for recycled water distribution considerations. The water demand calculations presented in the RWFS are included as an Appendix to this TM. The results of the analysis are presented in Table 1.1 and will be used for this memorandum. The total peak day recycled water demand for Colma, assuming all demand occurs simultaneously, is estimated to be 3.0 mgd.

The existing equalization basins at the Daly City WWTP do not have enough storage volume to accommodate the new recycled water facilities for the second phase of expansion. Therefore, it was assumed that new off-site storage facilities would be provided in Colma, near the potential recycled water customers. With storage located near the demands, the recycled water pipeline can be sized for peak daily demands rather than the peak flow required during the irrigation period. Normally irrigation occurs in the evening and early morning, typically over an eight hour period. Drawing from the storage tank will satisfy the peak water demands during the irrigation period. The storage tank will be filled during the non-irrigation period, which is normally about 16 hours. These assumptions are consistent with those considered in the Recycled Water Study for South San Francisco.

3.2 North Customer Demands

With a proposed expansion of 3.4 mgd additional tertiary capacity at the Daly City WWTP and a total peak day demand of 3.0 mgd for the potential Town of Colma customers, an additional 0.4 mgd of production capacity is available for recycled water customers to the

Table 1.1	**Town of Colma Customers Recycled Water Transmission Main Corridor Study City of Daly City**		
Name	**Current Water Supplier**	**Total Irrigated Acreage**	**Peak Day Demand (mgd)**
Alta Loma Park	Cal Water	5.4	0.03
El Camino High School	Cal Water	8.2	0.10
Alta Loma Middle School	Cal Water	5.0	0.04
Sunshine Gardens Elementary	Cal Water	3.4	0.02
Holy Cross Cemetery	Private Well	150	0.72
Cypress Lawn Memorial Park	Private Well	146	0.70
Cypress Hills Golf Course	Cal Water	30	0.17
Woodlawn Cemetery	Private Well	49.5	0.24
Olivet Memorial Park	Private Well	56.7	0.27
Salem Cemetery	Private Well	11.7	0.06
Hills of Eternity and Home of Peace	Private Well	31.5	0.15
Greenlawn Memorial Park	Cal Water	27	0.13
Golden Hill Memorial Park	Cal Water	2	0.05
Eternal Home	Cal Water	12.6	0.06
Winston Manor Park	Cal Water	1.44	0.01
Hoy Sun Cemetery	Cal Water	7.2	0.04
Serbian Cemetery	Cal Water	13.5	0.06
Italian Cemetery	Private Well/Cal Water	28	0.13
Total		**589.1**	**2.98**

north of Daly City. Customers to the north would be served from either the Harding Park pipeline or an extension of the pipeline, depending on the location of the customers. Two potential users to the north have been identified by the SFPUC: the San Francisco State University (SFSU) and the Parkmerced development. In addition, the SFPUC is currently evaluating other customers that could be served from the Harding Park pipeline extension. The SFPUC is currently in the final stages of a citywide water assessment to catalog the current water use demands for their customers. The SFPUC plans to complete the assessment in June and to identify potential customers to be served from the Daly City recycled water plant. The approximate recycled water demands for the preliminary list of customers to the north are summarized in Table 1.2.

Table 1.2	Northern Customers - San Francisco Recycled Water Transmission Main Corridor Study City of Daly City		
Name	**Type of Use**	**Total Irrigated Acreage**	**Peak Day Demand (mgd)**
Parkmerced Development (1)	Irrigation	73	0.24
	Year-Round	-	0.25
San Francisco State University (2)	Irrigation	Unknown (2)	0.21
	Year-Round	-	0.17
Total			**0.87**

Notes:
(1) Parkmerced Development water use was estimated using the same methods employed for the Town of Colma.
(2) SFSU water use information was provided by the SFPUC in 2007.

As indicated, the peak day demands for the preliminary list of customers would exceed the 0.4-mgd production capacity available to customers to the north. Depending on the final list of customers, there may be periods when part of the irrigation water will need to be augmented with fresh water.

4.0 COLMA TRANSMISSION PIPELINE CORRIDOR EVALUATION

4.1 Non-economic Evaluation Description

Alignment and construction method alternatives were identified and then evaluated based on the non-economic criteria presented below. Each alternative was assigned a score from 1 to 3, with 1 being the least desirable and 3 being the most desirable. The scores from each criterion for a given alternative were then added together to determine the most desirable alternative based on these non-economic factors.

4.1.1 Permitting

Permitting considers impacts to land use and environmental elements. Alternatives that score low for this category require more permitting compared to the other alternatives. Additional permitting can lead to schedule delays and additional costs to the design portion of the overall project. More permitting can also lead to more requirements during construction to mitigate impacts to the land use and environmental elements, adding time and cost to the overall project.

4.1.2 Community

Alternatives that score poorly for the community criterion had increased impacts to residences near the construction site. Factors that reduced the community score included increased dust from earthwork operations, increased noise during construction, modifications or restrictions to existing pedestrian, bicycle or automotive traffic patterns, and general public inconvenience.

4.1.3 Constructability

Alternatives with more elements of difficult or specialty construction receive reduced scores for constructability. Specialty construction includes various methods of trenchless construction that usually require specialty subcontractors to perform the work. Difficult construction would include deep trenches, high groundwater, construction in high traffic areas, construction with limited access routes, or construction near environmentally sensitive areas.

4.1.4 Easements

Alignments that stay within public rights of way or existing easements receive higher scores than alignments through private properties that require additional easement acquisitions or land purchases. Alignments that require temporary easements score better than alignments requiring permanent easements. Alignments that require permanent easements receive higher scores than alternatives requiring land purchases.

4.1.5 Utilities

Alternatives with alignments near more utilities score lower than alternatives away from existing utilities since the exact locations of existing utilities are not always known even though they may be shown on as-built drawings. Utility crossing conflicts during construction may lead to significant costs and delays in order to mitigate the conflict.

Parallel utilities are also of concern for pipelines. Spacing near existing utilities needs to consider the execution of future excavation for maintenance or repairs. The locations of overhead electrical lines are also important because they impact the movements of heavy construction equipment.

4.1.6 Traffic

Alternatives requiring construction in higher capacity arterial streets score lower than those with construction along the lower capacity surface streets because the construction within the arterial streets impacts more drivers, requires more traffic control, and may require night work. Alternatives requiring road closures or rerouting of traffic also score lower for this category.

4.1.7 Operations and Maintenance

Alternatives that provide limited future access or require road lane closures for operations and maintenance activity score lower than those with easier access. Alternatives requiring multiple pump stations or other maintenance intensive appurtenances, also score lower under this criterion.

4.2 Recycled Water Transmission to Town of Colma Customers

Supplying recycled water to customers in Colma will require construction of a new recycled water transmission main, storage facilities, booster pump station capacity, and a local distribution system. The corridor under consideration for the Colma pipeline generally follows SFPUC's existing 30-inch diameter Baden-Merced Pipeline (BMPL) alignment. The SFPUC is currently constructing a new 36-inch diameter water line known as the San Andreas Pipeline No. 3 (SAPL3). SAPL3 will extend from the San Pedro Valve Lot, located at the intersection of Junipero Serra Boulevard and San Pedro Road, to the Merced Reservoir. Portions of the BMPL will be replaced with the SAPL3, while the remainder of the BMPL will be abandoned in place. Figure 1.2 presents the alignments of the BMPL, SAPL3, and other major SFPUC water lines.

To facilitate the analysis, the Colma pipeline corridor was broken into five segments to address unique circumstances within each segment. For some segments, multiple alternatives for pipeline routing and/or pipeline construction methods were identified and evaluated. The pipeline segments are shown in Figure 1.3.

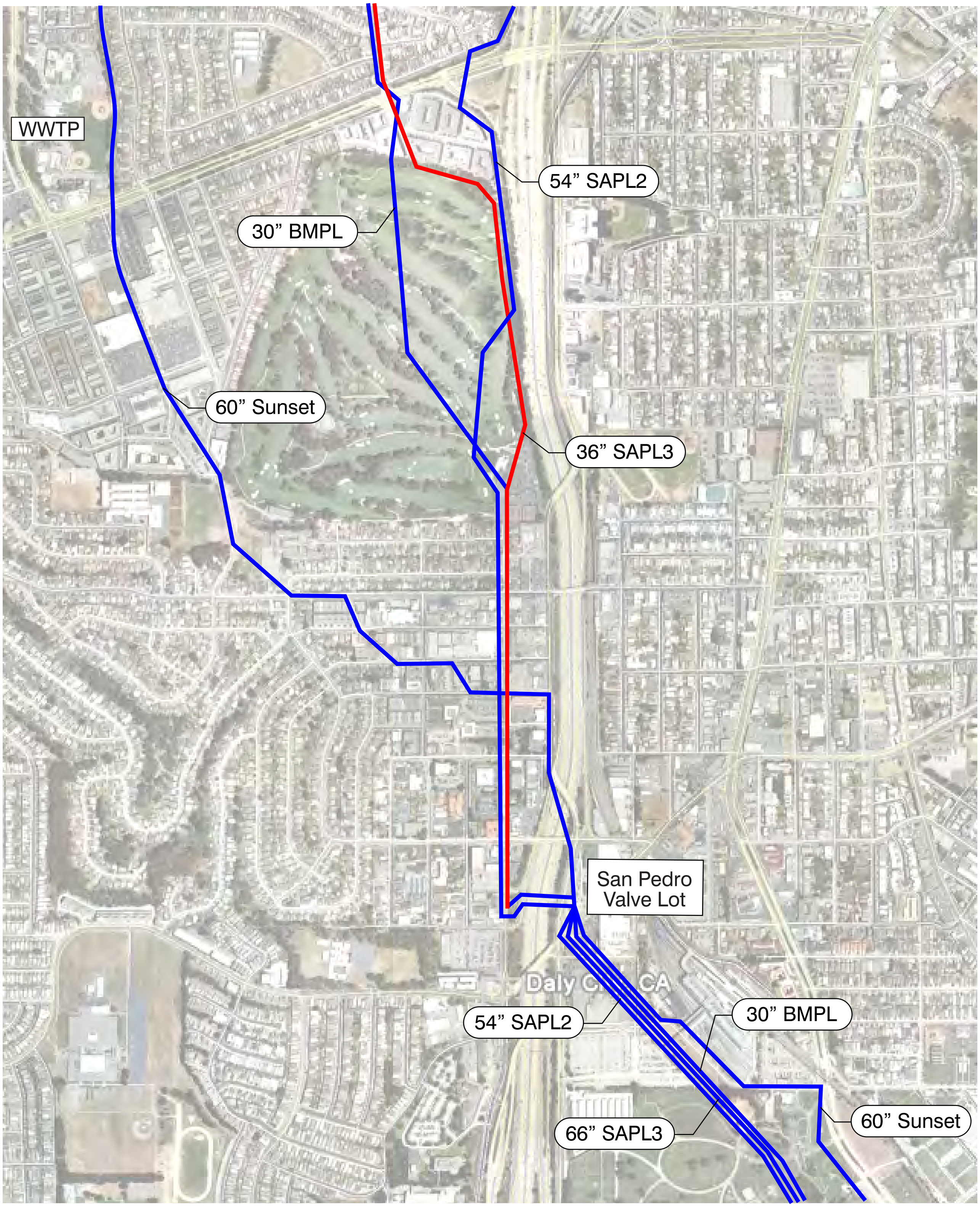
The routing alternatives were evaluated on the basis of both construction costs and the non-economic criteria discussed above. Preliminary construction costs were developed for each alternative for comparison purposes, assuming a 24-inch diameter pipeline. Preliminary costs do not include land acquisition or groundwater control. Based on experience with other projects in the area, it was assumed that the soils would not require special construction techniques. A cover of 36 inches for new pipe installation was assumed in developing trenching costs. In addition, it is assumed that the BMPL has enough structural integrity for slip lining with either PVC or HDPE pipe where required. A refined cost estimate will be prepared for the preferred alternative as part of the Recycled Water Transmission Main Corridor Study.

The evaluation of each pipeline segment is presented below.

4.2.1 Segment 1: East from the WWTP to the BMPL Alignment.

Segment 1 extends east from the new recycled effluent pump station (REPS) at the WWTP to the BMPL alignment just north of the Lake Merced Golf Club. From the proposed REPS, the proposed pipeline alignment bisects the Westlake Park ball field then proceeds south within the existing SFPUC Sunset Pipeline easement to John Daly Boulevard. From this point, there are three routing alternatives for Segment 1, all of which require construction of a new pipeline:

- Alternative A: North Mayfair Avenue.
- Alternative B: John Daly Boulevard.
- Alternative C: South Mayfair Avenue.



LEGEND

Existing SFPUC Water Mains

New SAPL3 Extension Currently Under Construction

Figure 1.2
SFPUC PIPELINES
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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Figure 1.3
COLMA PIPELINE CORRIDOR SEGMENTS
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

dc609f3-7813.ai

The alternative alignments for this segment are presented in Figure 1.4. The alternative evaluation is summarized in Table 1.3.

4.2.2 Segment 2: South through Lake Merced Golf Club (LMGC)

Segment 2 extends through the Lake Merced Golf Club to the Club's South entrance. The abandoned BMPL runs southward through the golf course. The new SAPL3 will be installed along the eastern boundary to avoid conflicts with the golf course. Both water lines are within a 25-foot floating easement (meaning the easement is defined by the location of pipeline facilities) within the golf course property. It was assumed that either of the two existing pipeline alignments would be available for the new recycled water pipeline. Accordingly, the two routing alternatives for Segment 2 are:

- Alternative A: Reuse the BMPL alignment. For this alternative, the preferred construction method would be to slip line the existing 30-inch diameter pipeline with plastic pipe.
- Alternative B: Parallel to the SAPL3. This would require construction of a new pipeline.

The alternative alignments for this segment are presented in Figure 1.5. The alternative evaluation is summarized in Table 1.4.

4.2.3 Segment 3: South from LMGC to the I-280 Utility Bridge

Segment 3 extends south from the golf club entrance to an existing utility bridge that crosses Highway I-280. From the golf club entrance, the BMPL runs south along the eastern side of Sullivan Avenue, parallel to I-280. However, this portion of the BMPL will be removed and replaced with construction of the SAPL3, and will not be available for potential slip-lining. A 54-inch diameter waterline known as San Andreas Pipeline No. 2 (SAPL2) also runs along the western side of Sullivan Avenue. Sullivan Avenue is highly congested with additional underground utilities, making construction of new pipeline facilities within this alignment difficult. Therefore, two adjacent streets were identified as possible alternative alignments between the LMGC and the existing utility bridge. All three routing alternatives along Segment 3 require construction of a new pipeline within the following city streets:

- Alternative A: Sullivan Avenue
- Alternative B: Junipero Serra Blvd
- Alternative C: Edgeworth Avenue

The alternative alignments for this segment are presented in Figure 1.6. The alternative evaluation is summarized in Table 1.5.

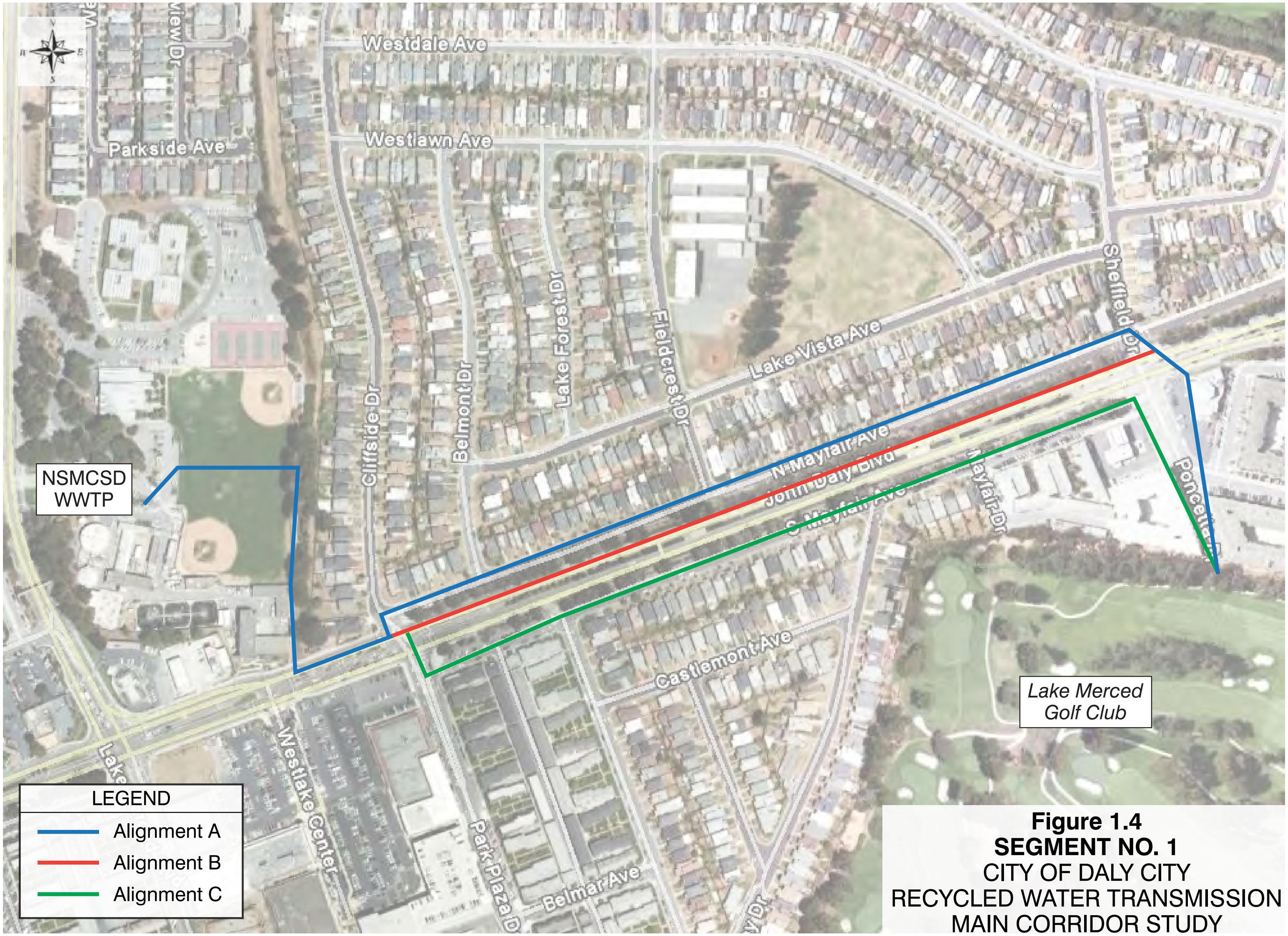

Figure 1.4
SEGMENT NO. 1
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

dc609f4-7813.ai

Table 1.3 Segment1 Alternative Evaluation
Recycled Water Transmission Main Corridor Study
City of Daly City

Criteria	Ranking Weight	Segment No. 1					
		Alternative A - WWTP to BMPL Alignment via N. Mayfair Avenue	**Criteria's Unweighted Score**	**Alternative B - WWTP to BMPL Alignment via John Daly Blvd**	**Criteria's Unweighted Score**	**Alternative C - WWTP to BMPL via S. Mayfair Avenue**	Criteria's Unweighted Score
Permitting (land use and environmental impacts)	13%	Encroachment permits required for City streets. No additional agency permits required.	3	Same permitting issues as Alternative A, although permit requirements may be more stringent for major thoroughfare.	2	Same permitting issues as Alternative A.	3
Community (Dust, noise and convenience)	13%	Significant impacts to residents along N. Mayfair. Potential business disruption at Westfield Shopping Center.	2	Potential business disruption at Westfield Shopping Center and other establishments along John Daly.	2	Significant impacts to residents and businesses along S. Mayfair. Potential business disruption at Westfield Shopping Center.	1
Constructability (trenchless, access)	13%	Open cut construction is viable along entire alignment. Night work may be required at John Daly portion or John Daly Crossing at Sheffield Drive. Open cut along N. Mayfair may require closing N. Mayfair to through traffic.	2	Open cut construction is viable along entire alignment. Night work may be required along John Daly Blvd.	2	Open cut construction is viable along entire alignment. Night work may be required at John Daly portion. Bore and jack method anticipated for John Daly crossing at Park Plaza Drive. Open cut along S. Mayfair may require closing S. Mayfair to through traffic.	2
Easements	13%	Construction entirely within public right-of-way (public streets, public parks, existing pipeline easements). May require temporary easements at several locations along N. Mayfair.	3	Construction entirely within public right-of-way (public streets, public parks, existing pipeline easements). May require temporary easements at several locations along John Daly Blvd, N. Mayfair, or S. Mayfair.	3	Construction entirely within public right-of-way (public streets, public parks, existing pipeline easements). May require temporary easements at several locations along S. Mayfair.	3
Utility	13%	Narrow corridor and congested with utilities including 4" water, 6"-21" sewer, and 12" recycled water.	1	Wide corridor with 42" sewer and 20" gas utilities in eastbound lanes. Wider corridor provides additional alignment flexibility.	2	Narrow corridor with 10" water and 6" -24" sewer.	2
Traffic	13%	Avoids majority of traffic impacts on John Daly Blvd. Traffic issues mostly limited to ingress/egress of residents along N. Mayfair.	3	Heavy traffic impacts both during commute hours and longer periods of time due to close proximity to shopping center.	1	Avoids majority of traffic impacts on John Daly Blvd. Traffic issues limited to access for businesses and ingress/egress of residents along S. Mayfair	2
Operation and Maintenance (Accessibility)	13%	Routine maintenance access on N. Mayfair consistent with any other facility located in residential streets. Excavation would impact residents.	3	Maintenance activities will require major traffic control effort, at a minimum requiring lane closure of major thoroughfare. Design considerations required to ensure at least one lane in each direction can be maintained if future excavation is required.	1	Routine maintenance access on S. Mayfair consistent with any other facility located in residential/collector streets.. Excavation would impact residents and businesses.	2
	75%	Total:	**17**	Total:	**13**	Total:	**15**
Approx. Total Length		**4070 LF**		**3940 LF**		**3870 LF**	
Estimated Total Direct Cost[(2)]		**$882,500**		**$876,400**		**$955,400**	

Notes:
(1) Unweighted score: Least desirable = 1, Most desirable = 3.
(2) Costs listed are used for comparison purposes. A refined cost estimate of the preferred alternative will be prepared for the Recycled Water Transmission Main Corridor Study.

Figure 1.5
SEGMENT NO. 2
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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Table 1.4 Segment 2 Alternative Evaluation
Recycled Water Transmission Main Corridor Study
City of Daly City

Criteria	Ranking Weight	Segment No. 2 Alternative A - BMPL Alignment through Lake Merced Golf Club	Criteria's Unweighted Score	Alternative B - New pipe parallel to SAPL3	Criteria's Unweighted Score
Permitting (land use and environmental impacts)	13%	Pipeline runs through Lake Merced Golf Course however, SFPUC has a 25' floating easement. May effect trees and require new landscaping.	2	Same permitting issues as Alternative A. Open-cut construction would affect more trees and landscaping.	1
Community (Dust, noise and convenience)	13%	Potential golfer disruption at access pit locations, design approach should locate pits in rough if possible..	1	Potential golfer disruption along exterior cart path.	2
Constructability (trenchless, access)	13%	Slip line of existing 30" BMPL is potentially viable based on talks with SFPUC staff. Will need access pits at pipeline bends. Otherwise, open-cut construction is viable but extremely disruptive to golf course. May require night construction and minimal trench lengths or tunnel (HDD) alternatives.	2	Open-cut construction is viable. Limited width of existing SFPUC construction easement and open space at golf course may require pipe trench to be deeper due to parallel waterline.	1
Easements	13%	May require additional construction easements if not covered by SFPUC 25' floating easement.	2	Same easement issues as Alternative A.	2
Utility	13%	Reuse of existing line avoids utility conflicts. Access pits may conflict with irrigation lines.	3	Narrow construction easement includes 36" SAPL3 and irrigation lines. 24" sewer and 54" SAPL2 also present in portions. May not be able to maintain 10' separation between water and recycled water line.	1
Traffic	13%	Traffic impacts limited to LMGC parking and access.	3	Traffic impacts limited to LMGC parking and access.	3
Operation and Maintenance (Accessibility)	13%	Good maintenance access but would need to be scheduled around LMGC schedule. Excavation would impact golfers.	2	Good maintenance access but would need to be scheduled around LMGC schedule. Excavation would impact golfers.	2
	75%	**Total:**	**15**	**Total:**	**12**
Approx. Total Length		**3065 LF**		**3400 LF**	
Estimated Total Direct Cost(2)		**$527,200**		**$612,500**	

Notes:
(1) Unweighted score: Least desirable = 1, Most desirable = 3.
(2) Costs listed are used for comparison purposes. A refined cost estimate of the preferred alternative will be prepared for the Recycled Water Transmission Main Corridor Study.

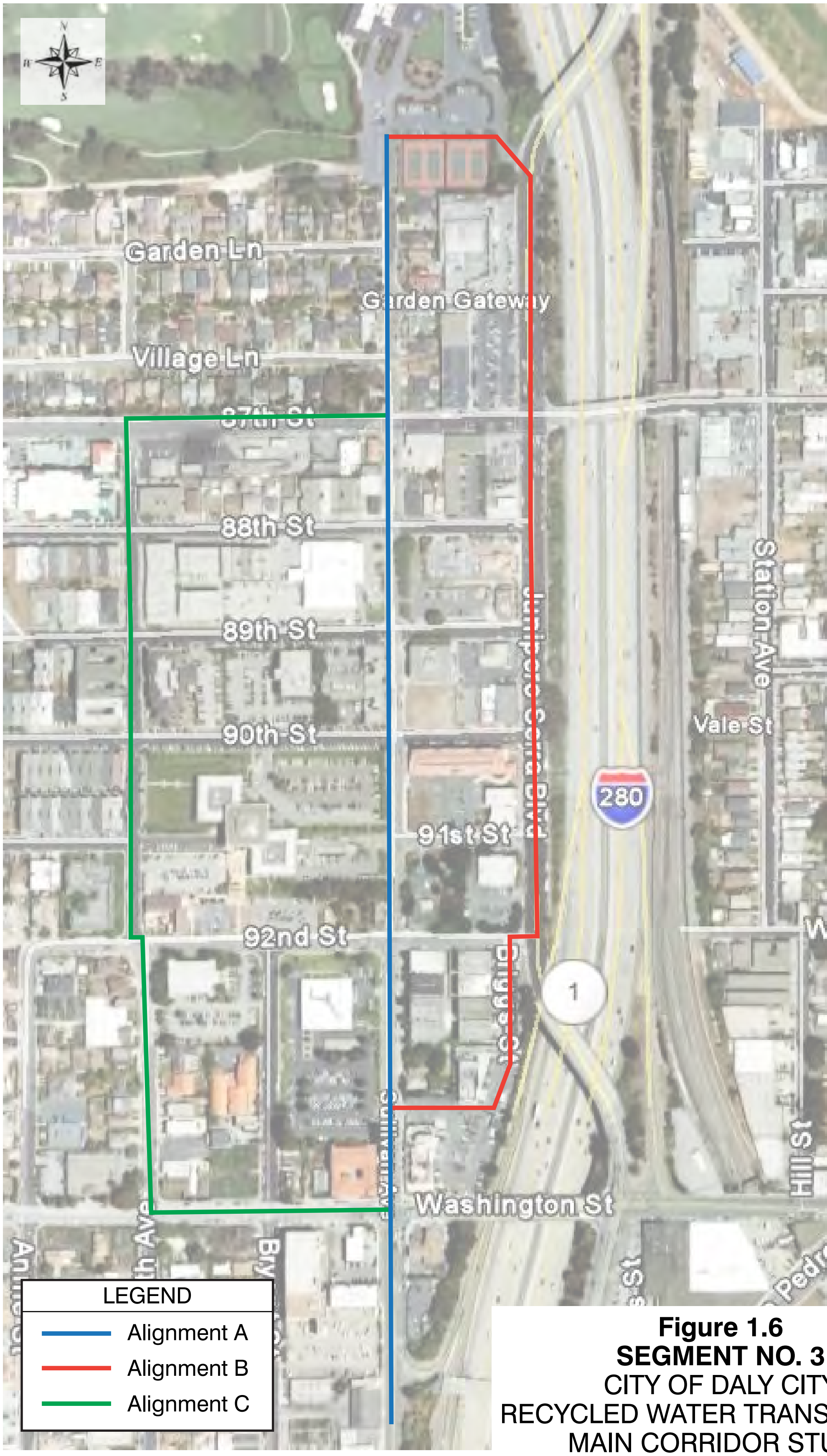

Figure 1.6
SEGMENT NO. 3
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

dc609f6-7813.ai

Table 1.5 Segment 3 Alternative Evaluation
Recycled Water Transmission Main Corridor Study
City of Daly City

Criteria	Ranking Weight	Alternative A - LMGC to I-280 Bridge via Sullivan Avenue	Criteria's Unweighted Score	Alternative B - LMGC to I-280 Bridge via Junipero Serra Blvd	Criteria's Unweighted Score	Alternative C - LMGC to I-280 Bridge via Edgeworth Avenue	Criteria's Unweighted Score
		Segment No. 3					
Permitting (land use and environmental impacts)	13%	Encroachment permits required for City streets. No additional agency permits required.	3	Encroachment permits required for City streets. Permit requirements may be more stringent for major thoroughfare. No additional agency permits required	2	Encroachment permits required for City streets. No additional agency permits required.	3
Community (Dust, noise and convenience)	13%	Potential significant impacts to residents, businesses, and City Hall.	1	Potential significant impacts to businesses.	2	Potential significant impacts to residents, businesses, and City Hall.	1
Constructability (trenchless, access)	13%	Open cut construction is viable but anticipate trenchless construction at intersections heavily congested with utilities. Open cut may require closing street to through traffic. Pipeline trench may be deep due to parallel waterline.	1	Open cut construction is viable along entire alignment. Pipeline trench may be deep due to parallel waterline.	1	Avoids major utilities in Sullivan Ave. Open cut construction is viable along entire alignment. Open cut may require closing street to through traffic.	2
Easements	13%	Construction entirely within public right-of-way (public streets, public parks, existing pipeline easements). May require temporary easements at several locations along Sullivan.	3	Construction entirely within public right-of-way (public streets, public parks, existing pipeline easements). May require temporary easements at several locations along Junipero Serra and Sullivan.	3	Construction entirely within public right-of-way (public streets, public parks, existing pipeline easements). May require temporary easements at several locations along Junipero Serra and Sullivan.	2
Utility	13%	Narrow corridor heavily congested with utilities including 8"-54" water, 6"-48" sewer, telephone, gas, electrical, and overhead utilities.	1	Wider corridor with 8"-60" water and 12"-21" sewer.	2	Narrow corridor with 6"-60" sewer, 8" water and overhead utilities.	2
Traffic	13%	Avoids traffic impacts on Junipero Serra.	2	Heavy traffic during commute hours.	1	Avoids traffic impacts on Junipero Serra.	2
Operation and Maintenance (Accessibility)	13%	Routine maintenance access on Sullivan consistent with any other facility located in residential streets. Excavation would impact residents.	2	Maintenance activities will require significant traffic control effort, at a minimum requiring lane closure of major thoroughfare. Design considerations required to ensure at least one lane in each direction can be maintained if future excavation is required.	1	Routine maintenance access on Edgeworth considered good. Excavation would impact residents and City Hall.	2
	75%	Total:	**13**	Total:	**12**	Total:	**14**
Approx. Total Length		**3070 LF**		**3800 LF**		**4385 LF**	
Estimated Total Direct Cost[2]		**$921,000**		**$1,048,500**		**$1,218,800**	

Notes:
(1) Unweighted score: Least desirable = 1, Most desirable = 3.
(2) Costs listed are used for comparison purposes. A refined cost estimate of the preferred alternative will be prepared for the Recycled Water Transmission Main Corridor Study.

4.2.4 Segment 4: East on the I-280 Utility Bridge

Segment 4 is an existing, unused 16-inch recycled water main that crosses over I-280 on an existing Caltrans maintained utility bridge. When the utility bridge was constructed in 1996, the City installed three 16-inch diameter pipelines for water, recycled water and sewer for future use. None of the pipelines are in service. Carollo has contacted the CA Department of Public Health to assess the upgrades required to place the recycled water pipeline into service. At this time, the only modification noted is to properly identify each of the lines across the bridge. Re-alignment of the buried pipeline on the west side of the bridge may also be necessary to obtain desired separation from existing parallel piping facilities. Figure 1.7 identifies the location of the existing recycled water line. No other alternative has been identified for this segment.

4.2.5 Segment5: South from the I-280 Utility Bridge to the Storage Tank

Segment 5 covers the portion of the pipeline alignment extending from the utility bridge south to Colma. The pipeline would end at a potential location for the proposed recycled water storage tank. As detailed below in Section 4.4.1, the preliminary site selected for the storage tank is the corner of El Camino Real and F Street. SFPUC maintains multiple pipelines on the I-280 utility bridge. These above ground facilities terminate just east of the I-280 pipe bridge at the San Pedro Valve Lot. At this location, the SFPUC has four large diameter water lines; the 30-inch BMPL; the 54-inch SAPL2; the 36-inch SAPL3; and, the 60-inch Sunset Line. Extending south into Colma, theses water lines run in parallel through parking lots, cemeteries, and other properties within an existing SFPUC pipeline easement that follows the route previously occupied by the railroad. The SFPUC easement is approximately 130 feet wide. The Sunset Line leaves this common easement at F Street and then parallels El Camino Real. The abandoned BMPL is the eastern most of the remaining 3 pipelines. Lining the BMPL or constructing a new pipeline parallel to the water lines along the eastern half of the existing easement are viable options. Segment 5 has two routing alternatives:

- Alternative A: Reuse the BMPL alignment to the Woodland Cemetery entrance, construct new pipeline to proposed storage site
- Alternative B: Reuse the BMPL alignment to F. Street, construct new pipeline in F Street to proposed storage site

The current condition of the BMPL is unknown. The preferred construction method would be to slip-line the BMPL due to an anticipated lower construction cost and reduced public impact. If the BMPL does not have sufficient structural strength, the BMPL would need to be replaced or paralleled within the existing easement. This approach is viable for both alternative alignments. The alternative alignments for this segment are presented in Figure 1.8. The alternative evaluation is summarized in Table 1.6.

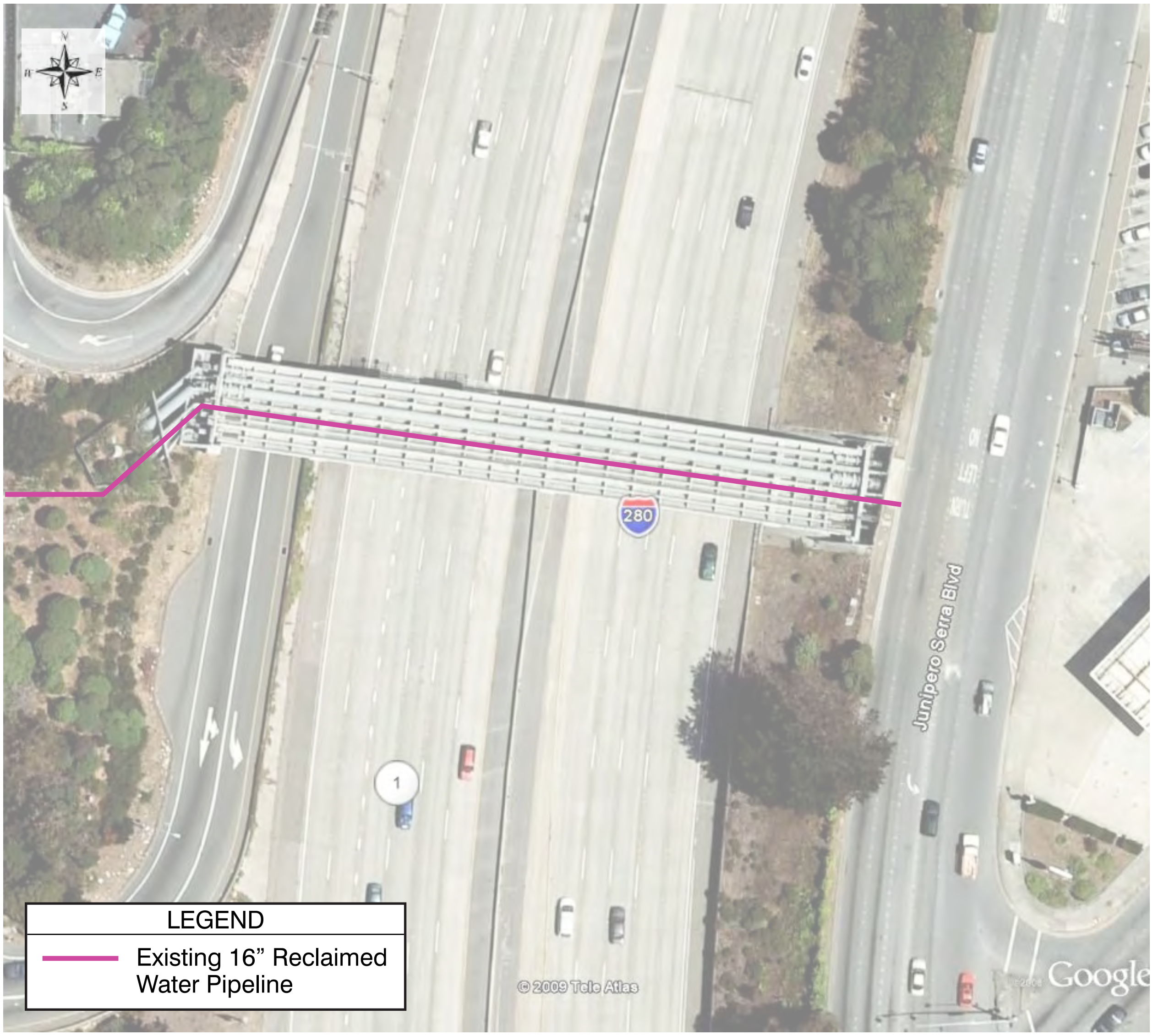

Figure 1.7
SEGMENT NO. 4
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

Figure 1.8
SEGMENT NO. 5
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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Table 1.6 Segment 5 Alternative Evaluation
Recycled Water Transmission Main Corridor Study
City of Daly City

Criteria	Ranking Weight	Segment No. 5			
		Alternative A - BMPL Alignment to the Woodlawn Driveway	**Criteria's Unweighted Score(1)**	**Alternative B - BMPL Alignment to F. Street**	**Criteria's Unweighted Score(1)**
Permitting (land use and environmental impacts)	13%	Requires work in Caltrans right-of-way to cross El Camino Real. Encroachment permits required for City streets and SFPUC easements.	2	Requires work in Caltrans right-of-way to cross and parallel portion of El Camino Real. Encroachment permits required for City streets and SFPUC easements.	1
Community (Dust, noise and convenience)	13%	Potential business disruption at Woodlawn Cemetery. Impacts to El Camino Real may be mitigated using trenchless construction methods.	2	Impacts to El Camino Real may be mitigated using trenchless construction methods. Potential impacts to rail yards along F Street.	2
Constructability (trenchless, access)	13%	Slip lining the BMPL may be a viable option - status of abandoned BMPL is unknown. Otherwise, open cut construction is viable for a majority of the alignment.	3	Similar constructability as Alternative A. However, pipeline along F street may require deeper trench due to parallel waterline, increasing construction risk.	1
Easements	13%	Construction primarily in public right of way (existing easements and city streets). Will require easement for portion along Woodlawn Cemetery driveway.	2	Construction entirely within public right of way (existing easements and city streets). May require encroachment agreement for rail yards along F Street.	1
Utility	13%	132' wide pipeline easement present for majority of the alignment. Existing water lines within the alignment, but open space available for new line.	3	F Street is a narrow corridor with a 60" waterline and overhead utilities. Remainder of Alignment similar to Alternative A.	2
Traffic	13%	Minimal traffic impacts at street crossings and parking lot.	3	Minimal traffic impacts on F Street. Remainder has same traffic issues as Alignment A.	2
Operation and Maintenance (Accessibility)	13%	Good access to facilities in existing SFPUC pipeline easement. Access to facility in Cemetery may be subject to terms of permanent easement.	2	Good access to facilities in existing SFPUC pipeline easement. F street access will require minimal traffic control to ensure one lane remains open during maintenance activities.	2
	75%	**Total:**	**17**	**Total:**	**11**
Approx. Total Length		**3350 LF**		**3270 LF**	
Estimated Total Direct Cost(2)		**$713,000**		**$747,500**	

Notes:
(1) Unweighted score: Least desirable = 1, Most desirable = 3
(2) Costs listed are used for comparison purposes. A refined cost estimate of the preferred alternative will be prepared for the Recycled Water Transmission Main Corridor Study

4.2.6 Hydraulics

Using the alternative alignments discussed above, 3 system curves were developed to determine the potential pressure required for the new recycled effluent pumps. The pumps will deliver recycled water from the Daly City WWTP to the proposed storage tank in Colma. Figure 1.9 presents the system curves. At a peak demand of 3.0 mgd, approximately 165 feet, or 72 pounds per square inch (psi), of pressure would be required. This pressure can be provided by the new Recycled Effluent Pump Station at the WWTP without the need for intermediate booster stations.

4.3 Preferred Route for Colma Transmission Pipeline

Based on the evaluation for each segment presented previously, the preferred alternative is:

- Segment No. 1: Alternative A: North Mayfair Avenue.
- Segment No. 2: Alternative A - Slip line the Baden-Merced Pipeline.
- Segment No. 3: Alternative C: Edgeworth Avenue.
- Segment No. 4: I-280 Utility Crossing.
- Segment No. 5: Alternative A - Slip line the BMPL to Woodlawn Cemetery driveway; construct new pipeline to proposed storage facility.

Table 1.7 provides a preliminary estimate of the total construction costs.

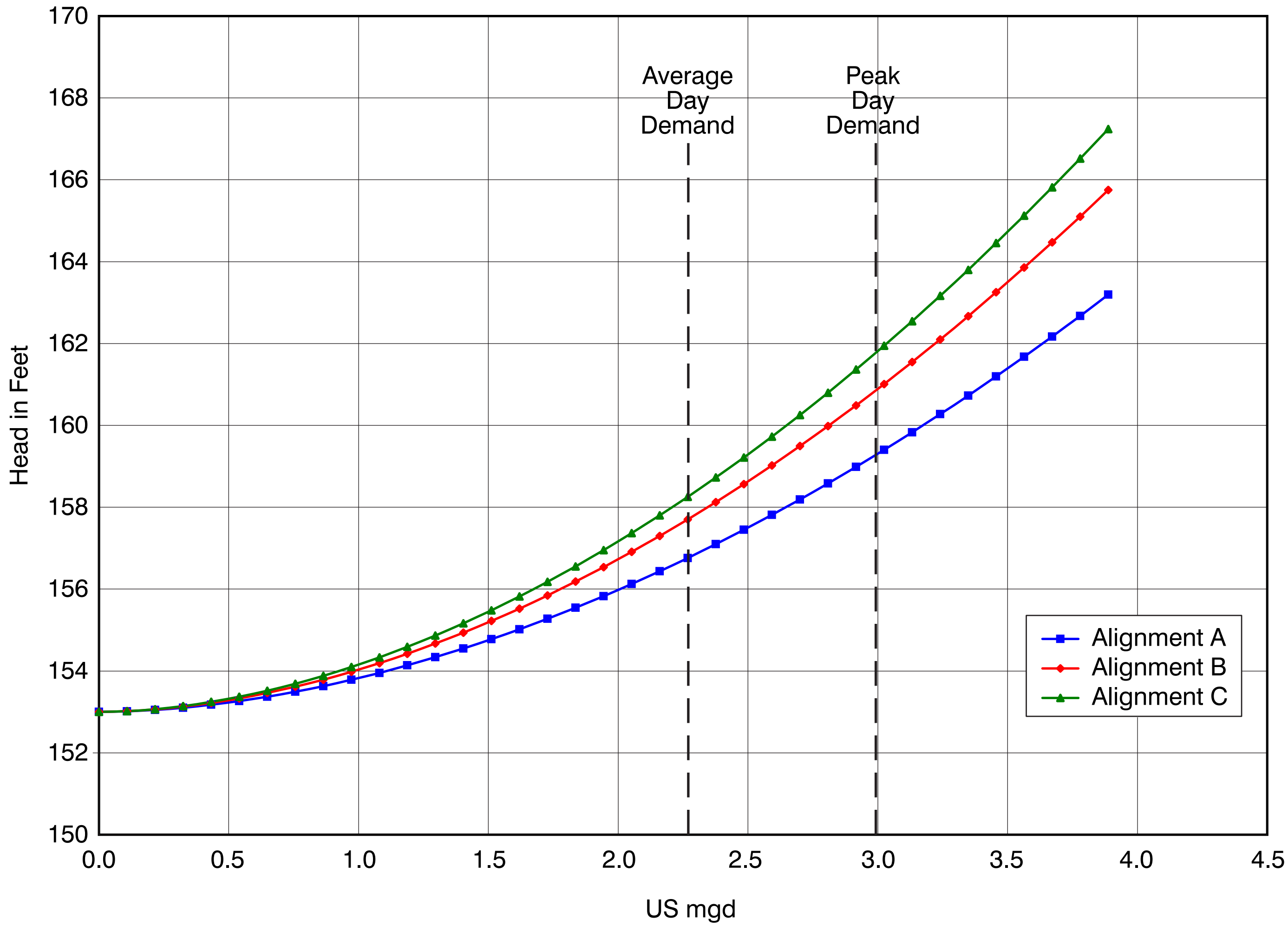
4.4 Additional Recycled Water Facilities for Town of Colma

4.4.1 Recycled Water Storage

An empty lot at the corner of El Camino Real and F Street was identified in the Facility Plan as a suitable site for the proposed storage tank due to its proximity to Colma customers. The property is also close to the Baden-Merced alignment as previously shown in Figure 1.8. A buried, rectangular, concrete storage tank with above ground pump stations is proposed. This would allow the lot to be used for multiple purposes (such as parking) and would also conceal the storage tank from El Camino Real, which is considered a scenic highway. Figure 1.10 presents a conceptual site plan for the storage tank.

4.4.2 Distribution Pumping

The preliminary system layout includes two distribution systems fed from the recycled water storage tank. One would serve the properties along El Camino Real at elevations from 150 to 200 feet and the other would serve the properties along Hillside Boulevard at elevations between 250 to 300 feet. It is assumed that each distribution system would be served from separate vertical turbine pump systems located directly above the storage tank. Figures 1.10 and 1.11 provide a conceptual look at the pump station and storage tank plan and cross-section.



Note:

(1) System curve plots the static and friction losses in the pump discharge line.

Figure 1.9
COLMA TRANSMISSION MAIN SYSTEM
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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Table 1.7	Transmission Pipeline Preferred Alternative Preliminary Cost Estimate Recycled Water Transmission Main Corridor Study City of Daly City	
Cost Item		**Total**
Segment No. 1 - 4,070 feet		$882,500
Segment No. 2 - 3,065 feet		$527,200
Segment No. 3 - 4,385 feet		$1,218,800
Segment No. 4 - contingency for modifications to existing pipeline		$100,000
Segment No. 5 - 3,350 feet		$713,000
Total Direct Cost		**$3,441,500**
Estimating Contingency	30%	$1,032,000
Contractor Overhead and Profit	12%	$537,000
Escalation to Midpoint	(5%/yr)	$790,000
Sales Tax	8.25%	$142,000
General Conditions	12%	$713,000
Total Estimated Construction Cost		**$6,656,000**
Engineering, Legal, and Administrative Fees	20%	$1,331,000
Owner's Change Order Reserve	5%	$333,000
Total Estimated Project Cost		**$8,320,000**

Notes:

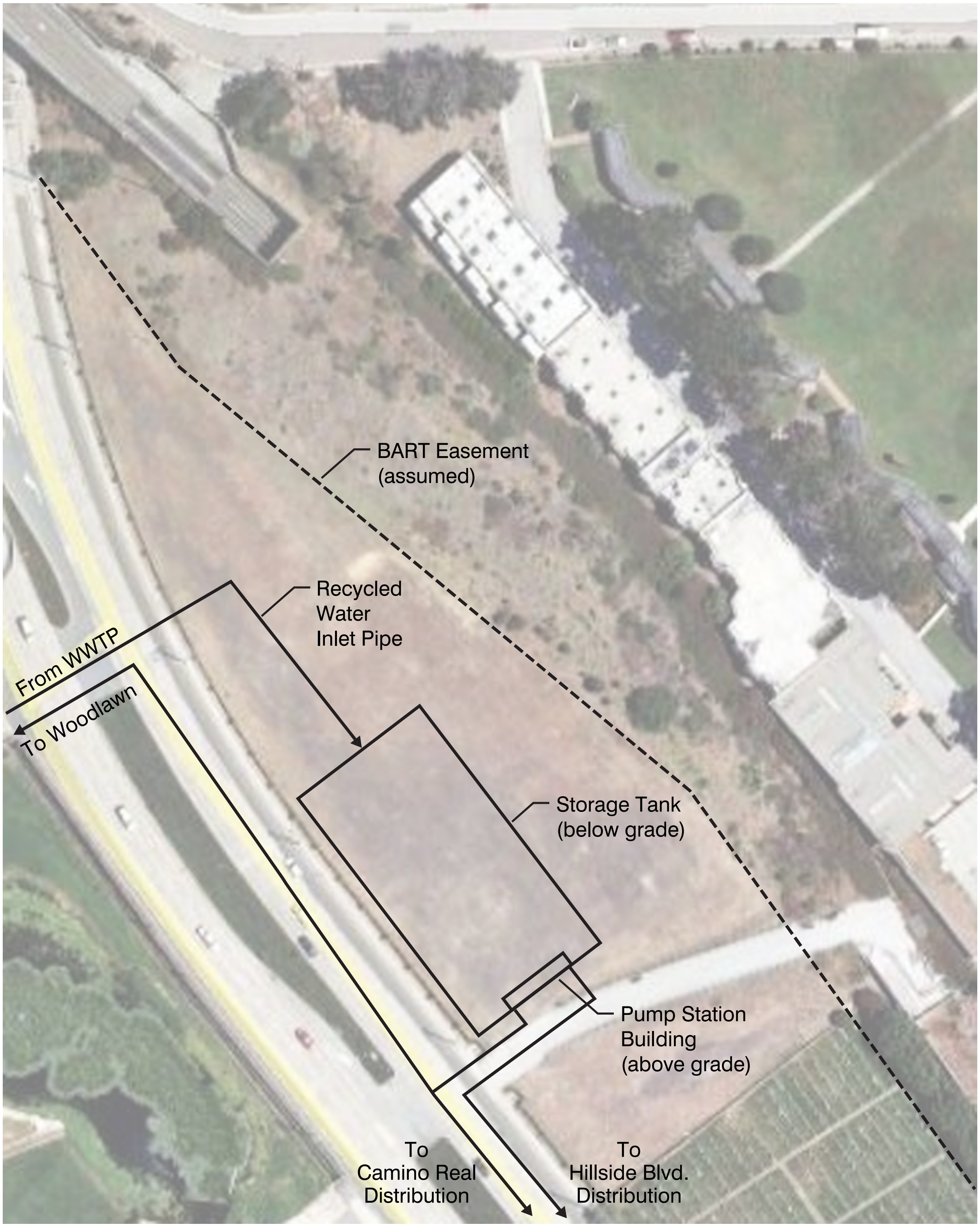
(1) 5% escalation to mid-point of construction added per year. Assumed 3 years to midpoint.

(2) Sales tax applied to 50% of total direct cost to estimate tax on materials.

The cost estimate herein is based on our professional opinion of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

4.4.3 Distribution System Pipelines

The preliminary system layout includes two distribution systems fed from the recycled water storage tank. All of the Colma properties identified as potential recycled water customers are located off of El Camino Real and Hillside Boulevard; therefore these two streets would provide the backbone for the distribution systems. The total dynamic head (TDH) for each pump station was estimated using elevations and lengths of pipe. Figure 1.12 shows an overview of the proposed Colma recycled water delivery system. The pipe diameters were sized using an average flow of 4 feet per second; the routings are conceptual. Hydraulic modeling of the distribution systems would be completed during preliminary design.



Approximate Scale: 1" = 100'

Figure 1.10
STORAGE TANK SITE
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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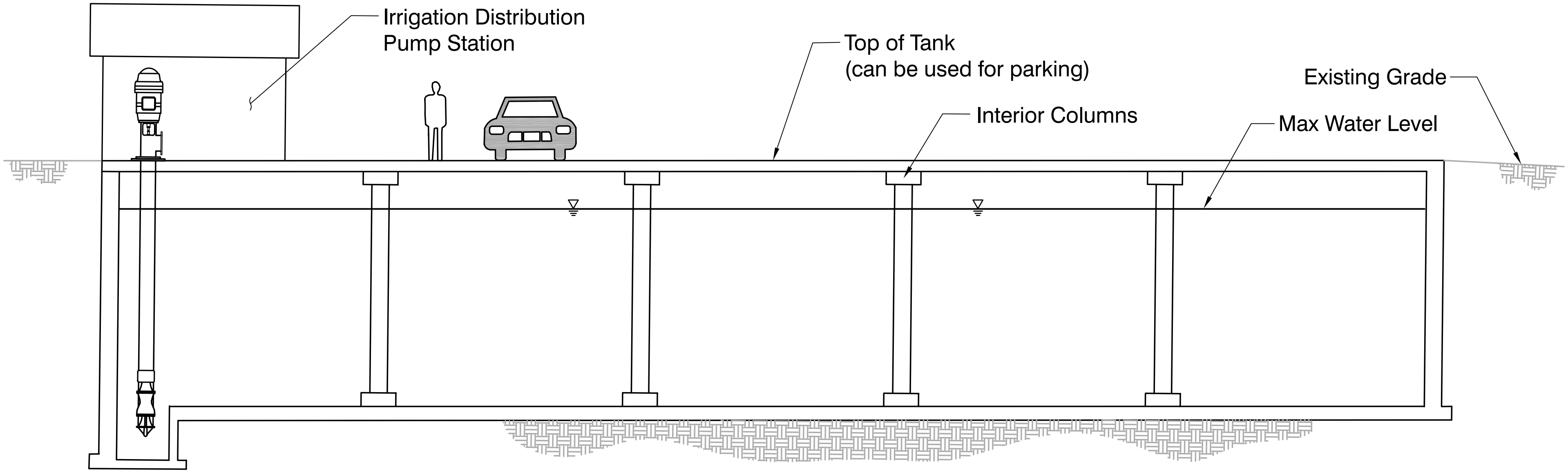

Figure 1.11
TYPICAL RECYCLED WATER STORAGE TANK AND IRRIGATION PUMP STATION
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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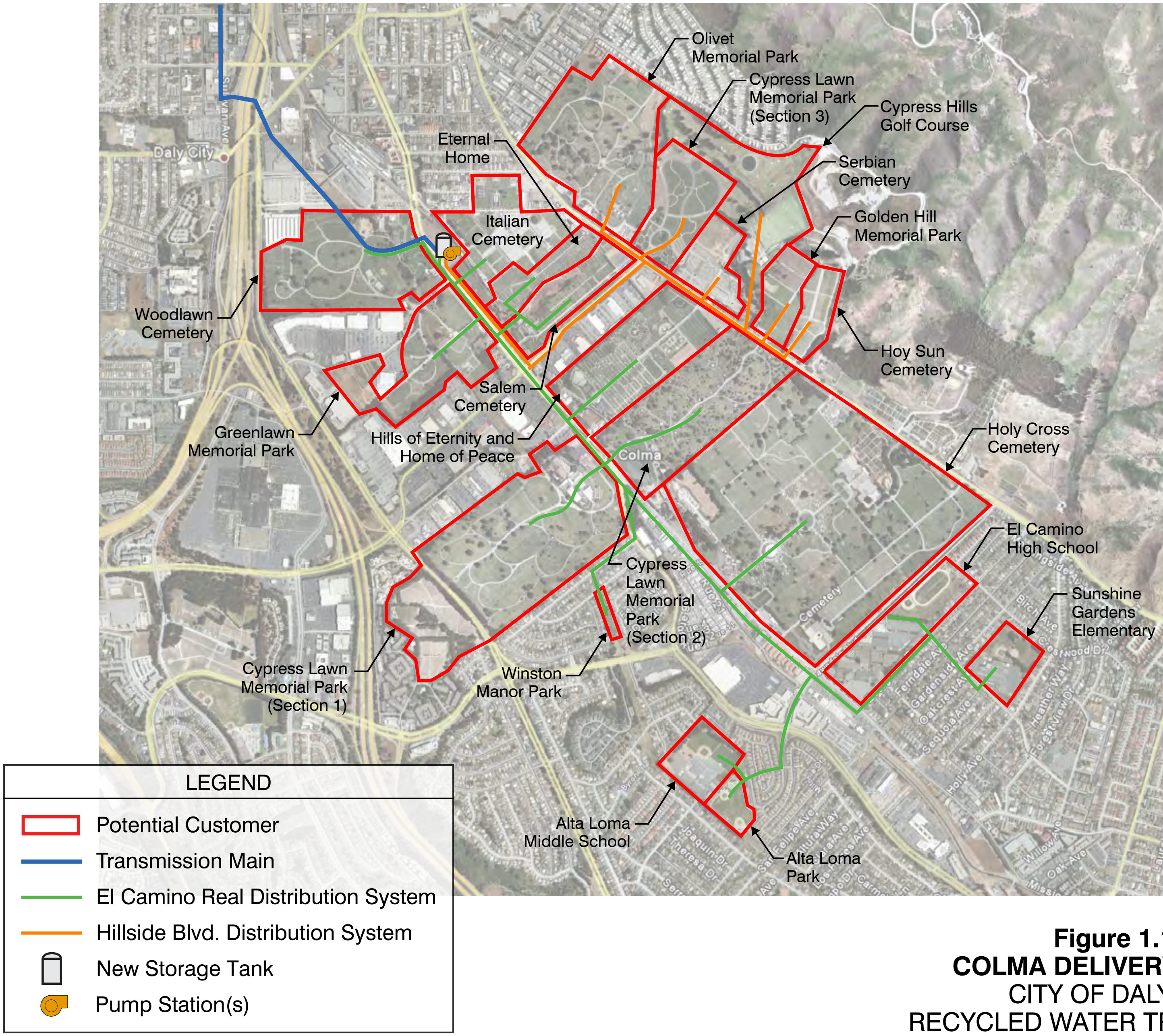

Figure 1.12
COLMA DELIVERY SYSTEM
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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5.0 NORTH (SAN FRANCISCO) TRANSMISSION MAIN CORRIDOR EVALUATION

5.1 Transmission Main

Utilizing the infrastructure currently being installed for the Harding Park Golf Course (Harding) represents the most efficient way to get recycled water to the new potential customers. For Harding, a new 18-inch diameter pipeline will extend from an existing 16-inch diameter pipeline supplying recycled water to the Olympic Club. This new 18-inch line will extend approximately 4,200 feet north along Lake Merced Boulevard to the Harding Park maintenance yard located near the intersection of Lake Merced Blvd and Higuera Rd. At this location, the recycled water pipeline turns west and connects to a new buried storage tank. Just before the storage tank, a 90-degree bend in Lake Merced Blvd would be replaced with a tee, and the 18-inch line would be extended north along Lake Merced Blvd to the additional recycled water customers.

5.2 Existing Recycled Effluent Pump Station Upgrades

Based on the demands listed above, the new REPS would supply 0.4 mgd of recycled water to the existing REPS to feed potential users downstream of Harding Park (north of the WWTP) and pump the remaining water south to the storage facility in Colma as shown in Figure 1.13.

Harding and Olympic Club will share a common pump. As shown in Figure 1.14 taken from the Harding Park Recycled Water Project Preliminary Design Report (PDR), the existing recycled effluent pump supplies Olympic Club with recycled water at a rate of approximately 2,400 gallons per minute (gpm) and Harding at a rate of 1,700 gpm. Assuming a maximum distribution rate 1,700 gpm for the additional customers using the existing pumps, it would take a minimum of 4 hours to distribute the additional 0.4 mgd.

As part of the PDR, a recommended recycled water distribution daily schedule was developed for a peak week and is presented in Figure 1.15. As shown, there are only two hours available in the distribution schedule to accommodate new customers. Therefore, the existing pumps would need to be upgraded to be able to meet all of the customer needs in a timely manner. Future analysis will determine exact upgrades at the existing REPS and the infrastructure needs downstream of Harding Park once the potential users to the north have been confirmed with the City of Daly City and the SFPUC.

5.3 Recycled Water Storage

Like the existing recycled water customers served by the WWTP, the new customers would need to have on-site storage so they can integrate into the batch delivery schedule shown

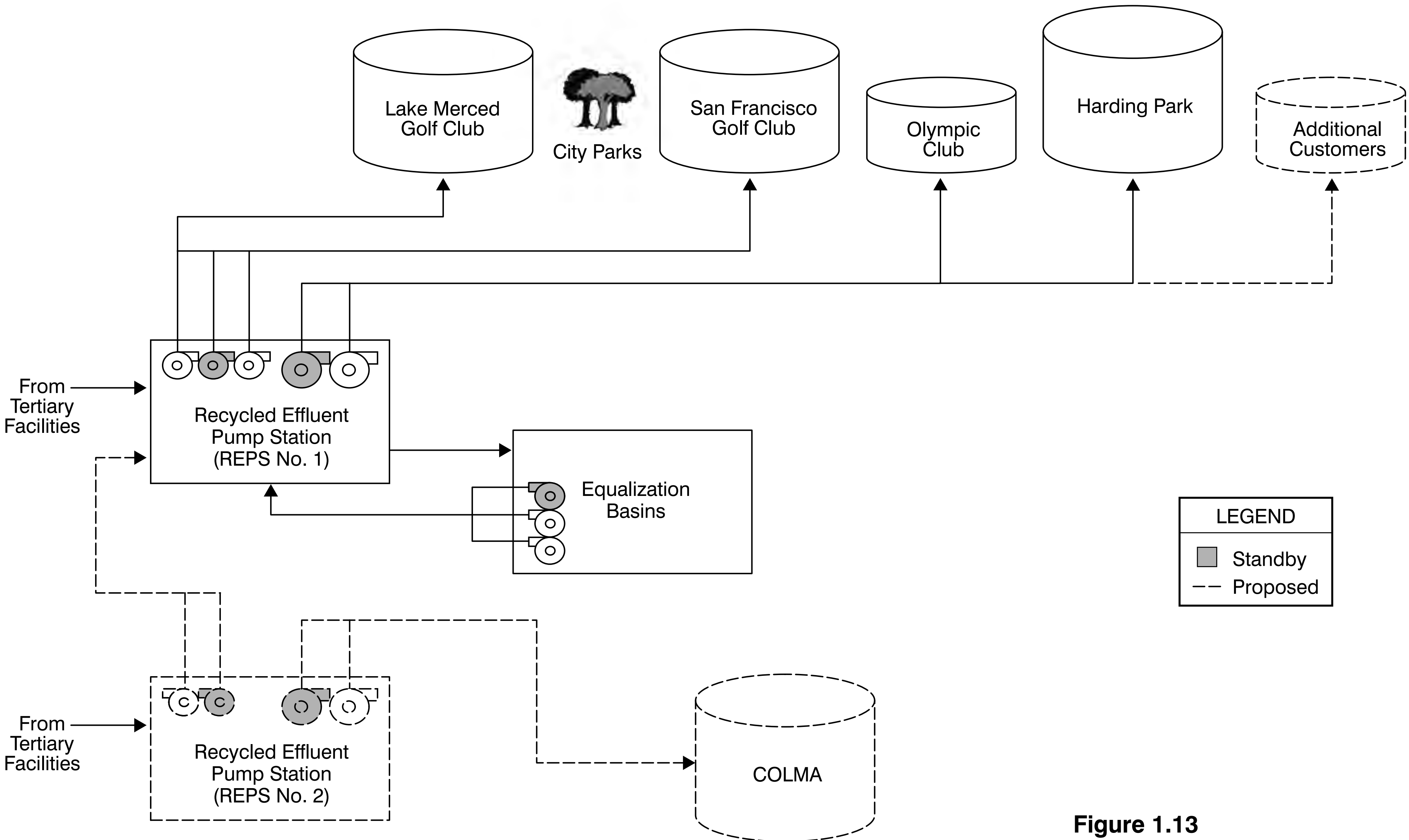

Figure 1.13
REUSE SYSTEM SCHEMATIC
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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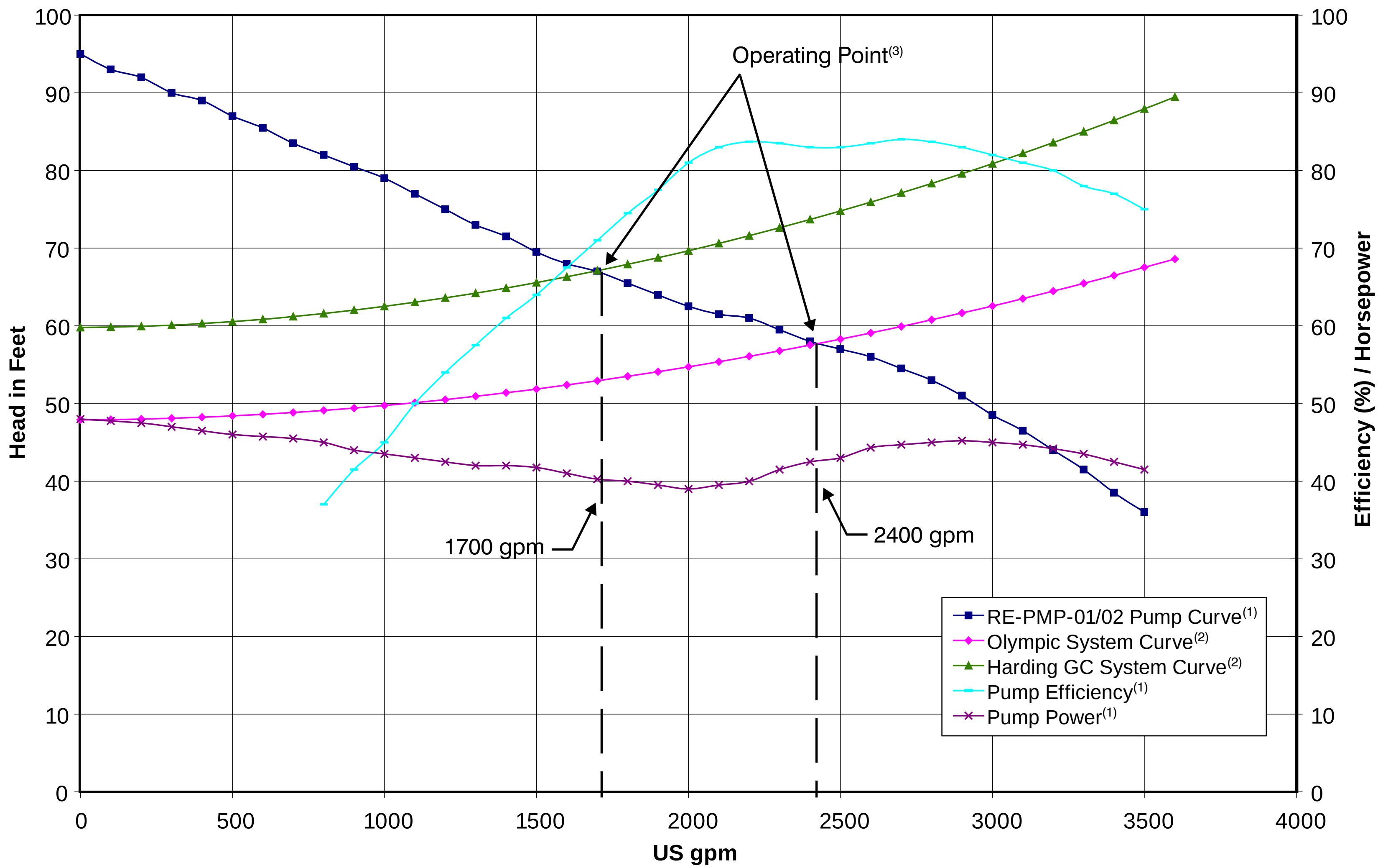

Notes:

(1) Pump information taken from 2003 Simflow Pumps submittal.

(2) System curve plots the static and friction energy losses in the pump discharge line.

(3) The intersection of each system curve and the pump curve defines the system's flow rate and operating head.

Figure 1.14
EXISTING RECYCLED EFFLUENT PUMP OPERATING POINTS
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION MAIN CORRIDOR STUDY

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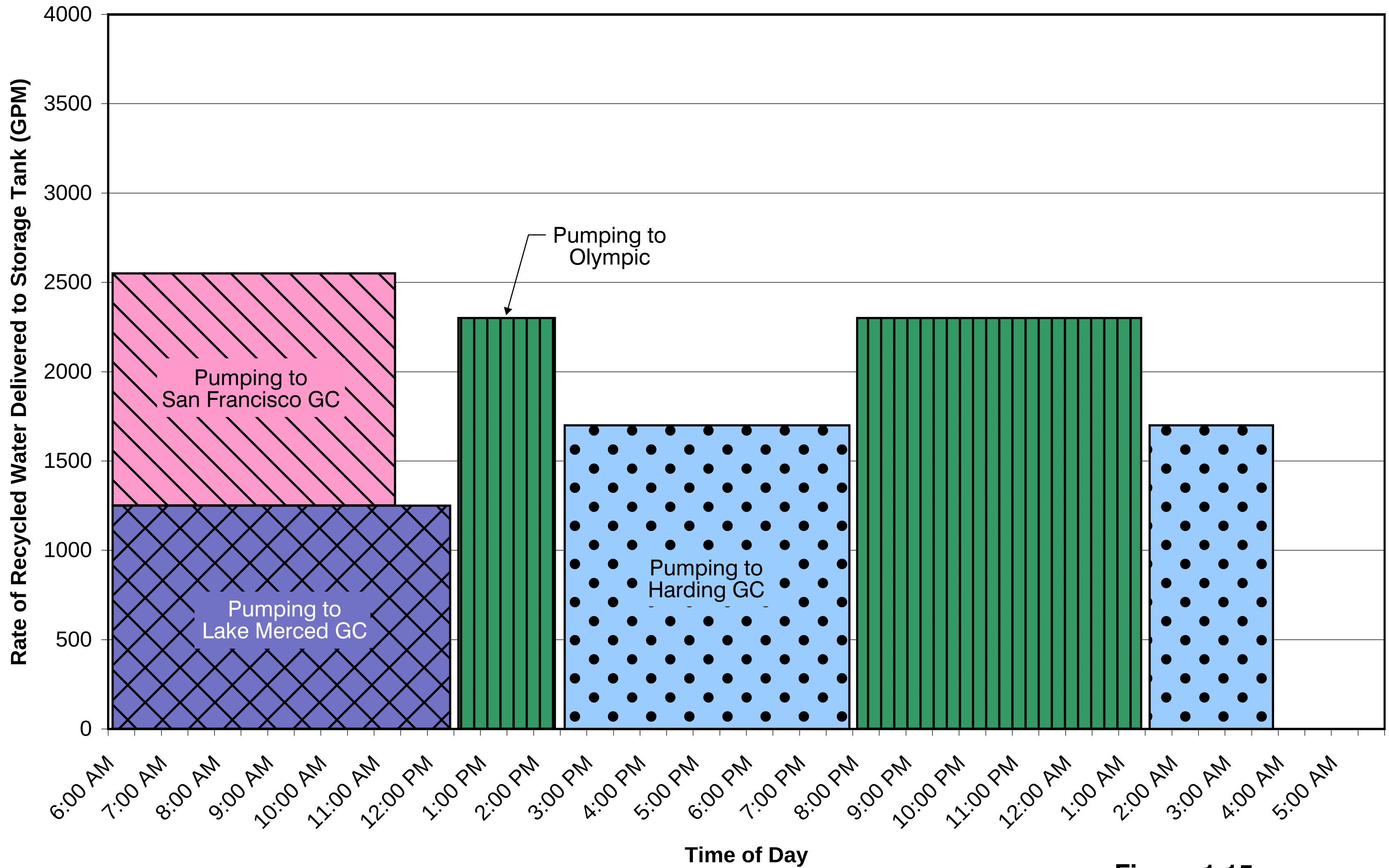

Notes:
(1) Asumes 8:00 p.m. to 4:00 a.m. irrigation schedule.

Figure 1.15
RECOMMENDED RECYCLED WATER DISTRIBUTION PEAK WEEK DAILY SCHEDULE
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION MAIN CORRIDOR STUDY

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in Figure 1.15. Once the recycled water customers are finalized, additional analysis is necessary to determine the storage size and location.

Currently, the WWTP maintains two of its four equalization basins for recycled water storage and equalization totaling approximately 1.3 million gallons (MG). Based on analysis included in the Harding Park Recycled Water Feasibility Study and PDR, the existing equalization basins would be able to accommodate the additional 0.4 mgd for daily distribution. However, during a peak flow wet weather event, the WWTP may need to use all four basins to handle wet weather inflows. In this case, the equalization basins would have to be cleaned and disinfected before being converted back to recycled water storage.

For the current system, this is not a problem because the recycled water is only distributed during the irrigation season (non-rainy reason). However both customers listed in Table 1.2 have identified year-round uses. This means that the customers would need to have either long-term storage or alternate water supplies to meet their needs when the WWTP's equalization basins cannot be used for recycled water storage.

6.0 NEXT STEPS

6.1 SAPL3 Project Modifications

The preferred alternative includes slip-lining a portion of the BMPL north of the Lake Merced Golf Course that is currently slated to be slurry filled as part of the SAPL3 construction. Modifications to the current construction plan should be identified and discussed with the SFPUC and the City of Daly City.

6.2 Customers to the North

The potential users north of Harding Park and their recycled water demands need to be identified and/or verified. From there, the necessary expansion infrastructure and upgrades at the existing recycled effluent pump station can be determined.

6.3 Existing Utilities

Based on the preferred alternative presented, additional drawings are needed including SAPL2 from the I-280 crossing to John Daly Boulevard and SAPL2, SAPL3, BMPL, and the Sunset Line from San Pedro Valve Lot south to Serramonte Boulevard. Additional information on the condition of the BMPL south of the San Pedro valve lot will aid in determining the viability of slip lining in that area.

6.4 NSMCSD Tertiary Facilities

As mentioned, upgrades to the existing REPS will be identified and further evaluation of the new REPS will be performed. The cost estimate presented in the Feasibility Study for Tertiary Treatment Expansion at the Daly City WWTP will be updated based on the new findings.

APPENDIX - EXCERPT FROM RECYCLED WATER FEASIBILITY STUDY

3.2.1 Landscape Irrigation Requirements

In many cases, landscape irrigation customers use less water than necessary because of conservation practices and cost considerations. Conversely, some customers over-irrigate because of uneven sprinkler coverage or overly conservative watering practices. Therefore, expected landscape irrigation requirements for the South San Francisco/San Bruno/Colma/Brisbane areas were calculated based on evapotranspiration and rainfall data. Calculated irrigation requirements, as defined below, were used to estimate irrigation use at sites for which existing use data was not available. Calculated irrigation requirements, in conjunction with existing water usage data, were also used to estimate peak month demand, peak day demand, and peak hour demand for distribution considerations. Peak sizing requirements and distribution system impacts are discussed in Chapter 5.

The amount of irrigation required for the potential irrigation customers is directly dependent on precipitation quantities in the region. The amount of precipitation, evapotranspiration, and irrigation required for the potential irrigation customers are listed in Table 3.1. To calculate the amount of evapotranspiration occurring in the study area, the following formula was used:

$$ET_L = K_L * ET_o$$

Where:

ET_L = Evapotranspiration of landscaped areas (in inches)

KL = Landscaped area crop coefficient

ET_o = Reference evapotranspiration (in inches)

The reference Evapotranspiration was obtained from the California Irrigation Management Information System Evapotranspiration zoning map. South San Francisco, San Bruno, and Colma are located in Zone 2, which is a coastal mixed fog area. This area exhibits less fog and higher ET_o than the coastal plains heavy fog belt. The coastal plains heavy fog belt occupies the western third of the peninsula and has the lowest ET_o in California.

To calculate the landscape evapotranspiration, the landscaped area crop coefficient was estimated using information contained in the Guide to Estimating Irrigation Water Needs of Landscape Plantings in California by the California Department of Water Resources. The landscaped area crop coefficient is the product of an average species factor (ks), density factor (kd), and microclimate factor (kmc). These were estimated to be 0.6, 1, and 1, respectively. The landscape coefficient was then multiplied by the reference evapotranspiration to determine the average landscape evapotranspiration for the study area.

Table 3.1 Average Annual Landscape Irrigation Requirements
Recycled Water Feasibility Study
Cities of South San Francisco, San Bruno, and Brisbane

Month	Evapo-transpiration (inches)(1)	Rainfall (inches)(2)	Net Irrigation Requirement (inches)(3)	Percent of Annual (%)(4)
January	0.74	4.47	0	--
February	1.01	3.59	0	--
March	1.86	2.81	0	0
April	2.34	1.37	1.31	7
May	2.79	0.39	3.25	16
June	3.06	0.12	3.98	20
July	2.98	0.02	4.00	20
August	2.79	0.05	3.71	18
September	2.34	0.19	2.91	14
October	1.67	0.94	0.99	5
November	1.08	2.45	0	--
December	0.74	3.69	0	--
Total	**23.41**	**20.09**	**20.15**	**100**
			1.68 feet	

Notes:

(1) Because there was no ET data from a station near SSF/SB, ET data from surrounding stations were averaged (#s 157, 104, and 111). The CIMIS Eto reference map indicated that South San Francisco is located in Zone 2. The zone 2 ET data was a direct measurement rather than an average and was therefore chosen for use in the analysis. Adjusted for landscape irrigation coefficient, kl.

(2) Data from Western Regional Climate Center, Station No. 047769, 1948-2004.

(3) [Evapotranspiration - Rainfall] *1.15/0.85. Where 0.85 = 85% Irrigation Factor (Average value from Carlos and Guitjens, University of Nevada) and 1.15 = 15% Leaching Fraction (Average value from Ayers and Westcot, "Water Quality for Agriculture", Food and Agriculture Organization of the United Nations).

(4) Current month net irrigation requirement divided by total net irrigation requirement.

As seen in Table 3.1, the net annual average landscape irrigation requirement in the study area is approximately 20 inches per year or 1.7 feet per year. The irrigation season is roughly April through October, a period of 7 months. Landscape irrigation demand peaks in the months of June and July at 4 inches, 20 percent of the annual total. The calculated landscape irrigation requirement compares favorably to the information obtained from the California Golf Club in South San Francisco. It was reported that the Golf Club uses approximately 67 million gallons (MG) of water for irrigation on a yearly basis, which is equivalent to 1.7 feet per year.

The net annual average landscape irrigation requirement and the empirical California Golf Club irrigation requirement figures were compared with the net annual average landscape irrigation of 2.2 acre feet (ac-ft) of water per acre of land per year obtained from the golf course superintendent, Pat Finlin, at the Olympic Club in Daly City. He stated that while it is foggier in Daly City than in the study area, the increased irrigation needed to compensate for the shorter grasses and high winds encountered at Olympic would cancel out the increase in evapotranspiration caused by the sunnier climate in the South San Francisco, San Bruno, and Colma areas. Because the calculated net annual average landscape irrigation requirement of 1.7 feet was verified by the California Golf Club, it was decided that 1.7 acre-feet water per acre of land was the more accurate number.

3.2.2 Large Potential Irrigation Customer Identification

Sixteen of the 106 total identified customers were defined as large landscape irrigation users. Large landscape irrigation users are defined as having a total irrigable area greater than 20 acres or a daily summer irrigation usage of greater than 50,000 gpd. These properties are important because they form the base of the potential recycled water demand in the study area. Eight cemeteries, 2 golf courses, 2 city parks, an apartment complex, a marina, and 2 development areas compose the major irrigation water users. These include the Golden Gate National Cemetery, the San Bruno City Park, Shelter Creek Apartments in San Bruno as well as the California Golf Club, Orange Memorial Park, Oyster Point Marina in South San Francisco, and the Sierra Point Development and future Baylands Development in Brisbane. Seven out of the 8 cemeteries and Cypress Hills Golf course are located in Colma: Holy Cross Cemetery, Cypress Lawn Memorial Park, Woodlawn Cemetery, Olivet Memorial Park, Greenlawn Memorial Park, Italian Cemetery, and the Salem, Hills of Eternity, and Home of Peace triumvirate.

Due to the urban environment of the study area, no major agricultural irrigation water users were identified.

3.2.3 Small Potential Irrigation Customers

Smaller landscape irrigation customers, including parks, cemeteries, and schoolyards were also identified. Although each smaller individual potential customer does not have a large quantity of expected recycled water demand, when taken as a whole, small customers could contribute a significant volume of recycled water use.

Six parks in the City of South San Francisco, not including Orange Memorial Park, were identified as potential recycled water irrigation customers. These parks contain a total estimated irrigable area of 25.8 acres and estimates put the yearly irrigation demand at 59 acre-feet per year (ac-ft/yr). Sign Hill Park was not considered because it is not currently irrigated. Numerous smaller parks were not considered due to their small size. These parks may be added to the list of potentially viable recycled water irrigation customers if a distribution line is located nearby.

5.2.2 Peak flow Demands

Peak flow demands were determined for each potential customer. Peak demands were extrapolated from average irrigation season flow for irrigation customers and average annual flow for industrial/commercial customers. Maximum month, peak day, and peak hour flow demands were calculated based on available information and conservative assumptions. Maximum month flow demands for irrigation sites were calculated as 20 percent of annual recycled water demand, based on evapotranspiration and rainfall data detailed in Section 3.2.1 of this report. Maximum month demands for industrial/commercial customers were estimated at 10 percent of annual recycled water demand, given the relatively constant flow demand for these industries. The calculated peak flows were compared to the actual maximum month demands and the more conservative (i.e., greater) peak flow was chosen for design. The majority of potential customers exhibited actual peak flows lower than the calculated peak demand. This may be due to conservation measures or economic considerations.

Total annual recycled water demand and maximum month recycled water flow demand for each customer grouping is summarized in Table 5.1. Total estimated maximum month flow demand for all potential customers is 6.64 million gallons per day (mgd).

Table 5.1 Maximum Month Flow Demands
Recycled Water Feasibility Study
Cities of South San Francisco, San Bruno, and Brisbane

Customer Grouping	Average Irrigation Season Demand (ac-ft/y)(1)	Maximum Month Demand (ac-ft/month)(2)	Maximum Month Demand (mgd)(2)
Colma	1801	207	2.22
I-280	1097	141	1.51
Industrial	337	37	0.39
South San Bruno	285	28	0.30
Year-Round(3)	613	90	0.96
Sign Hill	43	5	0.06
West San Bruno	262	19	0.20
Brisbane Lower	545	64	0.68
Brisbane Upper	143	17	0.18
Non-Grouped Sites	112	12	0.13
Total	**5,238**	**621**	**6.64**

Notes:
(1) Average Irrigation Season Recycled Water Flow in units of acre-feet per year.
(2) Demands in units of acre-feet per month (ac-ft/month) and million gallons per day (mgd).
(3) Average Annual Recycled Water Flow in acre-feet per year.

Peak day demands were calculated using a peaking factor of 1.3. The peaking factor was multiplied by the average daily demand of the maximum month for all customers. Peak hour demand is based on the assumption that irrigation will occur over an 8-hour period from 9:00 PM to 5:00 AM. Commercial and industrial users peak hourly demands were calculated on either 16 or 24-hour usage patterns.

Peak daily and peak hourly demands will be used to size the distribution system, including pipelines, pumping requirements, and storage requirements. The treatment system will be designed to operate at the peak daily demand and storage will be provided to supply the surplus recycled water needed during peak hours. Peak day and peak hour recycled water flow demands for each customer grouping are summarized in Table 5.2. Total estimated peak day demand for all existing and potential customers is 8.82 mgd, although peak flow demands may not necessarily occur simultaneously.

Table 5.2 Peak Day and Peak Hour Flow Demands
Recycled Water Feasibility Study
Cities of South San Francisco, San Bruno, and Brisbane

Customer Grouping	Peak Day Demand (ac-ft/day)(1)	Peak Day Demand (mgd)(1)	Peak Hour Demand (ac-ft/hour)(2)	Peak Hour Demand (mgd)(2)
Colma	8.98	2.93	1.12	8.78
I-280	6.12	2.00	0.77	5.99
Industrial	1.59	0.52	0.20	1.55
South San Bruno	1.23	0.40	0.15	1.21
Year-Round	4.04	1.32	0.26	2.01
Sign Hill	0.23	0.08	0.03	0.22
West San Bruno	0.82	0.27	0.10	0.80
Brisbane Lower	2.77	0.90	0.35	2.71
Brisbane Upper	0.73	0.24	0.09	0.71
Non-Grouped Sites	0.54	0.18	0.07	0.53
Total	**27.05**	**8.82**	**3.13**	**24.51**

Notes:
(1) Peak day demand includes a peaking factor of 1.3 over maximum month demand.
(2) Peak hour demand is based on the peak day demand averaged over the 8-hour nightly irrigation period (9:00 PM to 5:00 AM). Industrial/commercial users peak hour demands are based on 16 or 24 hour use patterns.

5.2.3 Seasonality and Daily Use Distribution

Recycled water customers often have varying seasonal demand. Irrigation customers have seasonal demand peaking in the warm, dry summer months. Industrial and commercial process customers have a consistent year-round demand. Additionally, daily use distribution can be customer-specific due to timing of water use, regulated irrigation-timing requirements, available storage, and other site constraints. Publicly accessible irrigation sites generally irrigate at night, when site use is minimal to nonexistent. The majority of potential customers in the study area are cemeteries, golf courses, parks, and schools; therefore, most irrigation will occur at night. For the purpose of this study, it was assumed irrigation occurred between the hours of 9:00 PM and 5:00 AM.

5.2.4 Storage Requirements

Because it is not economically feasible to design a recycled water treatment facility to meet maximum hourly recycled water demands, storage is necessary to meet these demands. Storage requirements are calculated by subtracting the designed production flow by the maximum hourly demand and multiplying the difference by the amount of time that the maximum hour demand will take place (8 hours in this case).

5.3 CONCEPTUAL DESIGN APPROACH

The objective of conceptual design is to link customer groupings, usage quantities, design flows, and treatment systems into recycled water system alternatives. The alternatives will vary in the number of customers served, extent of distribution system, treatment technologies, and wastewater source. The number of customers served depends on the extent of the distribution system. The extent of the distribution system is defined by the size, location, and number of pump stations and transmission pipelines as well as the storage capacity of the system. Customer elevation, distance from treatment point, and pipeline route usually decide the cost of a distribution system. The goal in designing a recycled water distribution system is to maximize usage while minimizing distance and elevation changes. Treatment technologies are dependent on the wastewater source. Raw wastewater must be treated by a biological process and tertiary treatment step, such as a membrane bioreactor, while secondary effluent obtained from an existing treatment facility (i.e., South San Francisco/San Bruno Water Quality Control Plant [WQCP]) can be treated solely by a tertiary process. Effluents from both types of treatment processes must be disinfected to meet Title 22 requirements.

The South San Francisco, San Bruno, and Brisbane recycled water feasibility project must consider several wastewater sources. The first is the secondary effluent produced by the South San Francisco/San Bruno WQCP. This effluent is currently discharged through the North Bayside System Unit (NBSU) outfall into the San Francisco Bay. Another possible source is the secondary effluent pumped from Millbrae and Burlingame to the NBSU. These pipelines run parallel to each other north through San Bruno to the WQCP where they are mixed with the WQCP effluent before being pumped into the NBSU outfall. Using the secondary effluent from Millbrae and Burlingame would allow a treatment facility to be located at various points in the study area. Additionally, secondary effluent can be drawn

REGISTERED PROFESSIONAL ENGINEER
MICHAEL JAMES BRYTEN
No. C27729
Exp. 3/31/10
CIVIL
STATE OF CALIFORNIA

September 1, 2009

REGISTERED PROFESSIONAL ENGINEER
NEAL BENTON ALLEN
No. C45446
Exp. 12/31/10
CIVIL
STATE OF CALIFORNIA

September 1, 2009

City of Daly City
Recycled Water Transmission Main Corridor Study

TECHNICAL MEMORANDUM NO. 2

COMPARISON OF WEST ROUTE AND EAST ROUTE

FINAL
September 2009

City of Daly City
Recycled Water Transmission Main Corridor Study

TECHNICAL MEMORANDUM
NO. 2
COMPARISON OF WEST ROUTE AND EAST ROUTE

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COMPARISON OF WEST ROUTE AND EAST ROUTE

1.0 PURPOSE

The purpose of Technical Memorandum No. 2 (TM2) is to evaluate the proposed west route for the recycled water transmission main and to select a recommended pipeline route to serve customers in the Town of Colma. During Workshop No. 1 held on June 18, 2009, the project team (City of Daly City, San Francisco Public Utilities Commission [SFPUC], and Carollo Engineers) reviewed the preliminary findings and recommendations presented in Technical Memorandum 1 (TM1). In TM1, the selected preferred route was through Lake Merced Golf Club and parallel to I-280 (the east route). However, as discussed in the workshop, there is a potential for conflicts with SFPUC's new San Andreas Pipeline No. 3 (SAPL3). The discussion led to proposing a new west route that would run through the residential streets in Daly City to the I-280 crossing. Beyond the I-280 crossing, the west route and the east route would follow the same alignment. Please refer to Figure 2.1.

TM2 provides a comparative analysis of the west route and the east route north of the I-280 crossing and identifies the recommended complete pipeline route for delivering recycled water to Colma.

2.0 COMPARISON OF EAST AND WEST ROUTES

Consistent with the alternatives analysis presented in TM1, alignment and construction method alternatives were identified for the east route and evaluated based on the non-economic criteria presented below. Each criterion was assigned a score from 1 to 3, with 1 being the least desirable and 3 the most desirable. The alternative evaluation is summarized in Table 2.1.

3.0 PREFERRED ROUTE FOR COLMA TRANSMISSION PIPELINE

The cost analysis presented in Table 2.1 indicates that the capital costs for west and east routes would be essentially the same. However, the west route would avoid potential scheduling conflicts with the San Andreas Pipeline 3 as well as a potentially lengthy permitting and right of way acquisition process that would be required for the east route. Therefore, the west route is the preferred alternative.

Figure 2.1
COLMA PIPELINE CORRIDOR SEGMENTS
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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Table 2.1 Segment 1 Alternative Evaluation
Recycled Water Transmission Main Corridor Study
City of Daly City

Criteria	Segment No. 1 East Route - East on N. Mayfair to BMPL and South through LMGC, Edgeworth Avenue, and Sullivan Avenue	Score	West Route - South on Lake Merced Boulevard, Park Plaza Drive, Washington Street and Edgeworth Avenue	Score
Permitting (Land use and environmental impacts)	Encroachment permits required for City streets, includes both Daly City and San Mateo County (for unincorporated Broadmoor area). Pipeline also runs through Lake Merced Golf Course however, SFPUC has a 25' floating easement. May effect trees and require new landscaping.	2	Encroachment permits required for City streets, includes both Daly City and San Mateo County (for unincorporated Broadmoor area).	3
Community (Dust, noise and convenience)	Potential impacts to residents and businesses along alignment including Westfield Shopping Center and City Hall. Potential golfer disruption at access pit locations, design approach should locate pits in rough if possible.	1	Potential impacts to residents and businesses along alignment including Westfield Shopping Center.	2
Constructability (Trenchless, access)	Open cut construction is viable along majority of alignment. Night work may be required at John Daly portion or John Daly Crossing at Sheffield Drive as well as intersection of Washington and Sullivan at I-280 off-ramp. Open cut along city streets may require closing to through traffic. Slip line of existing 30" BMPL is potentially viable based on talks with SFPUC staff. Will need access pits at pipeline bends. Open-cut construction is also viable but extremely disruptive to golf course. May require night construction and minimal trench lengths or tunnel (HDD) alternatives.	2	Open cut construction is viable along entire length of alignment. Night work may be required at John Daly Crossing at Westfield and Pierce at I-280 off-ramp. Open cut along city streets may require closing to through traffic.	2
Easements	Construction primarily within public right-of-way (public streets, public parks, existing pipeline easements). May require temporary easements at several locations along alignment. May require additional construction easements if not covered by SFPUC 25' floating easement.	2	Construction entirely within public right-of-way (public streets, public parks, existing pipeline easements). May require temporary easements at several locations along alignment.	3
Utility	Narrow corridor and congested with utilities including water, sewer, and recycled water. Parallels portions of major SFPUC waterlines (SAPL2 and SAPL3). Reuse of existing BMPL within LMGC avoids utility conflicts. Access pits may conflict with irrigation lines.	2	Narrow corridor with utilities including water and sewer, but not as congested as Sullivan Ave. Avoids paralleling any major SFPUC waterlines.	2
Traffic	Traffic issues on city streets mostly limited to ingress/egress of residents or businesses. Potential traffic impacts to LMGC parking and access as well as the I-280 off-ramp at Washington and Sullivan.	2	Traffic issues on city streets mostly limited to ingress/egress of residents or businesses. Potential traffic impacts at the I-280 off-ramp at Sullivan and Pierce.	2
Operation and Maintenance (Accessibility)	Routine maintenance access city streets consistent with any other facility located in residential streets. Excavation would impact residents, businesses and City Hall. Good maintenance access at LMGC but would need to be scheduled around LMGC hours. Excavation would impact golfers.	2	Routine maintenance access city streets consistent with any other facility located in residential streets. Excavation would impact residents and businesses	2
	Total:	**13**	**Total:**	**16**
Approx. Total Length	**12,255 LF**		**10,105 LF**	
Estimated Total Direct Cost(2)	**$2,530,000**		**$2,444,000**	

Notes:
(1) Score: Least desirable = 1, Most desirable = 3.
(2) Costs listed are used for comparison purposes and were developed using a pipeline diameter of 18 inches. A refined cost estimate of the preferred alternative is presented in Section 4.2. Costs do not include contingencies, Contractor OH&P, General Conditions, Tax or Engineering, Legal, & Administrative Fees.

3.1 Hydraulic Analysis

Additional hydraulic calculations were performed for the west route to optimize the pipeline diameter. As shown in Table 2.2, decreasing the pipe diameter from 24 inches to 18 inches only increases the total dynamic head (TDH) and horsepower by approximately 6 percent. At 16 inches and below, the TDH and horsepower begin to increase exponentially. Therefore, the optimal pipeline size is 18 inches.

Table 2.2 Colma Pumping Power Comparison
Recycled Water Transmission Main Corridor Study
City of Daly City

Pipeline Diameter (in)	Peak Day Demand (mgd)	Approx. TDH(1) (ft)	Pump Power Required(2) (hp)
24	3.0	156	97
20		160	100
18		165	103

Notes:
(1) Total dynamic head was calculated using the Hazen Williams coefficient for headloss with an additional 15% loss to account for pipe bends.
(2) Pumping horsepower calculated assuming 85% pump efficiency.

3.2 Updated Planning Cost Estimate

The preliminary cost estimate for the transmission main to Colma was updated using the west route and an 18-inch diameter pipeline. The costs are presented in Table 2.3.

This estimate was compared with the current construction bid for the SFPUC San Andreas Pipeline No. 3 obtained from Susan Hou, SFPUC. The prevailing contractor’s bid for 4.4 miles of 36-inch diameter pipeline was $16.3 million, which equates to approximately $700 per linear foot or $20 per inch diameter per linear foot. The cost presented in Table 2.3 for the west route is approximately $24 per inch diameter per linear foot.

The updated total costs for the recycled water transmission infrastructure, including transmission line, storage basin and distribution system to customers in Colma, are presented in Table 2.4.

Table 2.3 Transmission Pipeline - Updated Preliminary Cost Estimate for West Route
Recycled Water Transmission Main Corridor Study
City of Daly City

Cost Item		Total
Segment. 1 (WWTP to I-280) - 10,105 feet		$2,444,000
Segment. 2 (I-280 Bridge crossing)- contingency for modifications to existing pipeline		$100,000
Segment No. 3 (I-280 to Colma storage tank) - 3,350 feet		$511,000
Total Direct Cost		**$3,055,300**
Estimating Contingency	30%	$917,000
Contractor Overhead and Profit	12%	$477,000
Escalation to Midpoint	(5%/yr)	$701,000
Sales Tax	8.25%	$126,000
General Conditions	12%	$633,000
Total Estimated Construction Cost		**$5,909,000**
Engineering, Legal, and Administrative Fees	20%	$1,182,000
Owner's Change Order Reserve	5%	$295,000
Total Estimated Project Cost		**$7,386,000**

Notes:

(1) 5% escalation to mid-point of construction added per year. Assumed 3 years to midpoint.

(2) Sales tax applied to 50% of total direct cost to estimate tax on materials.

(3) Unit costs were estimated using an 18-inch diameter pipeline buried 36 inches below grade.

The cost estimate herein is based on our professional opinion of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

Table 2.4 Colma Recycled Water Infrastructure - Updated Preliminary Cost Estimate
Recycled Water Transmission Main Corridor Study
City of Daly City

Cost Item		Total
Colma Transmission Main		$3,055,300
Colma Buried Storage Tank		$3,441,000
Hillside Booster Pump Station		$292,000
Hillside Distribution Network		$1,565,000
El Camino Real Booster Pump Station		$343,000
El Camino Real Distribution Network		$3,404,000
Total Direct Cost		**$12,100,300**
Estimating Contingency	30%	$3,630,000
Contractor Overhead and Profit	12%	$1,888,000
Escalation to Midpoint	(5%/yr)	$2,777,000
Sales Tax	8.25%	$499,000
General Conditions	12%	$2,507,000
Total Estimated Construction Cost		**$23,401,000**
Engineering, Legal, and Administrative Fees	20%	$4,680,000
Owner's Change Order Reserve	5%	$1,170,000
Total Estimated Project Cost		**$29,251,000**

Notes:

(1) 5% escalation to mid-point of construction added per year. Assumed 3 years to midpoint.

(2) Sales tax applied to 50% of total direct cost to estimate tax on materials.

(3) Unit costs were estimated using an 18-inch diameter pipeline buried 36 inches below grade.

The cost estimate herein is based on our professional opinion of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

September 1, 2009

September 1, 2009

City of Daly City
Recycled Water Transmission Main Corridor Study

TECHNICAL MEMORANDUM NO. 3

SAN FRANCISCO LAKE MERCED AREA RECYCLED WATER DELIVERY SYSTEM EVALUATION

FINAL
September 2009

City of Daly City
Recycled Water Transmission Main Corridor Study

TECHNICAL MEMORANDUM
NO. 3
SAN FRANCISCO INFRASTRUCTURE

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SAN FRANCISCO INFRASTRUCTURE

1.0 PURPOSE

The purpose of Technical Memorandum No. 3 (TM3) is to identify the potential customer demands and the infrastructure required to deliver recycled water to additional customers located north of the Daly City Wastewater Treatment Plant (WWTP). This memorandum serves as a reference document for participants in the upcoming Workshop No. 2. Information on potential customers south of the WWTP (in the Town of Colma) can be found in TM1 and TM2 for the Recycled Water Transmission Main Corridor Study.

2.0 SAN FRANCISCO CUSTOMER RECYCLED WATER DEMANDS

The Daly City WWTP is considering expanding its tertiary treatment capacity to produce an additional 3.4 million gallons per day (mgd) of recycled water for distribution to potential customers in the Town of Colma to the south and the City of San Francisco to the north. TM1 identified demands of approximately 3.0 mgd for the Town of Colma. The remaining 0.4 mgd of production capacity is available for recycled water customers in the San Francisco Lake Merced area. Three potential recycled water customers were identified by the San Francisco Public Utilities Commission (SFPUC) and the City of Daly City: Housing developments at Lake Merced Hill and Parkmerced, and the San Francisco State University. The Parkmerced development and San Francisco State University would use recycled water for irrigation and residential non-potable uses (i.e., toilet flushing and commercial laundry).

2.1 Lake Merced Hill Demand

According to Lake Merced Hill representative, Michael Doleger, the average annual irrigation demand for the development is estimated at 2.4 million gallons (MG) per year. This estimate is based on calculations using methods outlined in the 1992 SFPUC Recycled Water Master Plan. Using the same evapotranspiration and rainfall data detailed in the South San Francisco Recycled Water Feasibility Study (included in the Appendix of TM1), the maximum month demand was calculated as 20 percent of annual recycled water demand. The peak day demand was calculated using a peaking factor of 1.3. The results are presented in Table 3.1.

Table 3.1	Lake Merced Hill Recycled Water Demand for Irrigation Recycled Water Transmission Main Corridor Study City of Daly City
Description	**Value**
Average Annual Demand(1)	2.4 million gallons
ET Percentage for Max Month	20%
Max Month Demand	0.48 million gallons
Max Month Average Daily Demand(2)	0.016 mgd
Peaking Factor	1.3
Peak Day Demand	**0.021 mgd**

Notes:
(1) Reported to SFPUC by Michael Doleger, representative for Lake Merced Hills.
(2) Based on 30 days per month.

2.2 Parkmerced Demand

In 2008, Gibson, Dunn & Crutcher, LLP provided the SFPUC with an estimate of recycled water demand for the Parkmerced Development. The average annual demand for year-round residential use (toilet flushing, commercial laundry, etc.) is estimated at 0.14 mgd. The average annual demand for irrigation is estimated at 0.09 mgd. The average annual demands were then analyzed using the same methods detailed above. The results are presented in Table 3.2 below.

Table 3.2	Parkmerced Recycled Water Demand Recycled Water Transmission Main Corridor Study City of Daly City	
Description	**Irrigation Demand**	**Year-Round Use Demand**
Average Annual Demand(1)	32.5 million gallons	0.14 mgd
ET Percentage for Max Month	20%	n/a
Max Month Demand	6.57 million gallons	n/a
Max Month Average Daily Demand(2)	0.219 mgd	n/a
Peaking Factor	1.3	1.3
Peak Day Demand	**0.285 mgd**	**0.182 mgd**

Notes:
(1) Reported to SFPUC by Gibson, Dunn & Crutcher LLP, representative for Parkmerced. Average demand of 0.09 mgd multiplied by 365 days per year.
(2) Based on 30 days per month.

2.3 San Francisco State University (SFSU) Demand

San Francisco State University is interested in using recycled water for irrigation and year-round uses for a new building that is planned to be constructed with dual plumbing. The average annual use was reported as 0.07 mgd for irrigation and 0.01 mgd for year-round use. The average annual demands were analyzed using the same methods detailed above. The results are presented in Table 3.3 below.

Table 3.3 SFSU Recycled Water Demand
Recycled Water Transmission Main Corridor Study
City of Daly City

Description	Irrigation Demand	Year-Round Use Demand
Average Annual Demand(1)	25.55 million gallons	0.01 mgd
ET Percentage for Max Month	20%	n/a
Max Month Demand	5.11 million gallons	n/a
Max Month Average Daily Demand(2)	0.170 mgd	n/a
Peaking Factor	1.3	1.3
Peak Day Demand	**0.221 mgd**	**0.013 mgd**

Notes:
(1) Reported to SFPUC by San Francisco State University in 2007.
(2) Based on 30 days per month.

2.4 Total Customer Demands

The total estimated customer demands are presented in Table 3.4. The estimated peak day demand for the preliminary list of customers exceeds the 0.4 mgd production capacity available from the Daly City WWTP. The WWTP will be able to supply the average day demands for these customers, but during peak demand periods the recycled water supply will need to be augmented with potable water. This is consistent with current recycled water delivery system operation for Harding Park.

3.0 SAN FRANCISCO LAKE MERCED AREA CUSTOMER RECYCLED WATER DELIVERY SYSTEM

As discussed in TM1, the most efficient way to convey recycled water to customers in the San Francisco Lake Merced area is to utilize the recycled water pipeline currently being installed for the Harding Park Golf Course. The new 18-inch Harding Park line will extend approximately 4,200 feet north along Lake Merced Boulevard from Olympic Club to the Harding Park maintenance yard located near the intersection of Lake Merced Boulevard

Table 3.4 Northern Customers - San Francisco Recycled Water Transmission Main Corridor Study City of Daly City		
Name	**Type of Use**	**Peak Day Demand (mgd)**
Lake Merced Hill	Irrigation	0.021
	Year-Round Use	n/a
Parkmerced Development	Irrigation	0.285
	Year-Round Use	0.182
San Francisco State University	Irrigation	0.221
	Year-Round Use	0.013
Total		**0.722**

Note:
(1) The total recycled water demand for the northern customers is greater than the 0.4 mgd surplus available for peak days.

and Higuera Road. This new line fronts the east side of the property for each customer and parallels the existing 60-inch diameter Sunset Line transmission main that will provide potable water to each customer. Figure 3.1 provides a general map showing each property location.

The existing recycled water system currently operates as a batch delivery system, supplying water to each user at different time periods each day. To accommodate the batch schedule and incorporate more flexibility for the customer, each customer would require a storage tank. For the purposes of this TM, it is assumed that the storage tank would be buried, similar to Harding Park, with a pump station building above ground. As stated above, a potable supply would be required to augment for the recycled water system during peak day demands.

3.1 Lake Merced Hill

Lake Merced Hill (LMH) is a private secured community located between Lake Merced Boulevard and the San Francisco Golf Club. The community is made up of townhomes encircling central parking areas and enveloped by trees.

The tank for Lake Merced Hill would be sized for the peak day demand of 21,000 gallons. Due to its small size, an above ground cylindrical storage tank is most appropriate. There would be a small pump station adjacent to the tank to supply recycled water to the irrigation system.

Siting an aboveground storage tank within the Lake Merced Hill community is probably unfeasible because of visual impacts. However, there is a plot of land just north of North Lake Merced Hills called Camp Ida Smith (leased by the Girl Scouts of America) which may be suitable for the tank. During the renovation of the Lake Merced Pump Station, the SFPUC has relocated the pump station maintenance staff to this property in exchange for

Figure 3.1
NORTHERN CUSTOMERS
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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making several improvements to the property. The gated entrance off of Lake Merced Boulevard contains portable trailers, portable storage units, and gravel parking. There is ample space within this footprint to construct the water storage tank shown in Figure 3.2.

3.2 Parkmerced

For Parkmerced, the recycled water storage tank would be sized for the peak day demand of 467,000 gallons. It is assumed that the storage tank would be buried concrete similar to Harding Park. Because there is both an irrigation and a year-round demand, two pump stations are needed. For irrigation, an aboveground vertical turbine irrigation station system similar to Harding Park is assumed. For the year-round demand, a hydropnuematic system is required.

Parkmerced is located directly across Lake Merced Boulevard from the Harding Park Maintenance Yard. A new tee would be installed on the 18-inch recycled water pipeline and a new pipeline extended east on Higuera Avenue to Arballo Drive. There is an existing asphalt-paved area at the southeast corner of Arballo Drive and Serrano Drive that appears to be unused, making it a viable location to site the storage tank. Figure 3.3 provides location and site plans for the Parkmerced storage tank.

3.3 SFSU

SFSU's recycled water distribution requirements are similar to those for Parkmerced. The storage tank would be buried with an aboveground vertical turbine irrigation system. A smaller hydropnuematic system is required for the year-round uses.

SFSU is located immediately northeast of Harding Park. A new tee would be installed where the new 18-inch transmission main for Harding Park turns west onto the Harding Park property and the pipeline would be extended north along lake Merced Boulevard to serve SFSU. A softball field at the corner of Lake Merced Boulevard and Font Boulevard is surrounded by both paved and un-paved areas. This location is suitable for siting an underground storage tank. Figure 3.4 shows the location and site plan for the SFSU storage tank.

3.4 Design Criteria

3.4.1 <u>Pipelines</u>

To be consistent with the new Harding Park system, the proposed recycled water supply pipelines to each customer are assumed to be 18 inch in diameter based on proximity in elevation and location to Harding Park. Pipeline sizes would be refined during preliminary design based on pump selection and pipe material. The pipelines are assumed to be 36 inches below grade and primarily within city streets and right-of-way.

The connection between the recycled water pump station and the customer's irrigation system for each customer is assumed to be a new 12-inch line. At Lake Merced Hill, the irrigation lines are assumed to be within 350 feet of the storage tank. Parkmerced and SFSU are much larger properties, so an allowance of 1,000 feet of pipeline between the pump station and irrigation system was included.

3.4.2 Storage Tanks

Table 3.5 presents the design criteria for the three storage tanks in the San Francisco Lake Merced Area.

Table 3.5 Recycled Water Storage Tank Design Criteria
Recycled Water Transmission Main Corridor Study
City of Daly City

Item	LMH Storage Tank	Parkmerced Storage Tank	SFSU Storage Tank
Storage Tank and Piping			
Design Standard		CA Building Code 2007	
Construction Method	Aboveground Steel Tank	Buried Concrete	Buried Concrete
Approximate Net Working Capacity	21,000 gallons	467,000 gallons	234,000 gallons
Nominal Width	-	56 feet	40 feet
Nominal Length	-	84 feet	62 feet
Nominal Diameter	20 feet	-	-
Water Level when tank is full	10 feet	15 feet	15 feet
Freeboard when tank is full		3 feet	
Recycled water inlet pipe size		18 inches	

3.4.3 Recycled Water Supply Pump Stations

For Parkmerced and SFSU, it is assumed that the supply pump stations would be prefabricated and mounted on top of the buried storage tanks. The pumps would be housed in a CMU block building. For Lake Merced Hill, the pump station would be a small multistage pump adjacent to the aboveground storage tank. Table 3.6 presents the design criteria for the pump stations for the three customers.

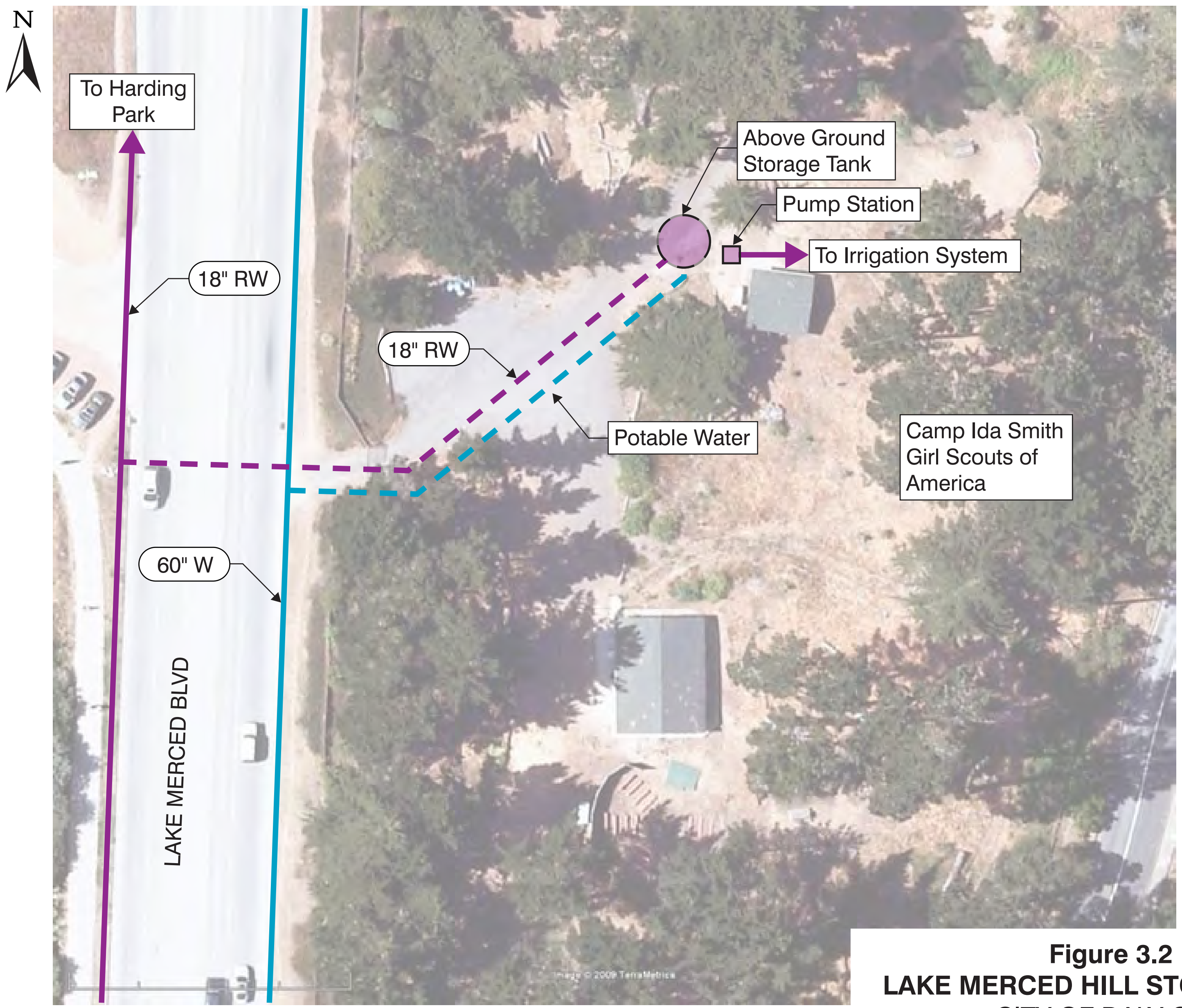

Figure 3.2
LAKE MERCED HILL STORAGE SITE
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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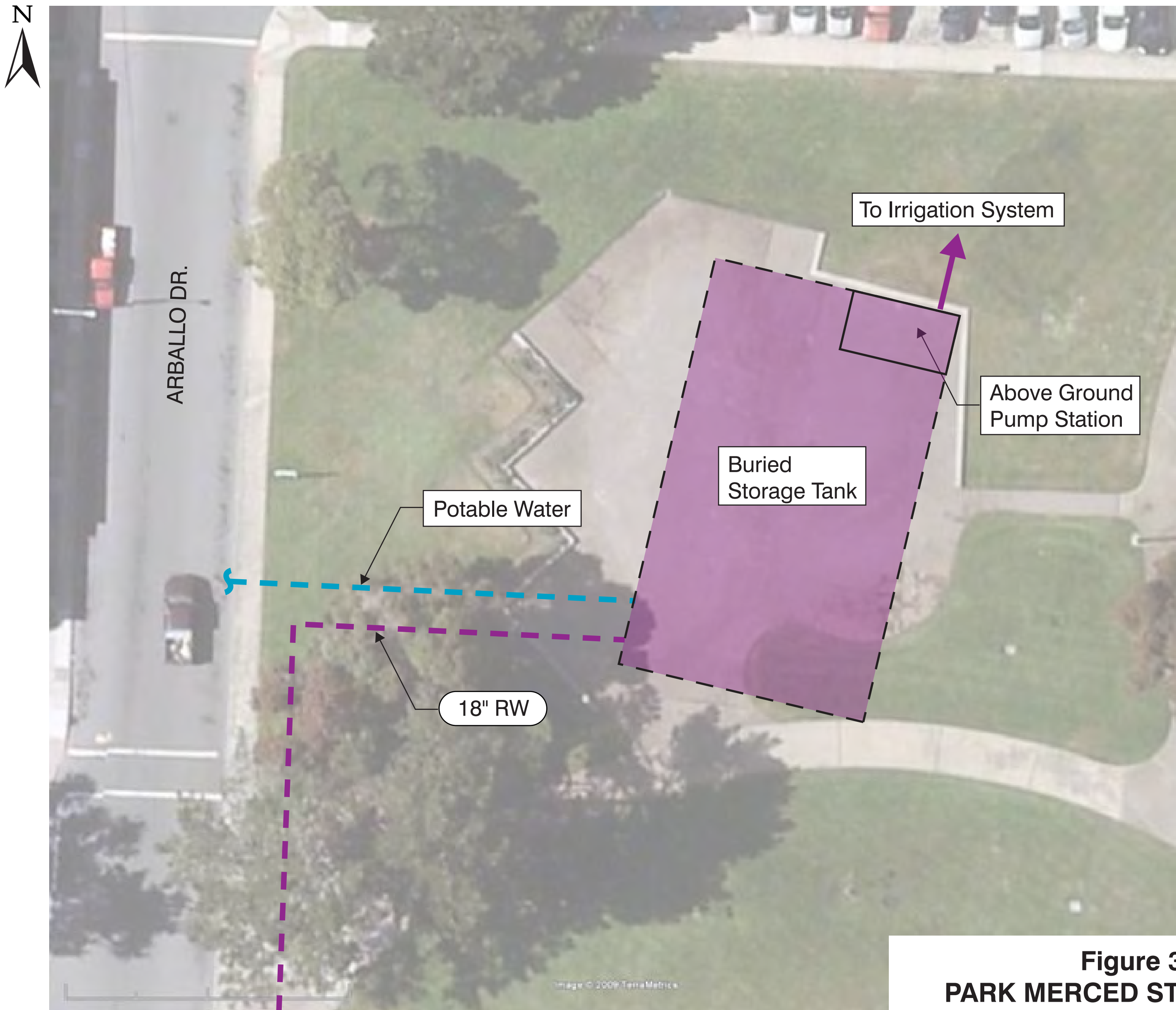

Figure 3.3
PARK MERCED STORAGE SITE
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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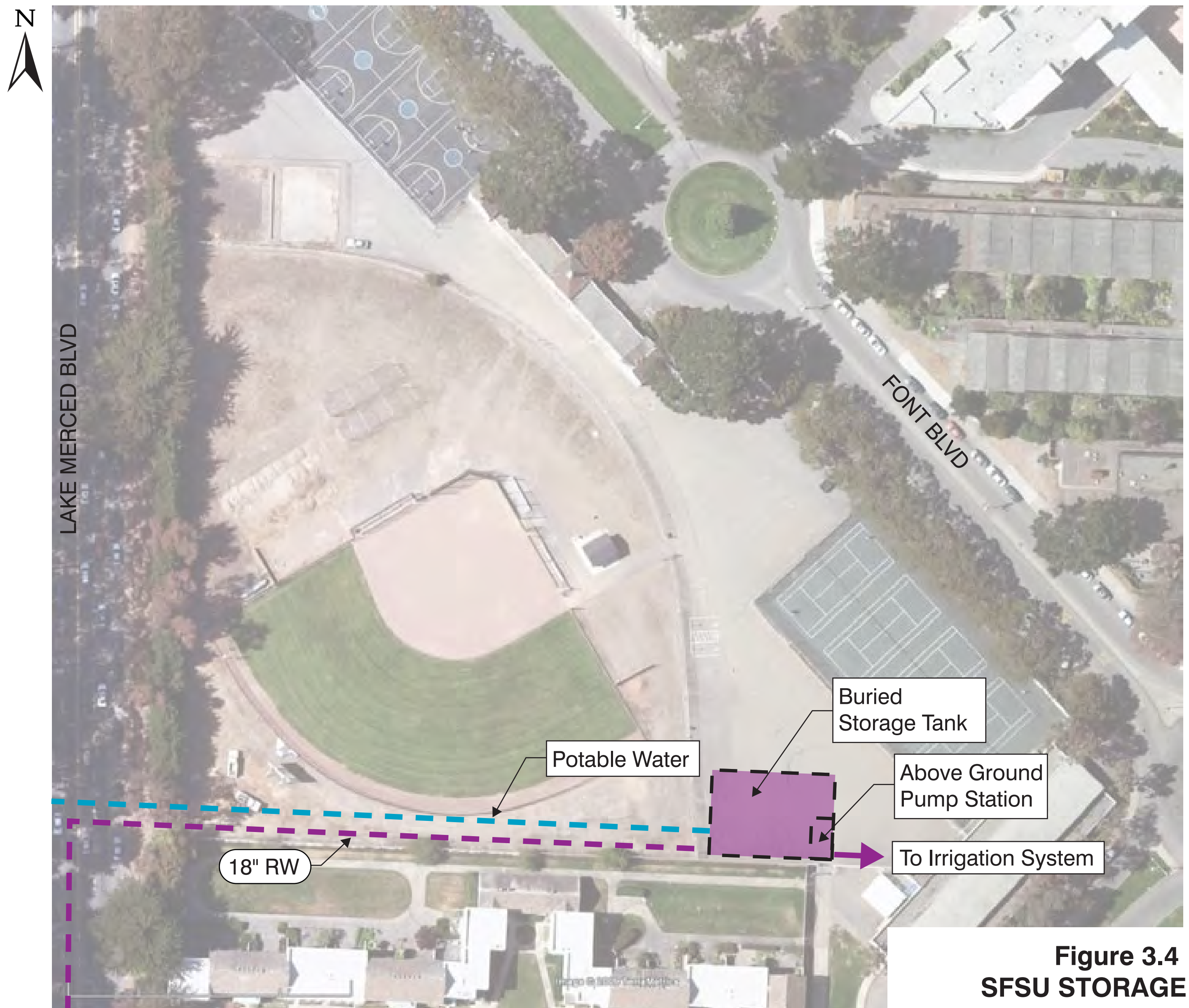

Figure 3.4
SFSU STORAGE SITE
CITY OF DALY CITY
RECYCLED WATER TRANSMISSION
MAIN CORRIDOR STUDY

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Table 3.6 Pump Station Design Criteria Recycled Water Transmission Main Corridor Study City of Daly City			
Item	**LMH Pump Station**	**Parkmerced Pump Station**	**SFSU Pump Station**
Irrigation System			
Pump Configuration	1 duty	2 duty 1 standby	2 duty 1 standby
Pump Capacity (each)	50 gpm	300 gpm	230 gpm
Maintenance Pump Capacity	n/a	5 hp	5 hp
Pump Type	Vertical Multistage	Vertical Turbine	Vertical Turbine
Drive	Variable Frequency Drive (VFD)		
Motor (each pump)	5 hp	25 hp	20 hp
Hydropnuematic System			
Pump Configuration	-	1 duty 1 standby	1 duty 1 standby
Pump Capacity (each)	-	250 gpm	20 gpm
Pump Type	-	Vertical Turbine	Horizontal
Drive	-	VFD	
Motor (each pump)	-	25 hp	5hp

4.0 UPGRADES AT THE DALY CITY WWTP

To accommodate the users located in the Lake Merced area, the recycled water delivery pumps at the Daly City treatment plant must be expanded. The existing pumps would need to be removed and replaced with larger pumps capable of pumping at an average rate of 2,200 gallons per minute (gpm) to each customer. The existing pump will only supply Harding Park at a rate of 1,700 gpm.

5.0 PLANNING LEVEL COST ESTIMATE

Table 3.7 presents the planning level cost estimate for expanding the Daly City recycled water distribution system to the San Francisco Lake Merced area customers.

The costs for aboveground storage and pumping at Lake Merced Hills are based on vendor quotes. The costs for buried storage tanks and vertical turbine pump stations at Parkmerced and SFSU were estimated using numbers developed for the construction of Harding Park storage tank project. Pipeline costs were estimated using the same unit costs developed for the transmission main to Colma.

Table 3.7 San Francisco Infrastructure Planning Level Cost Estimate
Recycled Water Transmission Main Corridor Study
City of Daly City

Cost Item		Total
Lake Merced Hill Transmission Main(1)		$50,000
Lake Merced Hill Storage Tank(1)		$30,000
Lake Merced Hill Irrigation Pump Station(1)		$11,000
Lake Merced Hill Irrigation Connection(1)		$65,000
Parkmerced Transmission Main		$203,000
Parkmerced Storage Tank		$1,200,000
Parkmerced Hydropnuematic Station		$150,000
Parkmerced Irrigation Pump Station		$160,000
Parkmerced Irrigation Connection		$187,000
SFSU Transmission Main		$370,000
SFSU Storage Tank		$824,000
SFSU Hydropnuematic Station		$25,000
SFSU Irrigation Pump Station		$144,000
SFSU Irrigation Connection		$187,000
Allowance for Upgrades at Existing REPS		$300,000
	Total Direct Cost	**$3,906,000**
Estimating Contingency	30%	$1,172,000
Contractor Overhead and Profit	12%	$609,000
Escalation to Midpoint(2)	(5%/yr)	$896,000
Sales Tax(3)	8.25%	$161,000
General Conditions	12%	$809,000
	Total Estimated Construction Cost	**$7,553,000**
Engineering, Legal, and Administrative Fees	20%	$1,511,000
Owner's Change Order Reserve	5%	$378,000
	Total Estimated Project Cost	**$9,442,000**

Notes:
(1) Lake Merced Hill is not currently interested in pursuing recycled water due to high costs associated with new infrastructure.
(2) 5% escalation to mid-point of construction added per year. Assumed 3 years to midpoint.
(3) Sales tax applied to 50% of total direct cost to estimate tax on materials.
The cost estimate herein is based on our professional opinion of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

6.0 CONCLUSION

In summary, it is technically feasible to expand the recycled water distribution system to San Francisco Lake Merced area customers. The cost to distribute recycles water to all three customers, including piping, storage tanks and pump stations is estimated at $9.4 million. Representatives from Lake Merced Hill have indicated that they are not interested in being served with recycled water due to high costs. The costs without Lake Merced Hill are estimated at $9.1 million

On an average day, there would be enough water produced to meet demands from all existing and identified future customers. However, the demands calculated for Lake Merced Hill, Parkmerced, and San Francisco Sate University would exceed the available supply of 0.4 mgd on a peak day. Therefore, each customer will need a potable back-up supply to accommodate their irrigation needs when there is not enough recycled water available. In addition, the pumps at the existing recycled effluent pump station would need to be upsized and the new users would need to be integrated into the recycled water distribution schedule using the City's automated control software.

APPENDIX B - FEASIBILITY STUDY FOR TERTIARY TREATMENT EXPANSION

9/8/08

9/8/08

CITY OF DALY CITY

FEASIBILITY STUDY FOR TERTIARY TREATMENT EXPANSION AT THE DALY CITY WWTP

FINAL

September 2008

2500 VENTURE OAKS WAY • SUITE 320 • SACRAMENTO, CALIFORNIA 95833 • (916) 565-4888 • FAX (916) 565-4880

CITY OF DALY CITY

FEASIBILITY STUDY FOR TERTIARY TREATMENT EXPANSION AT THE DALY CITY WWTP

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FEASIBILITY STUDY FOR TERTIARY TREATMENT EXPANSION AT THE DALY CITY WWTP

1.0 INTRODUCTION

This report presents the findings of the feasibility study for expanding the tertiary treatment facilities at the Daly City Wastewater Treatment Plant (WWTP) to produce additional recycled water. As part of its program to reduce demands for potable water supplies, the San Francisco Public Utilities Commission (SFPUC) is partnering with the City of Daly City (City) on this project. Recycled water produced by the project will be used for landscape irrigation in San Francisco and Daly City on a seasonal basis

In 2003, the North San Mateo County Sanitation District (NSMCSD), a subsidiary of the City, added tertiary facilities to produce recycled water. As a result, the City has been delivering recycled water to several customers since 2004, including the San Francisco Golf Club, Olympic Club, Lake Merced Golf Club, and the City of Daly City for irrigation of area parks and medians. The San Francisco Golf Club and Lake Merced Golf Club are located east of the recycled water facilities and each has an 18-hole golf course. The Olympic Club is located just west of the recycled water facilities and maintains two 18-hole and one 9-hole golf course. Additionally, the City and the SFPUC are currently partnering on a project to add Harding Park Golf Club to the City's existing recycled water distribution system. Harding Park is comprised of an 18-hole course (Harding) and a 9-hole course (Fleming).

This report presents the initial feasibility of a treatment process to produce additional recycled water. It does not attempt to determine specific locations, conveyance, or storage of the product water from the treatment system. If the project continues, these items must be considered in future project implementation steps.

2.0 OVERVIEW OF EXISTING DALY CITY WWTP

The existing WWTP treats raw wastewater through primary, secondary, and tertiary processes. Primary treatment consists of headworks facilities, with mechanical bar screening for removal of large debris (larger than 3/4-inch), primary sedimentation basins for settling of large solids, and flow equalization basins. The equalization basins have a storage capacity of 2.8 million gallons to equalize seasonal and dry weather fluctuations in flow. The basins are designed to convert the fluctuating influent flow into a constant flow rate.

Equalized (constant) primary effluent flow is sent to secondary treatment. Secondary treatment consists of two parallel, activated sludge reactors using high purity (90 percent) oxygen for reduction of biochemical oxygen demand (BOD). Nitrogen and ammonia are not removed through this process. The process water then flows through three parallel secondary clarifiers for removal of smaller settleable solids. The secondary effluent from the clarifiers is then either chlorinated and dechlorinated for discharge through the ocean outfall or sent through the tertiary treatment train to produce recycled water for irrigation.

The existing WWTP tertiary treatment facilities are permitted by the State of California Department of Public Health (CDPH) to produce unrestricted irrigation water as defined by the California Code of Regulations (Title 22). The tertiary effluent undergoes several treatment processes before being pumped to the recycled water users for irrigation. First, the secondary effluent is treated with coagulants (poly aluminum chloride) to coagulate the minute particles in the water. Then the coagulated water is flocculated, or mixed slowly, to help the particles agglomerate into clusters of particles that can be more easily filtered out. Once coagulated and flocculated, the particles are removed through continuous backwash sand filters, leaving an effluent relatively free from suspended solids and turbidity.

Chlorine, in the form of sodium hypochlorite solution, is used to disinfect the tertiary effluent and oxidize remaining organic material.

Gypsum (calcium sulfate) is added after disinfection to condition the recycled water for turf grass irrigation. Gypsum is used to adjust the sodium absorption ratio (SAR) to a value of 3.0 or less.

After treatment, the recycled water is either stored in underground storage basins or pumped to the recycled water users.

2.1 Existing WWTP Flows

The existing WWTP secondary treatment processes are designed to treat a constant flow of 10.3 million gallons per day (mgd). However, the National Pollution Discharge Elimination System (NPDES) permit for the WWTP permits the plant to discharge a maximum of 8 mgd to the ocean outfall. Based on historical dry weather influent flow data, the average dry weather influent flow is currently only about 6.2 mgd. Influent flow data from the dry weather month of June 2007, a typical dry weather month, is shown in Figure 2.1.

There is little land area available for future growth in the WWTP service area, with the exception of possible future infill development of the existing Cow Palace area. It is therefore unlikely that future dry weather flows will exceed 8 mgd at buildout in the foreseeable future. The recycled water facilities are currently permitted to deliver a maximum recycled water flow of 2.77 mgd to existing customers. This leaves an available flow of approximately 3.4 mgd for additional recycled water production. As part of this Feasibility Study, Carollo was asked to evaluate new tertiary treatment facilities sized to deliver 4 mgd with the possibility to expand to 7 mgd for future flows, if dry weather flows increased in the future to the maximum WWTP capacity of 10.3 mgd. Since dry weather flows are not expected to surpass 8 mgd, the maximum additional recycled water production could only be approximately 5.2 mgd. However, based on other site constraints discussed further in this report, the maximum practical size for the proposed tertiary facilities is 4 mgd

2.2 Tertiary Process Flow Diagram

To minimize disruption of the existing WWTP processes, the process flow for the new tertiary treatment facilities will be kept separate from the existing tertiary treatment system. A process flow diagram for the proposed tertiary treatment train is shown in Figure 2.2. The new tertiary treatment train will resemble the existing tertiary system and will consist of a secondary effluent pump station, coagulant addition, filtration, disinfection, a recycled water pump station, and addition of chlorine for residual disinfection in the distribution system.

2.3 Site Constraints

The existing WWTP site is approximately 4 acres and is bounded by John Daly Boulevard on the South, Lake Merced Boulevard on the West, and Westlake Park on the North and East as shown in Figure 2.3. The site is mostly built out with little room available for expansion. About half of the plant is built below grade including the existing primary sedimentation and equalization basins, which are built underneath the Westlake Park Ball Field. The plant staff has expressed concerns that there is little room available to park operations vehicles. Trucks currently have difficulties entering and exiting the facility and large trucks must back in through the plant's front gate to enter. Space is therefore at a premium at this site, so footprint size was a key component in the selection criteria of the new treatment process technologies.

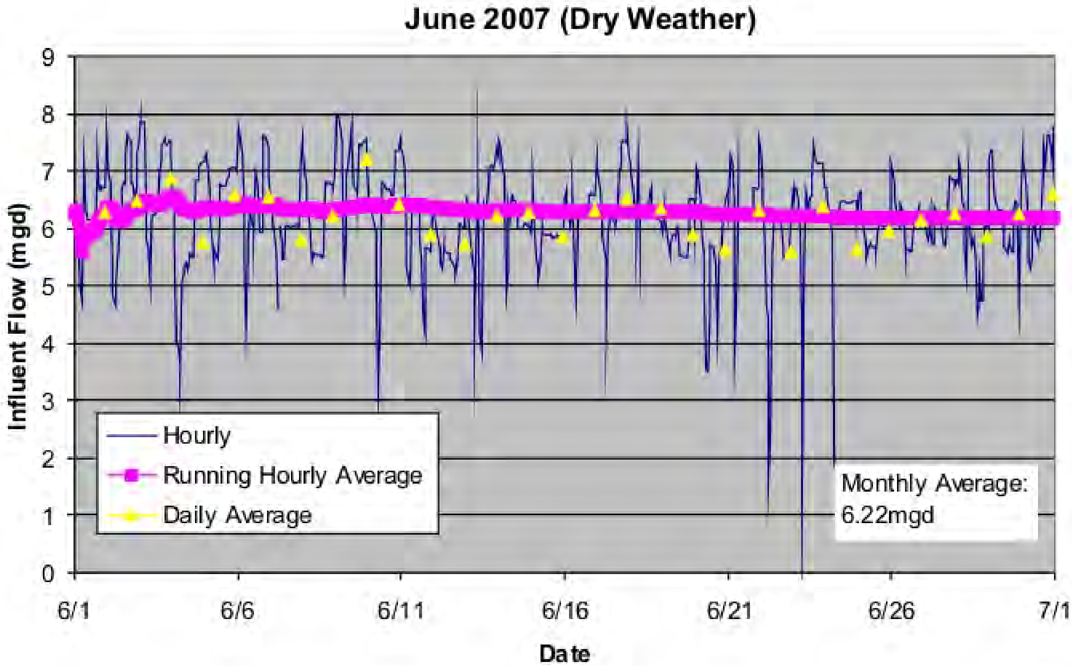
3.0 TREATMENT TECHNOLOGY EVALUATION

This chapter describes the technologies evaluated for filtration and disinfection and the selection criteria for each process.

3.1 Filtration Technologies

Secondary effluent will be pumped through a filtration process for removal of residual organic and inorganic suspended solids, reduction in turbidity, and reduction in bacteria to condition the water for disinfection. The types of filters used for advanced wastewater treatment typically fall into three categories: depth filtration, surface filtration, and low-pressure membrane filtration.

Depth filters, such as the existing Dynasand™ Filters at the facility, have relatively large footprints due to the large filter surface area and flocculation chambers required. Therefore, they will not fit on the existing site without major modifications and disruption to the existing facilities. Figure 2.1Influent Flow Data



Daly City WWTP Influent Flow

FIGURE 2.1

City of Daly City
Feasibility Study for Tertiary Treatment Expansion at the Daly City Wastewater Treatment Plant

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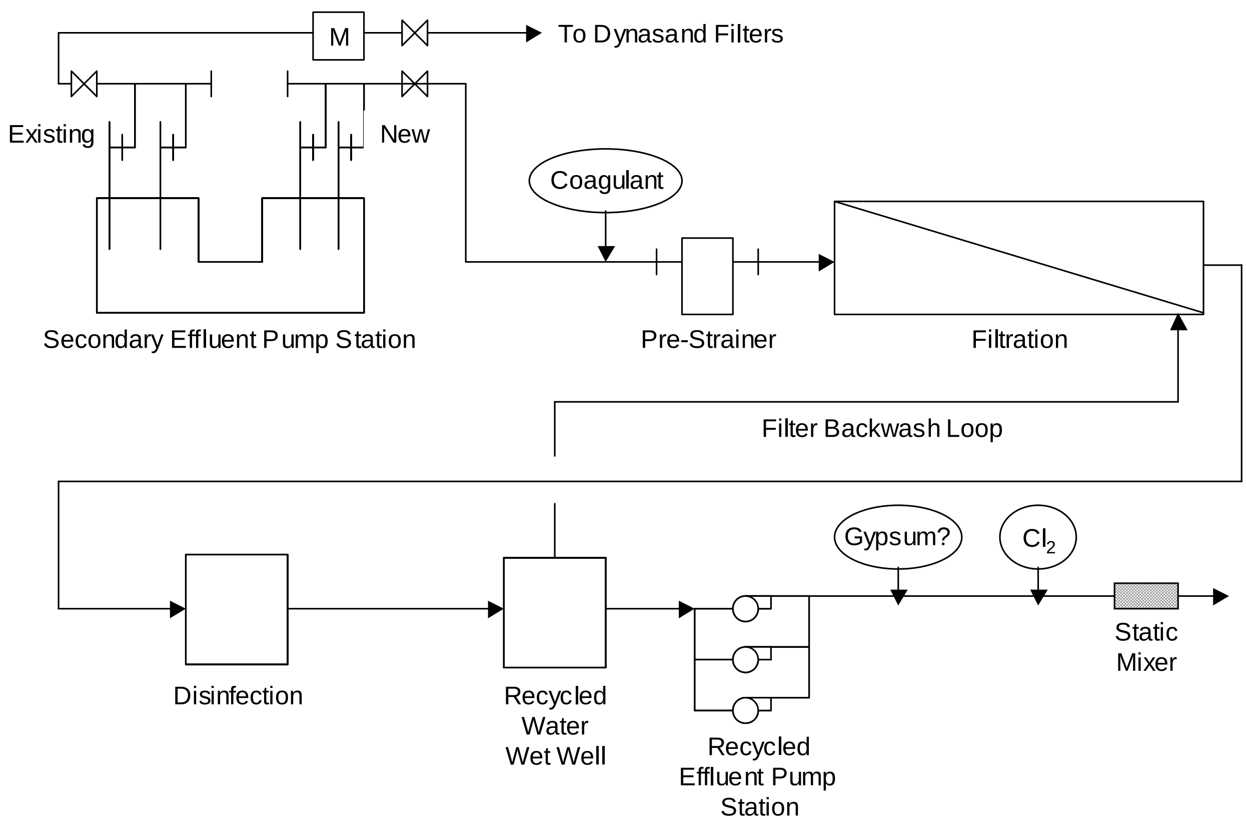
carollo
Engineers...Working Wonders With Water™



Proposed Tertiary Treatment Process Flow Diagram

FIGURE 2.2

City of Daly City
Feasibility Study for Tertiary Treatment Expansion at the Daly City Wastewater Treatment Plant

Site Map of Existing Recycled Water Facilities

FIGURE 2.3

City of Daly City
Feasibility Study for Tertiary Treatment Expansion at the Daly City Wastewater Treatment Plant

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Cloth Media Filters, a type of surface filter, have much smaller footprints than the Dynasand™ Filters. Pilot testing using Cloth Media Filters was performed at the WWTP in 2002, prior to construction of the existing recycled water facilities, to determine their effectiveness in comparison to the Dynasand™ Filters. The testing determined that Cloth Media Filters were only able to meet the discharge requirements when coagulant was added to the secondary effluent and flocculation was performed to allow larger particles to form and be removed. This is due to the characteristics of the secondary effluent water at the WWTP, which has a small particle size distribution as a result of the pure oxygen activated sludge process. Proper coagulation and flocculation is critical when Cloth Media Filters are used since over dosing of coagulant can foul the cloth media and the flocs must be properly formed to get sufficient removal.

Flocculation is also necessary for Dynasand™ Filters although not as critical since depth filters do not use sieving as the primary mechanism for removal and the depth of the filter bed allows for removal of smaller particles by adsorption. The cloth media footprint size, increased by the flocculation chamber, and the operational difficulties associated with removing small particles, eliminated this type of filter from further consideration.

Of the available filtration technologies, low-pressure membrane filters (microfiltration (MF)/ultrafiltration (UF)) have the smallest footprint and they are able to remove very small particles without significant flocculation due to the small membrane pore size. They are therefore the only type of filters considered feasible for this site.

3.1.1 <u>Microfiltration/Ultrafiltration Membranes</u>

Microfiltration and ultrafiltration consist of hollow fiber membranes with a pore size in the range of 0.1 microns and 0.01 microns, respectively. The pore sizes are typically small enough to remove suspended solids, protozoan cysts, and most bacteria. They function primarily as a sieving mechanism to separate particles from the membrane permeate (filtered water). Two main types of MF/UF membrane systems are available, submerged, and pressurized. Submerged membranes are placed in an open tank and utilize vacuum pressure to pull the permeate water through the membranes. In a pressurized membrane system, the feed water is pumped directly through the membranes. For projects of this size and given the hydraulic profile of the proposed facilities, pressurized membrane systems have a smaller footprint, require less pumping and are therefore the preferred technology for this application. Pall Corporation and Siemens Corporation both manufacture this type of membrane system. The Pall MF Membranes were used for the preliminary system layout in this study because of their smaller required footprint for this site that has little available space. However, it remains to be determined how final membrane selection and procurement will be performed.

To treat 4 mgd of recycled water, three (3) membrane module racks will be provided, each with a capacity of 2 mgd. This will allow for one redundant membrane rack for when a rack is taken out of service for cleaning or maintenance. Figure 3.1 shows an example of an installed membrane rack of Pall membranes at the City of Bakersfield. The membrane modules operate in an outside-in mode. Solids retained on the outside of the hollow fiber membranes are removed via periodic backwashing, air scrubbing, chemical wash, and clean-in-place processes. Permeate is produced and collected on the inside of the fibers.

The backwashing cycle is an automated process referred to as Simultaneous Air Scrub – Reverse Flow (SASRF). During this process, Reverse Feed (RF) Pumps are used to pump permeate back through the membranes while compressed air is simultaneously pumped through to shake and loosen particles attached to the membranes. Typically, the backwashing is performed at approximately 20-minute intervals. Backwash waste is sent back to the plant headworks for treatment and settlement of the solids in the clarifiers.

The chemical wash process, referred to as Enhanced Flux Maintenance (EFM), is also an automated process performed on a daily or weekly basis depending on the solids loading rate. The process takes approximately 60 minutes to complete and involves the following steps:

- Add 0.1% Sodium hypochlorite to the permeate
- Recirculate the permeate through the membrane modules
- Drain the membrane rack
- Perform an SASRF

Periodically, about once a month, the system will require a more thorough cleaning using a chemical clean-in-place (CIP) process. The CIP process is performed on one membrane rack at a time while the other racks remain in operation. The CIP process consists of two steps, utilizing Caustic and Acid, and takes approximately six (6) to eight (8) hours to complete. The spent CIP waste solutions are neutralized and can be recycled back to the head of the WWTP.

Pressurized MF/UF membrane systems have the following components:

- Self-Cleaning Strainers - For removal of larger particles to protect the membrane modules from damage or clogging. The strainers have permanent stainless steel of plastic screens that are cleaned through backwashing based on pre-set differential pressures.
- MF/UF Membrane Racks - The membrane racks consist of hollow fiber membranes supported vertically by a steel framework and connect to manifold piping. For the Pall system feed water enters through the lower end manifold and permeate exists out the top manifold. Pneumatically operated process valves are included as part of the assembly.
- Compressed Air System - This system provides the air supply for the pneumatically actuated process valves, for testing the integrity of the membranes, and for the

backwash cycle with simultaneous air scrub. The system includes an air compressor unit, a receiver, dryers, filters, regulators, and associated controls.

- CIP System – The CIP system consists of chemical tanks, RF pumps, hot water system, chemical transfer and recirculation pumps, and associated piping and valves.
- Instrument and Control System including flow metering, clean-in-place controls, valve controls, and membrane monitoring. The system is equipped with a master programmable logic controller (PLC) with distributed I/O, which monitors and controls all aspects of operation.

3.2 Disinfection Technologies

Three different disinfection technologies were considered in this study: ultraviolet light (UV), pasteurization, and ozonation. Chlorination was not considered due to lack of space for a new contact basin sized for Title 22 requirements. Table 3.1 provides a summary comparison of three technologies evaluated in this study. All three technologies evaluated meet the most important criteria: achieving 5-Log or greater reduction of poliovirus to meet California Title 22 certification standards, small footprint to meet site constraints, and minimal operator attention required for operation and maintenance of the system. Therefore, other performance parameters and costs were the determining factors in selecting the most appropriate system for this application.

**Table 3.1 Comparison of Disinfection Technologies
Feasibility Study for Tertiary Treatment Expansion
City of Daly City**

Disinfection Technology	Ozone	UV Disinfection	Pasteurization
Achieve 5-Log or Greater Reduction of Poliovirus	✓	✓	✓
Small Footprint	✓	✓	✓
Minimal Amount of Operator Attention Required	✓	✓	✓
No Hazardous Waste Disposal	✓		✓
No Air Emissions Permits Required	✓	✓	
Produce Electricity and Excess Heat for In-Plant Use			✓
Potential Chlorine Residual Cost Savings	✓		

Installed Pall Microfiltration Membrane Rack (3 mgd)

FIGURE 3.1

City of Daly City
Feasibility Study for Tertiary Treatment Expansion at the Daly City Wastewater Treatment Plant

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3.2.1 Ultraviolet Disinfection

Over the past two decades, UV disinfection systems have gained prominence due to several advantages over other disinfection systems. These include UV's ability to inactivate a wide variety of microorganisms, small chemical usage for cleaning of lamps, compactness, and overall low capital and operating costs. The major cost involved in operation of UV systems is power consumption. A potential downside to UV systems is the mercury contained in the lamps, which could be released into the recycled water system if a lamp and sleeve were to break during operation resulting in hazardous waste disposal issues.

There are several types of UV systems currently available on the market. These include both in-vessel type systems and channel systems. The in-vessel type systems are more compact and would be a better choice for this application due to the space limitations. Wedeco and Aquionics both manufacturer in-vessel systems with Title 22 certifications. Both systems were evaluated in this study. A photograph of the Aquionics system is shown in Figure 3.2.

The Wedeco system uses low-pressure high output (LPHO) type lamps and has a larger footprint compared to the Aquionics system, which utilizes medium pressure (MP) lamps. Although the MP lamp systems have higher power consumption and operation costs, it was determined that the Wedeco system is too large for this site. Therefore, the cost analysis was performed on the Aquionics system for comparison to the other disinfection technologies evaluated.

3.2.2 Pasteurization

The pasteurization process utilizes heat to inactivate pathogens. The process was discovered by Louis Pasteur in 1864 and is commonly used in the food industry as well as for production of Class A biosolids. Ryan Pasteurization and Power (RP&P), a California based company, has recently received Title 22 certification for a high temperature, short-time pasteurization process that uses flash heating for disinfection of recycled water. The RP&P pasteurization system consists of two heat exchangers and a gas turbine for the heat source as shown in the process flow diagram in Figure 3.3. The non-disinfected influent water passes through the heat exchangers in series. The first heat exchanger is a plate type regenerative heat exchanger that utilizes heat from the disinfected effluent water to preheat the non-disinfected influent water to above 130 degrees Fahrenheit. The second heat exchanger is an economizer type, which utilizes waste heat from the microturbine exhaust to further heat the process water to over 170 degrees Fahrenheit. The disinfected effluent is then returned to the preheater (first heat exchanger) to preheat the influent water. This also cools the disinfected water to just above ambient temperature. The system is very efficient and can be cost competitive when digester gas is used to power the microturbines. The microturbines in turn generate electricity, which can be utilized by the plant or sold back to the utility company. The WWTP currently has microturbines to heat the digesters. The existing microturbines utilize a portion of the digester gas produced at the WWTP, however they do not have sufficient capacity to provide excess heat for the pasteurization process. Additionally, there is little available waste gas at the facility. For these reasons, pasteurization is not the most cost effective alternative for this application.

3.2.3 Ozone

Ozone is an extremely reactive oxidant and therefore a very effective disinfectant. It is also believed to be more effective than chlorine at destroying viruses. The technology is well established for drinking water treatment and has recently begun to be implemented for disinfection of recycled water. In the past, the high cost of ozone production combined with the higher ozone demands of recycled water made the use of ozone disinfection cost prohibitive. However, recent improvements and efficiencies in the ozone generation technology are making it competitive with UV disinfection. This is true particularly when used in conjunction with higher quality membrane filtered water, which has less organic compounds and therefore a lower ozone demand. The addition of chlorine for residual disinfection is still required, since ozone decomposes rapidly. However, the amount of chlorine required will likely be less than for water disinfected by UV or pasteurization, since the oxidizable compounds will already be oxidized by the ozone and not consume the chlorine.

Currently, the HiPOx™ disinfection system manufactured by Applied Technologies is the only ozone disinfection system that has completed Title 22 certification testing. Figure 3.4 shows the process flow diagram for the HiPOx™ system. The HiPOx™ reactor is a pipeline plug flow reactor with ozone injected via several injection points. Peroxide, if used, is injected first. It is anticipated that high purity liquid oxygen (LOX) will be delivered to the site to be used for onsite ozone generation. The existing WWTP currently has a high purity oxygen generation system, which could be capable of supplying oxygen for ozone generation. However, based on communication with plant staff, it appears that the system may not have sufficient capacity to provide oxygen to both the activated sludge and ozone processes. Additional investigations into utilizing the pure oxygen system will be performed in future project steps to verify the system does not have additional capacity.

A 4 mgd system is a 40-foot by 12-foot skid mounted unit, which includes the following components:

- 4 mgd HiPOx™ reactor
- 200 pound per day ozone generation system
- Ozone destruct reactor, to destroy any remaining ozone
- Hydrogen peroxide delivery system
- Ancillary piping

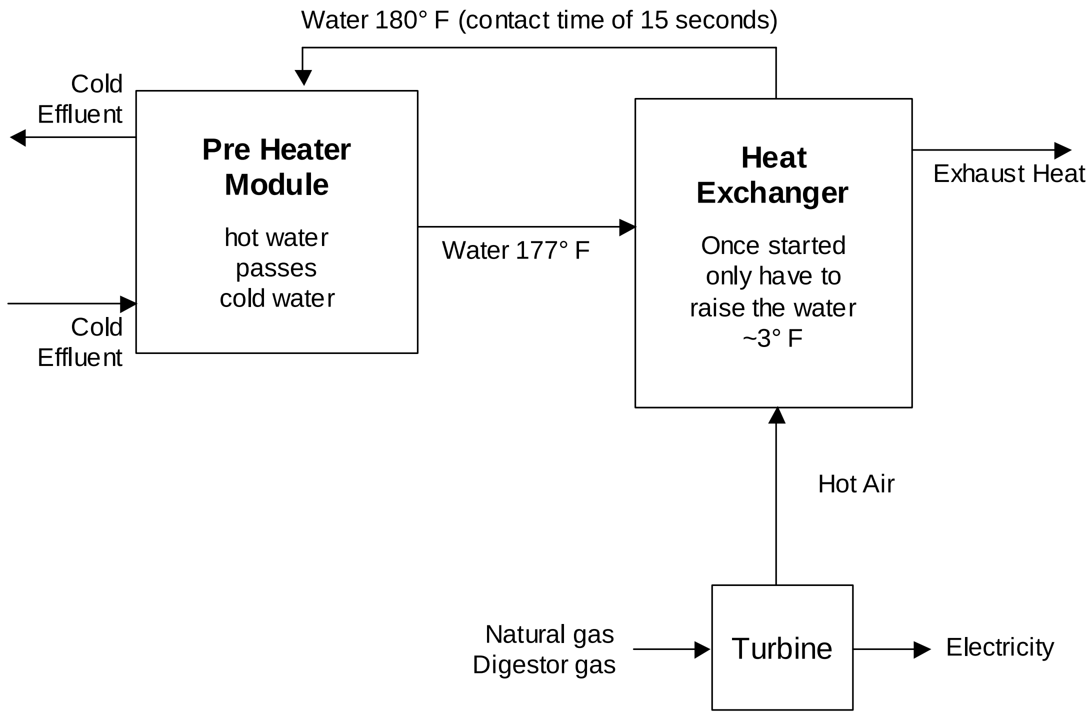
Other necessary components not part of the skid include a high purity liquid oxygen tank and vaporizer unit to be used for onsite ozone generation. A photograph of the HiPOx^{TM} reactor is shown in Figure 3.5.

There are a few potential downsides to the use of ozone. One is the possibility for formation of disinfection byproducts (DBPs), particularly if bromide is present in the secondary effluent. However, bromide is not known to be a common constituent in the City wastewater and therefore this is not a significant concern. Another is that Ozone is a highly corrosive and reactive gas, which could be a potential safety concern. However, the HiPOx^{TM} system effectively destroys residual ozone and therefore offgassing of ozone should not be an issue. A topic that should be investigated in future project steps is the formation of assimilable organic carbon (AOC), or biodegradable carbon. Ozonation of tertiary effluent with dissolved organics, which will pass through the upstream membrane, may create carbon compounds that are more readily biodegradable in the distribution system, potentially causing biogrowth. If the increase in AOC is minimal, or the biogrowth is not significant, then the impact of this reaction is not an issue. However, this should be confirmed through future study as part of the project.

Aquionics In-Vessel UV System

FIGURE 3.2

City of Daly City
Feasibility Study for Tertiary Treatment Expansion at the Daly City Wastewater Treatment Plant

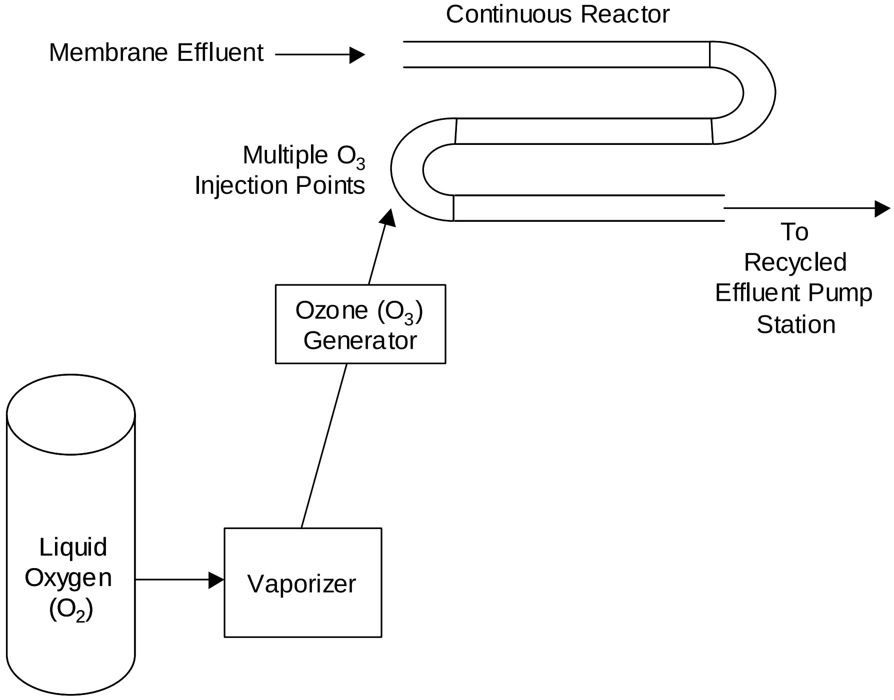


Heat exchangers and pre heaters 200 ft^2
Turbine 20 x 8 feet

RP&P Pasteurization System Process Flow Diagram

FIGURE 3.3

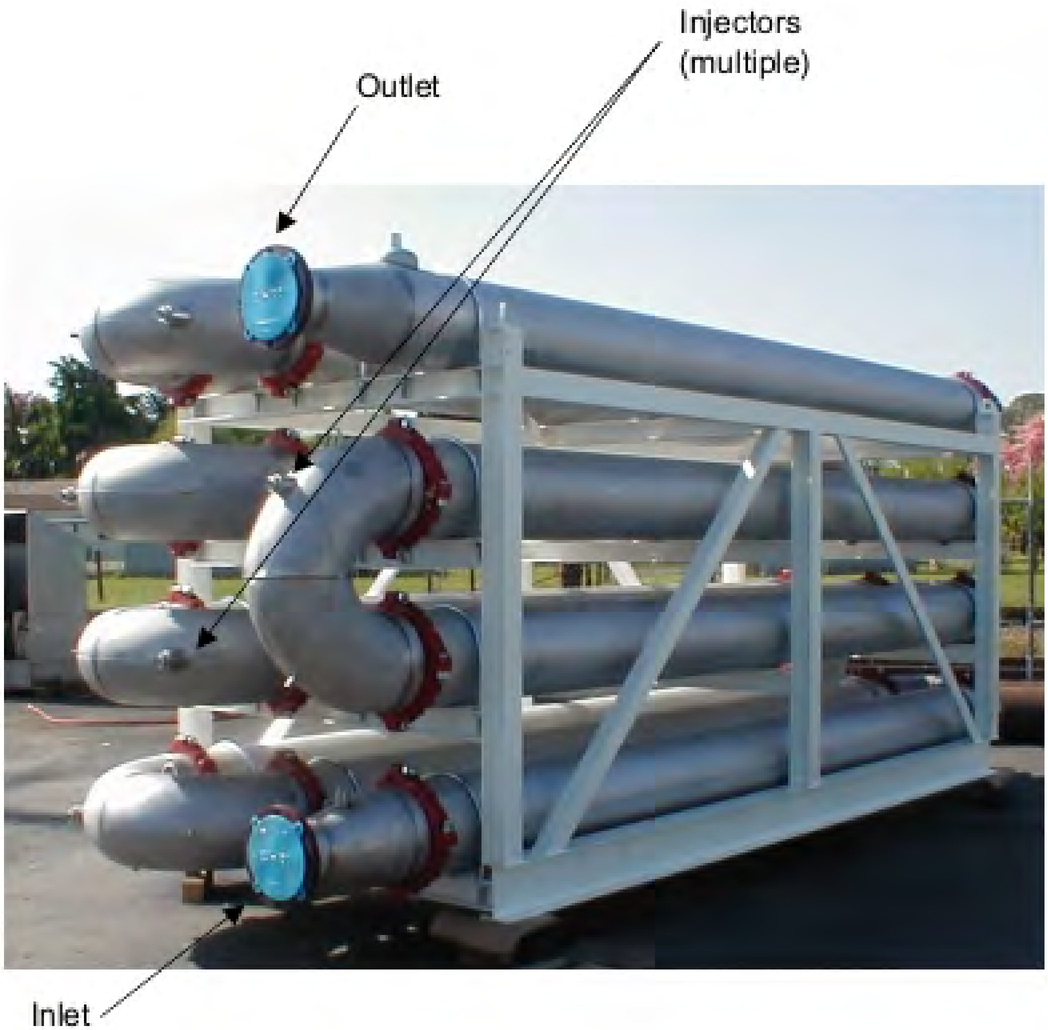
City of Daly City
Feasibility Study for Tertiary Treatment Expansion at the Daly City Wastewater Treatment Plant



HiPOx™ Process Flow Diagram

FIGURE 3.4

City of Daly City
Feasibility Study for Tertiary Treatment Expansion at the Daly City Wastewater Treatment Plant



HiPOx™ Reactor Photo (3 mgd)

FIGURE 3.5

City of Daly City
Feasibility Study for Tertiary Treatment Expansion at the Daly City Wastewater Treatment Plant

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3.3 Cost Comparison of Disinfection Technologies

A cost comparison of the disinfection technologies evaluated in this study is provided in Table 3.2. The table includes capital costs for the equipment including installation, operation, and maintenance costs, and present worth costs based on a 20-year life cycle and 6 percent interest rate.

Both the HiPOx™ and UV systems have relatively low capital costs, with the cost of the HiPOx™ system being about $500,000 less than UV. The capital cost for pasteurization is about four times as much as the cost of the other disinfection systems evaluated, partly due to the need for new microturbines for this process. Pasteurization had the lowest operation and maintenance (O&M) costs, since the process generates electricity, which can be sold back to the utility company. The HiPOx™ system had the next lowest O&M costs, approximately half that of the UV system. The UV system is the most energy intensive and therefore has the highest operational costs. When the capital and O&M costs are evaluated over a 20-year period, the HiPOx™ system is clearly the most cost effective alternative. Based on these costs and the selection criteria presented in Table 3.1, the HiPOx™ system was selected as the preferred disinfection alternative for this application.

Table 3.2 Cost Comparison of Disinfection Technologies
Feasibility Study for Tertiary Treatment Expansion
City of Daly City

Capital Costs	**HiPOx™**	**UV**	**Pasteurization**
Equipment and Installation Capital Cost (4 mgd)	$1,440,000	$1,980,000	$5,970,000
Operation and Maintenance Costs			
Annual O&M Cost per Year (4 mgd)	$120,000(7)	$220,000	$80,000
Total Present Worth Costs(5,6)			
Life Cycle	$2,810,000	$4,480,000	$6,850,000
Annual Amortized	$170,000	$270,000	$410,000

Notes:
(1) Power cost is assumed to be $0.12/kW
(2) Buy back power assumes $0.10/kW
(3) Natural gas cost is assumed to be $8.50/mmBTUs
(4) Labor cost is assumed to be $50/hour
(5) Interest rate = 6%
(6) Period = 20 years
(7) Includes LOX delivered to site at a cost of $12,000 per year.

4.0 FACILITY LAYOUT ALTERNATIVES

This chapter presents three alternatives for the proposed facility layout. For all alternatives the secondary effluent pumping to the facility, the recycled water pump station to the distribution system, and the electrical requirements are the same.

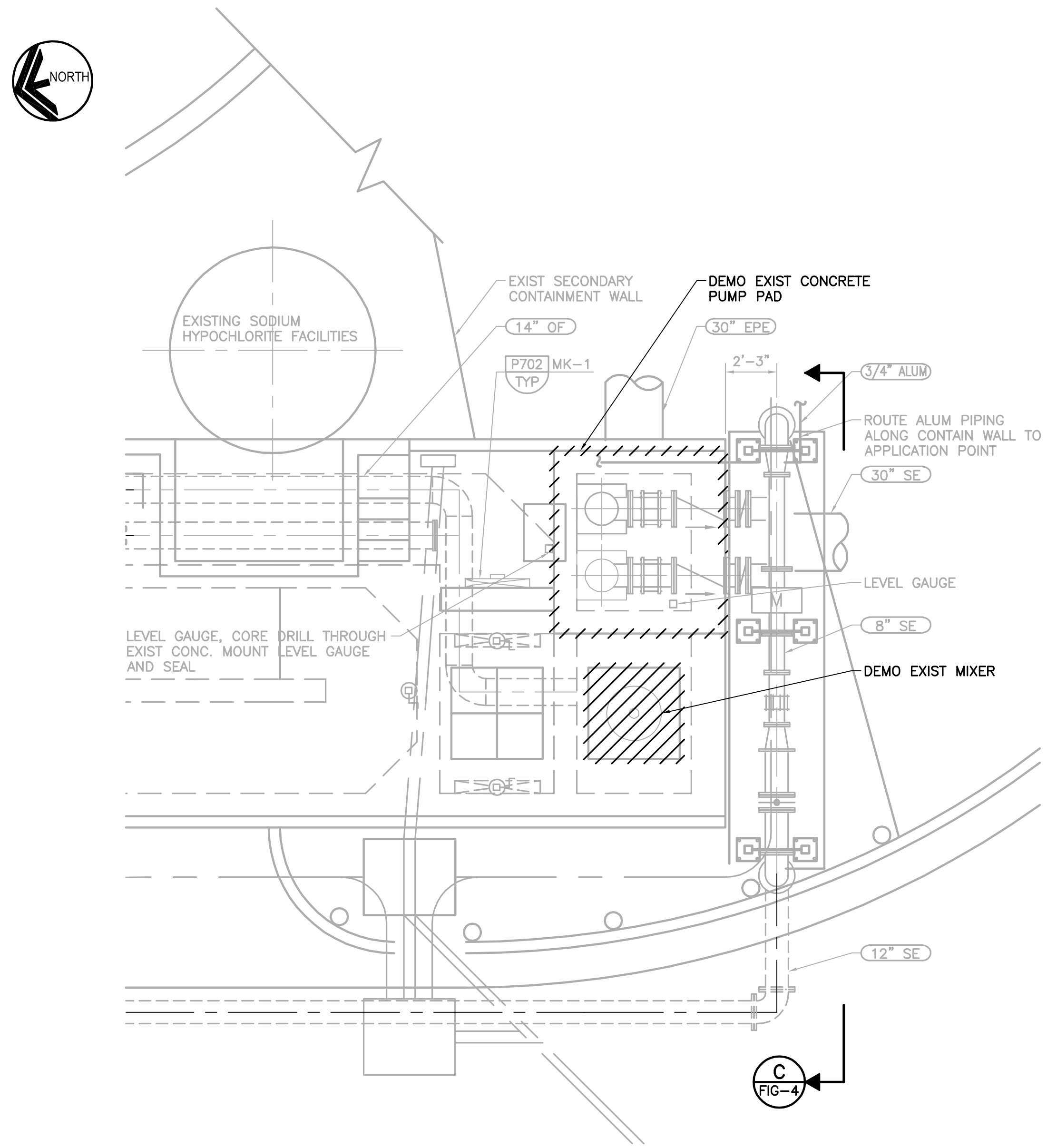
4.1 Secondary Effluent Pump Station

New secondary effluent pumps are needed to supply source water for the tertiary treatment system. To produce 4 mgd of tertiary effluent, the Secondary Effluent (SE) pumps will need to provide 4.23 mgd through the tertiary treatment train, since 0.23 mgd will be required to backwash the filters. This arrangement is shown in the process flow diagram presented in Figure 2.2. The membranes operate at a pressure of approximately 45 psi. Based on this requirement and additional head loss through the strainers, disinfection system, and associated piping, the design operating point for the pump station will be about 4.23 mgd at 80 feet of total dynamic head (TDH).

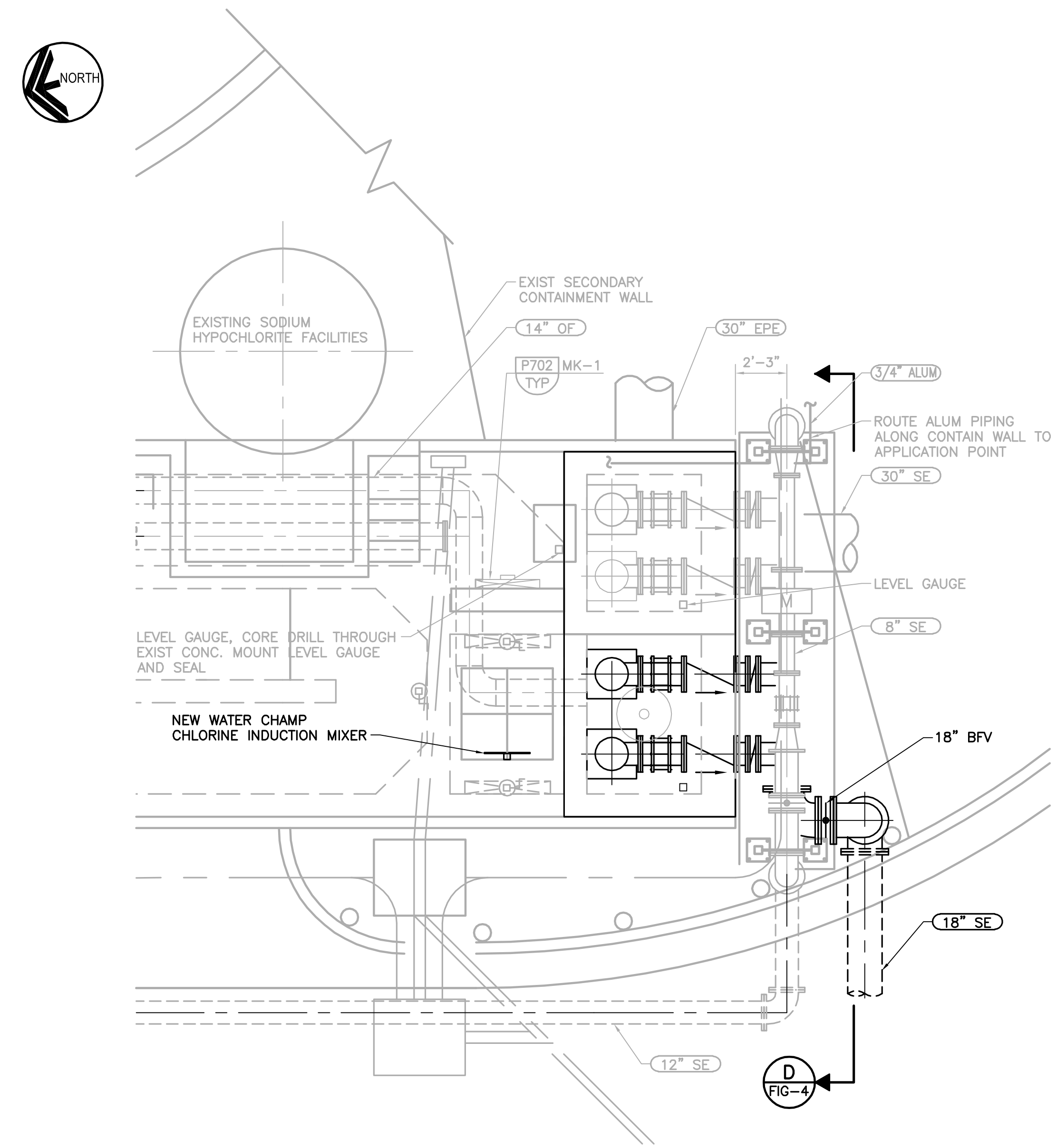
The SE pump station will be an extension of the existing SE pump station. Two vertical turbine pumps, with the second pump serving as standby, will be installed at the location of the existing chlorine mixer in the influent chamber of Chlorine Contact Basin (CCB) No.2, adjacent to the existing SE pumps. Figures 4.1 and 4.2 show conceptual plans and section drawings of the proposed SE pump station.

Demolition work at the existing SE pump station will include removal of the existing chlorine mixer, demolition of the existing concrete pump pad, demolition of the north wall of CCB influent chamber to elevation 44-feet to create a weir wall, and blocking of the bottom opening in the wall. Piping modifications will consist of removal of the mag-meter bypass piping and installation of new 18-inch diameter SE piping to the MF membranes. Additionally, a new chlorine induction mixing system will need to be installed to chlorinate water entering Chlorine Contact Basin No.1. Temporary bypass pumping may be required during demolition and construction activities to allow flow to continue to Chlorine Contact Basin No. 1.

The existing SE pumps will still be used to pump to the Dynasand™ filters and will remain unmodified. The new SE pumps will only serve the new tertiary facilities. Pump motors on the new SE pumps will be 200 Horsepower (Hp) and will have variable frequency drives (VFD) to allow for a range of flow rates.



A PARTIAL DEMOLITION PLAN
SCALE: 1/8" = 1'-0"
FILE: WMDC102rev



B PARTIAL MODIFICATION PLAN
SCALE: 1/8" = 1'-0"
FILE: 00-M-100

PLAN VIEW - SECONDARY EFFLUENT PUMP STATION MODIFICATIONS

FIGURE 4.1

City of Daly City
Feasibility Study for Tertiary Expansion at the Daly City Wastewater Treatment Plant

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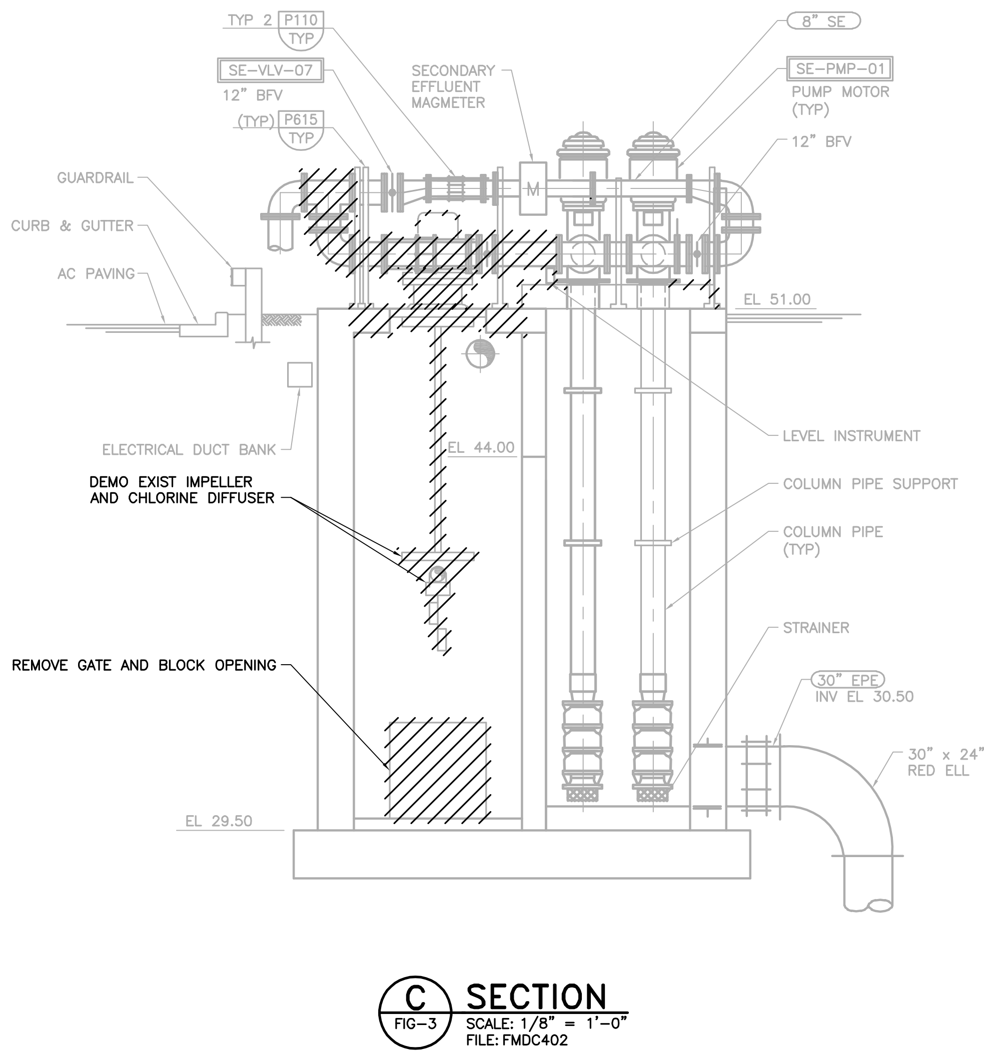
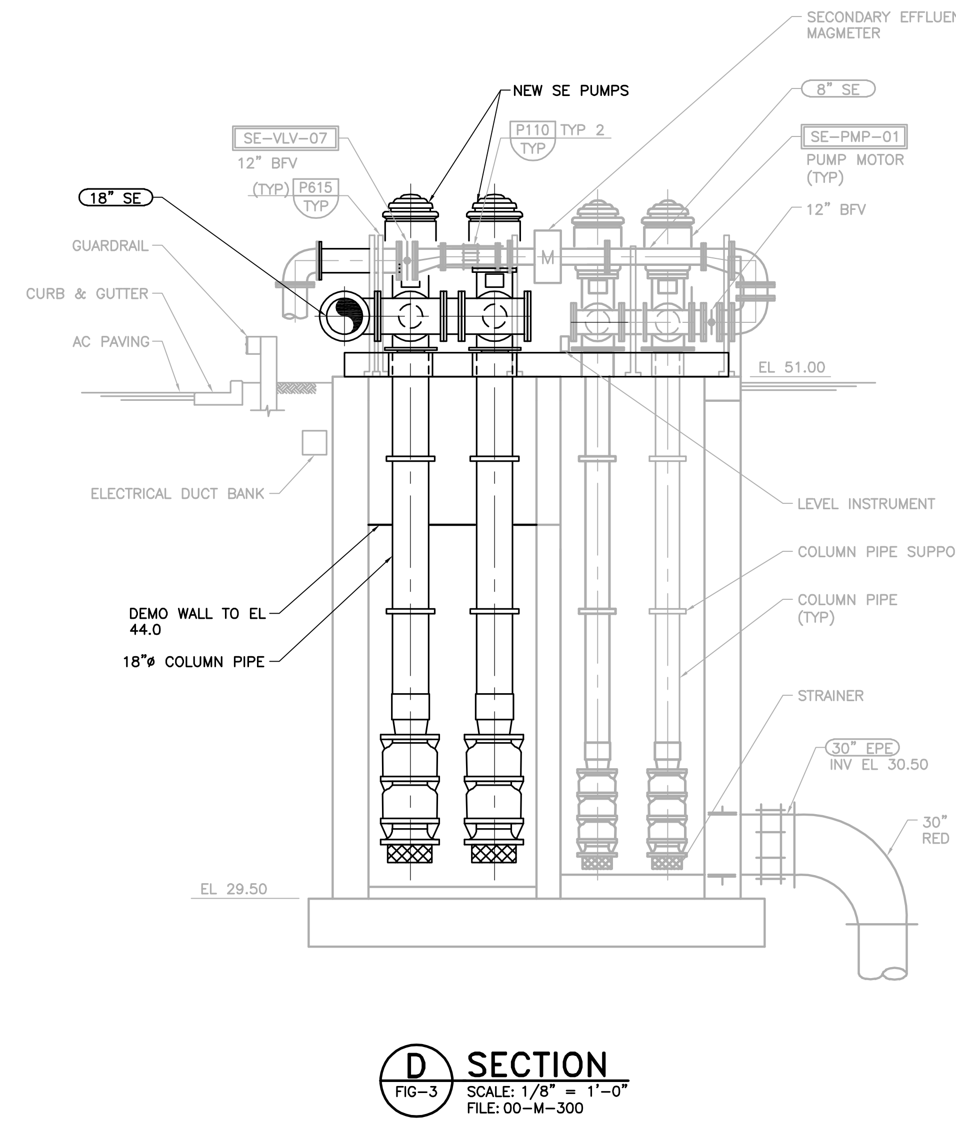




SECTION VIEW - SECONDARY EFFLUENT PUMP STATION MODIFICATIONS

FIGURE 4.2

City of Daly City

Feasibility Study for Tertiary Expansion at the Daly City Wastewater Treatment Plant

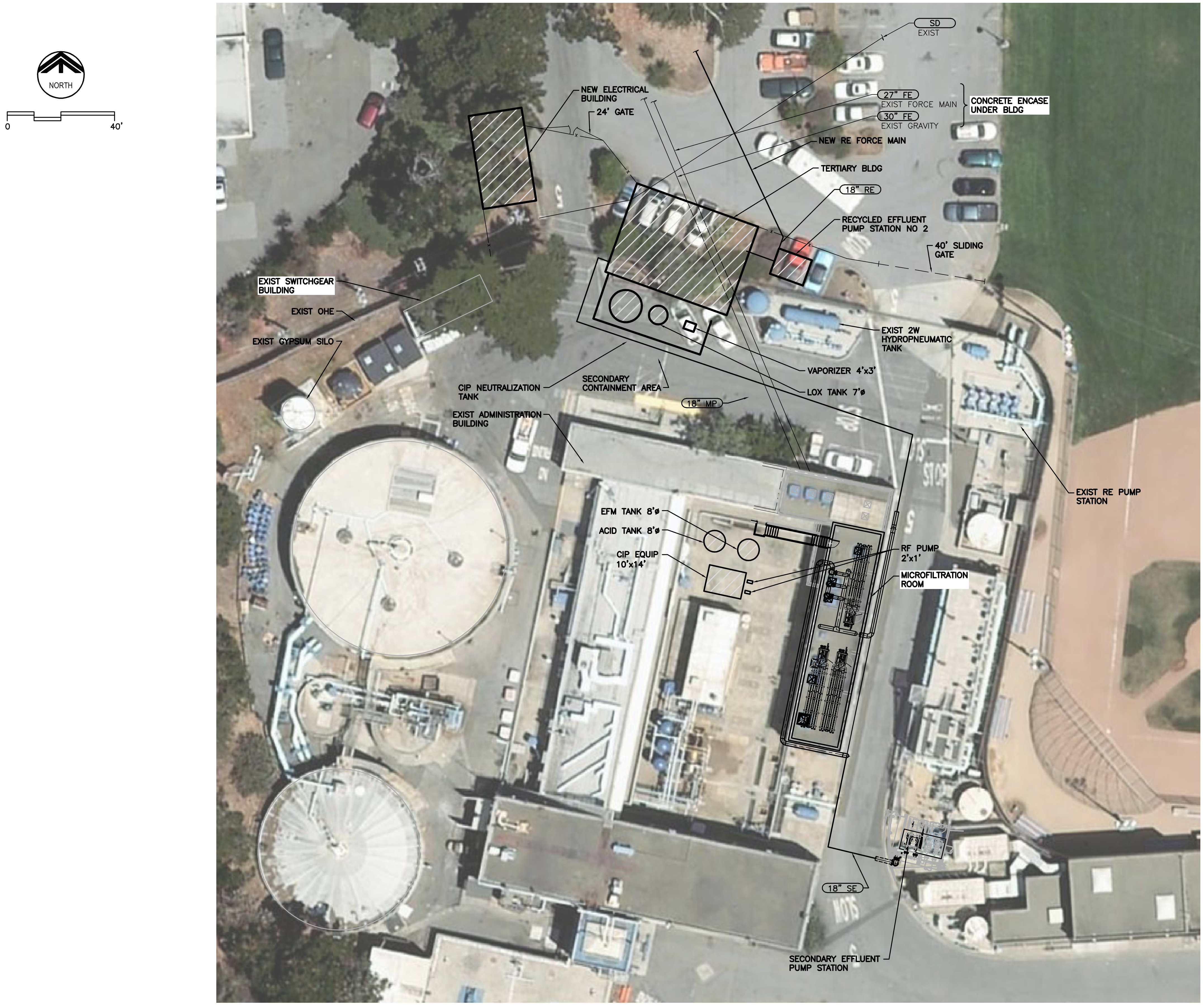
Three MF membrane racks, each with a capacity of 2 mgd, can be arranged on the roof of the existing structure as shown in Figures 4.4 and 4.5. The existing structure was built in 1975 and consists of the below grade Chlorine Contact Tank No.1 with the Generator Room built over it at grade level. The current building code requires a modified structure to meet the current code if the load on the existing building elements is increased by more than five percent. In this case, the additional load will be much greater than five percent and the existing building is likely to have seismic deficiencies that will need to be mitigated if this alternative is selected. The City currently has plans to install new standby generators in the existing Generator Room, so routing of the generator exhaust system would also need to be addressed. Also, particulate filters may need to be added to the generators at a future date and the roof location may be needed at that time.

4.2 Tertiary Facility Layout Alternative 2

The site layout for Alternative 2 is depicted in Figure 4.6 and consists the following:

- A two-story Tertiary Building, with a footprint of 48 feet by 35 feet, located between the WWTP entrance gates and adjacent to the existing No.2 Water System Hydropneumatic Tank will house both filtration and disinfection equipment.
- Ancillary MF Membrane equipment located on the first floor of the Tertiary Building adjacent to the HiPOx™ system.
- HiPOx™ LOX tank, vaporizer unit, and the membrane CIP neutralization tank located in a containment area behind the new Tertiary Building.

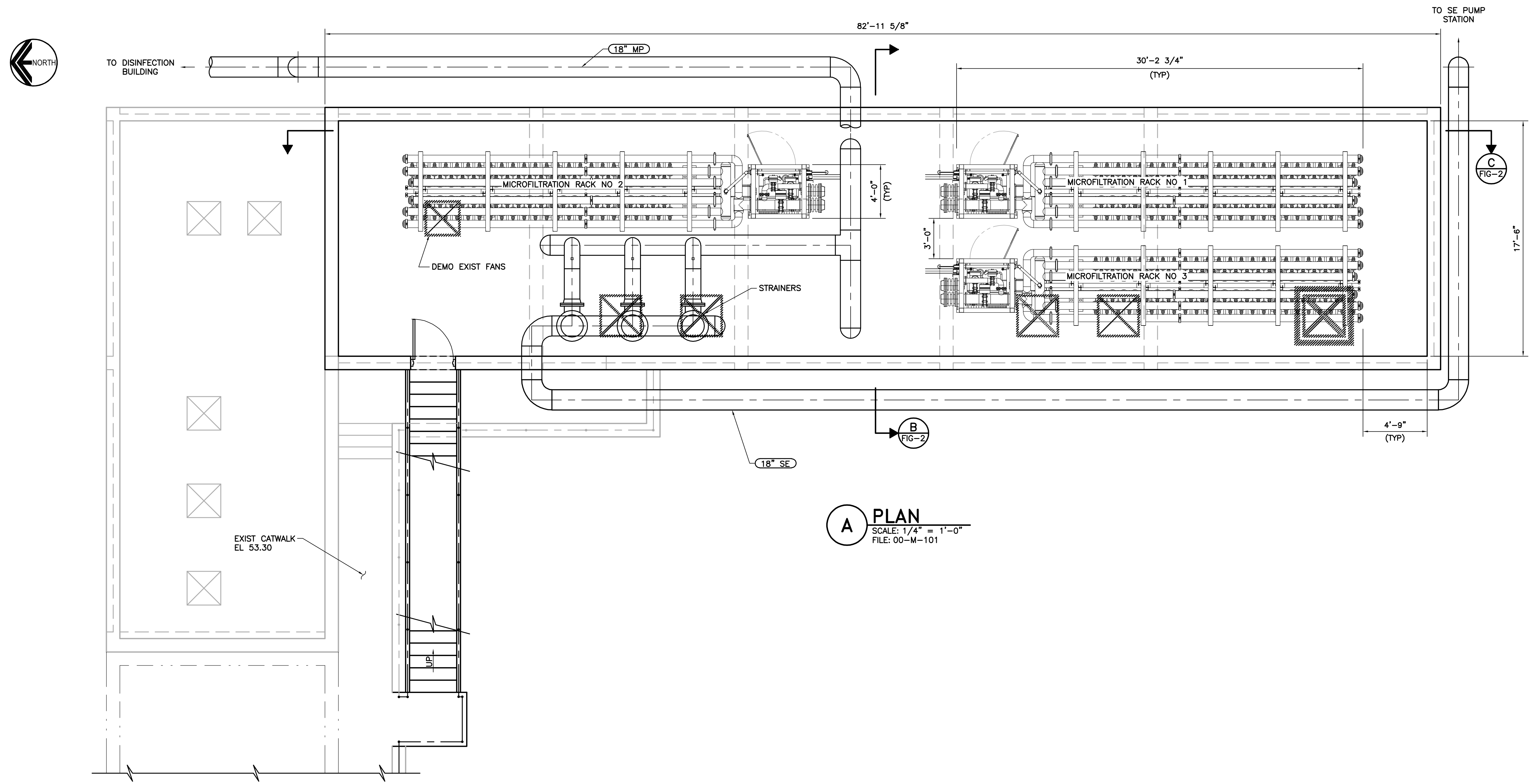
Figure 4.7 shows the proposed Tertiary Building layout. SE pumps will pump directly to the strainers and MF Membranes located on the second floor of the Tertiary Building. Membrane permeate will flow by gravity through the HiPOx™ disinfection system on the first floor of the building to the RE Pump Station. One concern with this layout option is the ability for trucks to continue access to the plant. Adequate turning radius must be maintained once the new building is in place. A complete truck access analysis will be performed in future project implementation steps to verify access can be maintained with the new facilities and adjustments to the layout made as required.



ALTERNATIVE NO 1 - SITE LAYOUT

FIGURE 4.3

City of Daly City
Feasibility Study for Tertiary Expansion at the Daly City Wastewater Treatment Plant



ALTERNATIVE NO 1 - MEMBRANE RACK LAYOUT

FIGURE 4.4

City of Daly City
Feasibility Study for Tertiary Expansion at the Daly City Wastewater Treatment Plant

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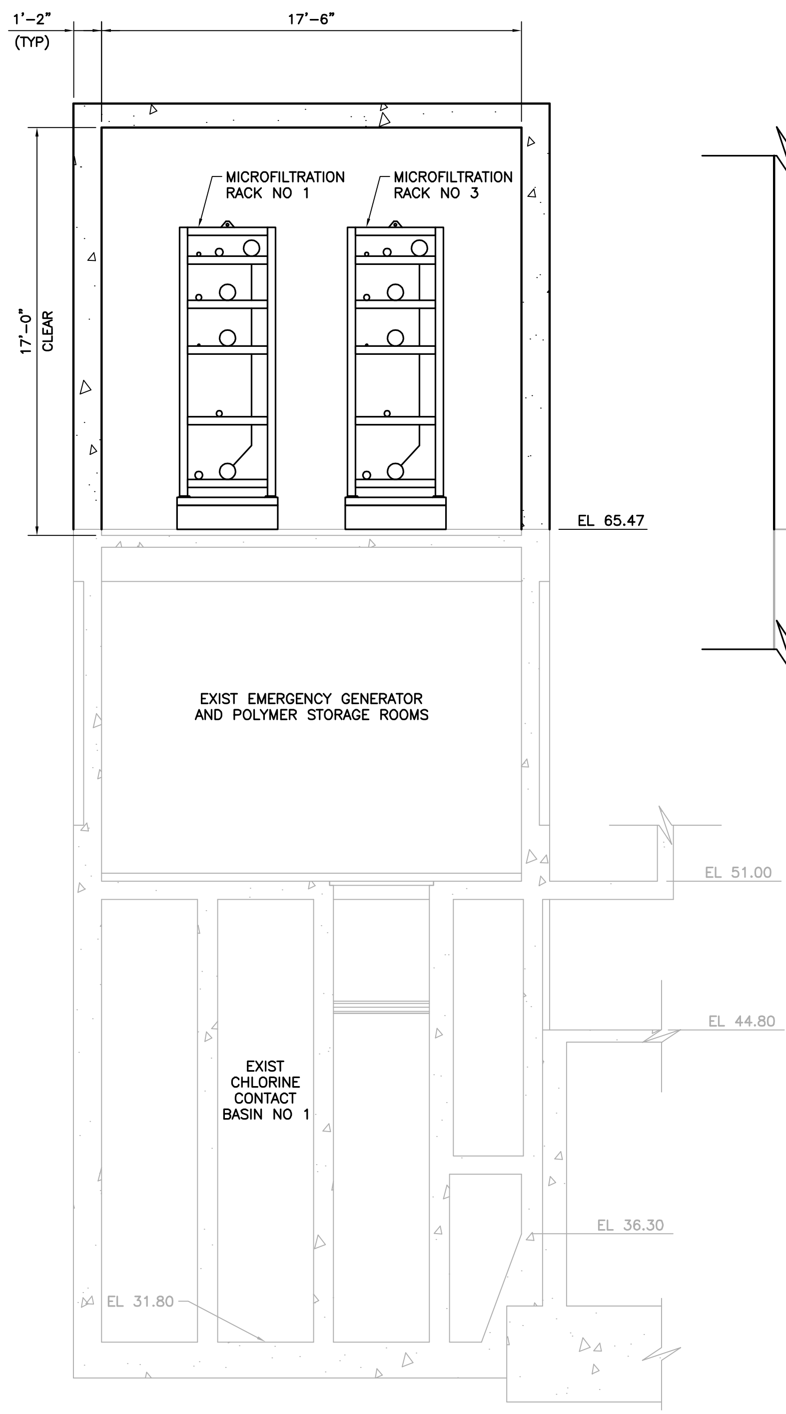
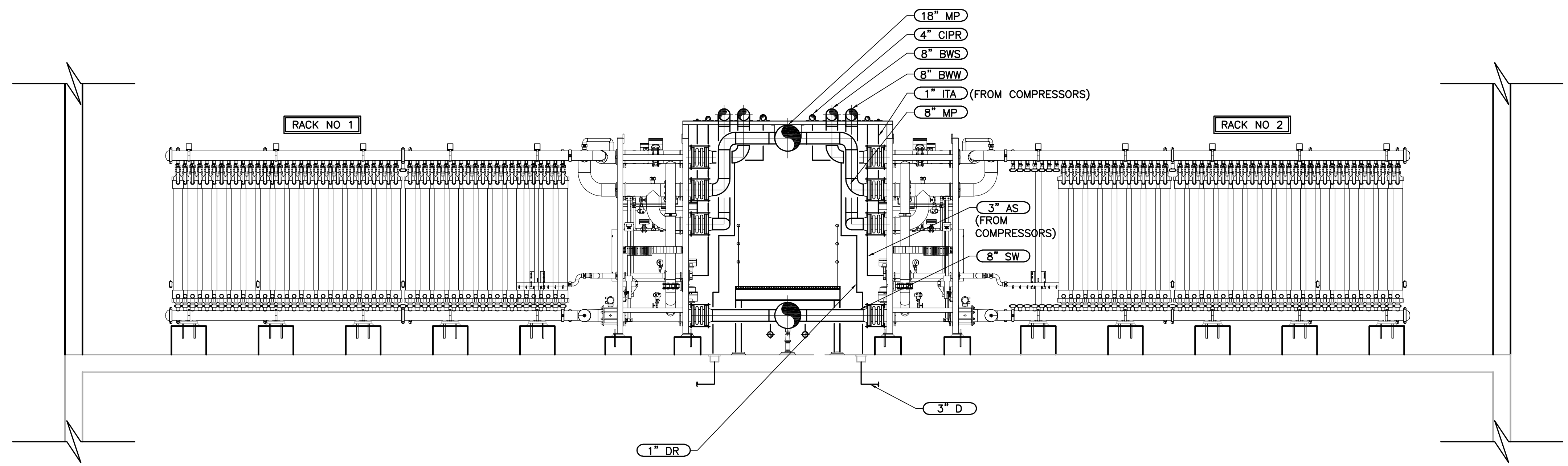


B SECTION
FIG-1 SCALE: 1/8" = 1'-0"
FILE: 00-M-301



C SECTION
FIG-1 SCALE: 1/8" = 1'-0"
FILE:

ALTERNATIVE 1 - SECTIONAL DRAWINGS OF MEMBRANE RACKS OVER GENERATOR BUILDING

FIGURE 4.5

City of Daly City
Feasibility Study for Tertiary Expansion at the Daly City Wastewater Treatment Plant

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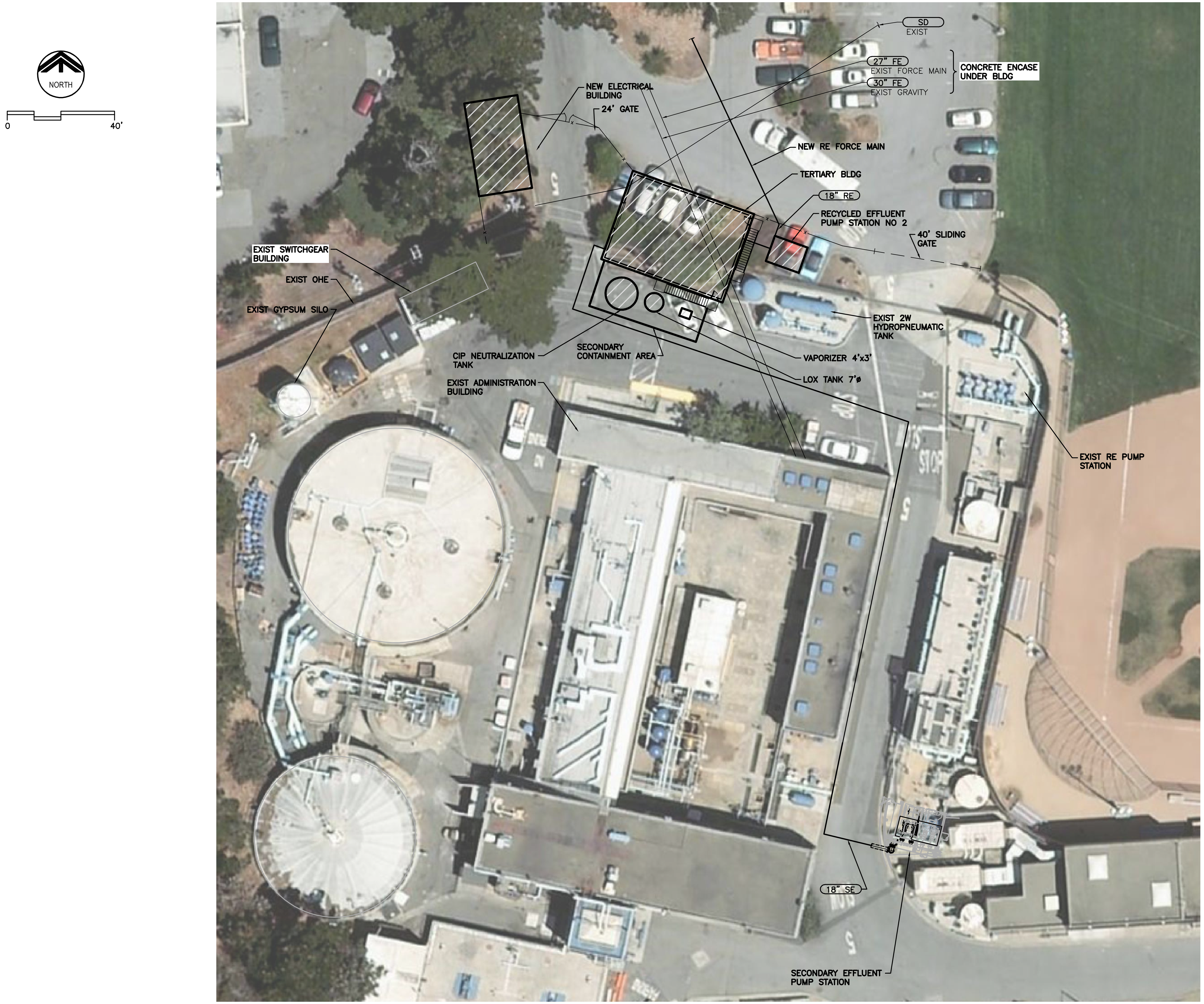
C:\pw_working\projectwise\mahrens\dms56836\FIG-4.5 8-08-08 04:17pm MAhrens XREFS: FIG-4.4; 00-M-301; 00-M-101



ALTERNATIVE NO 2 - SITE LAYOUT

FIGURE 4.6

City of Daly City

Feasibility Study for Tertiary Expansion at the Daly City Wastewater Treatment Plant

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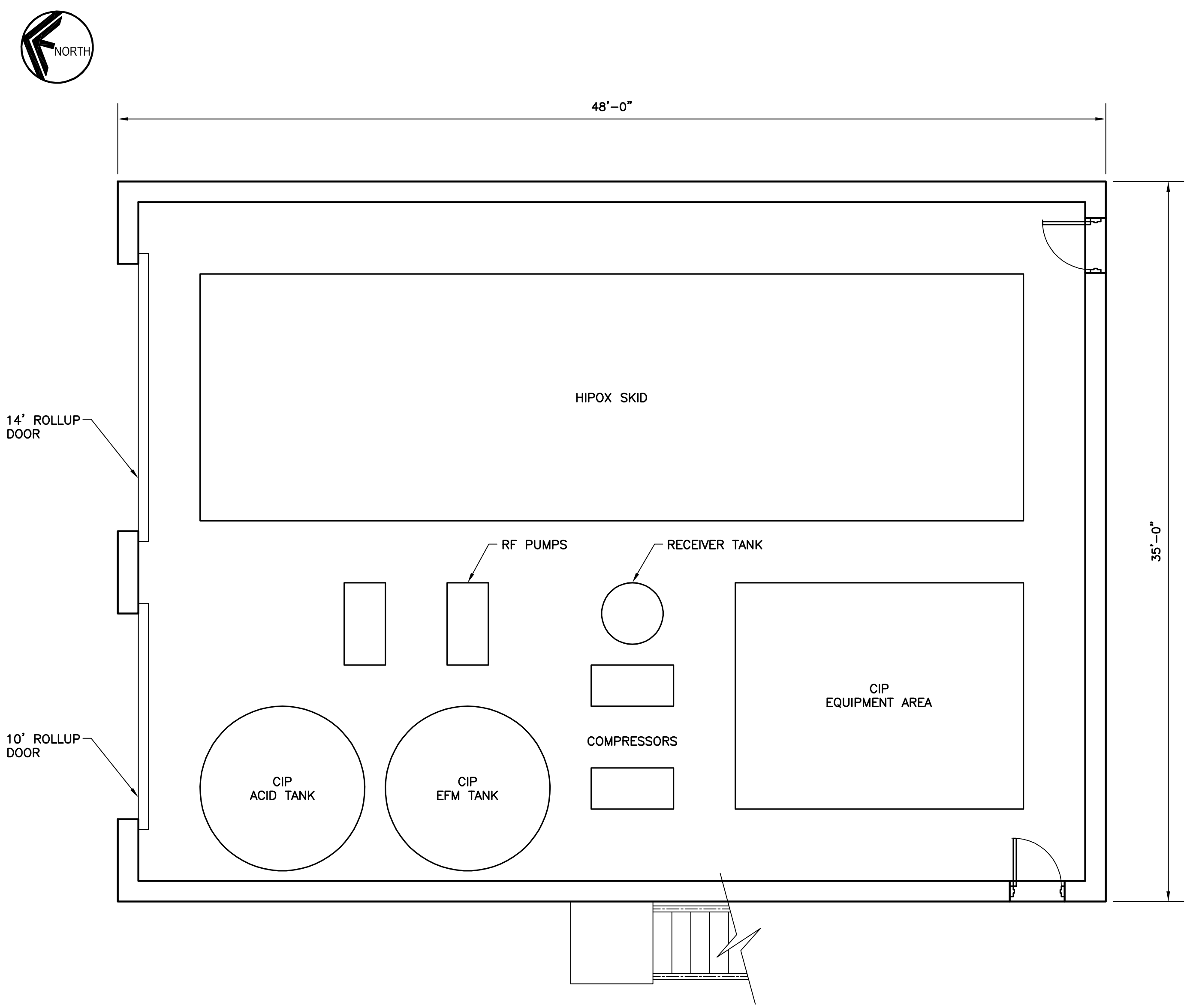
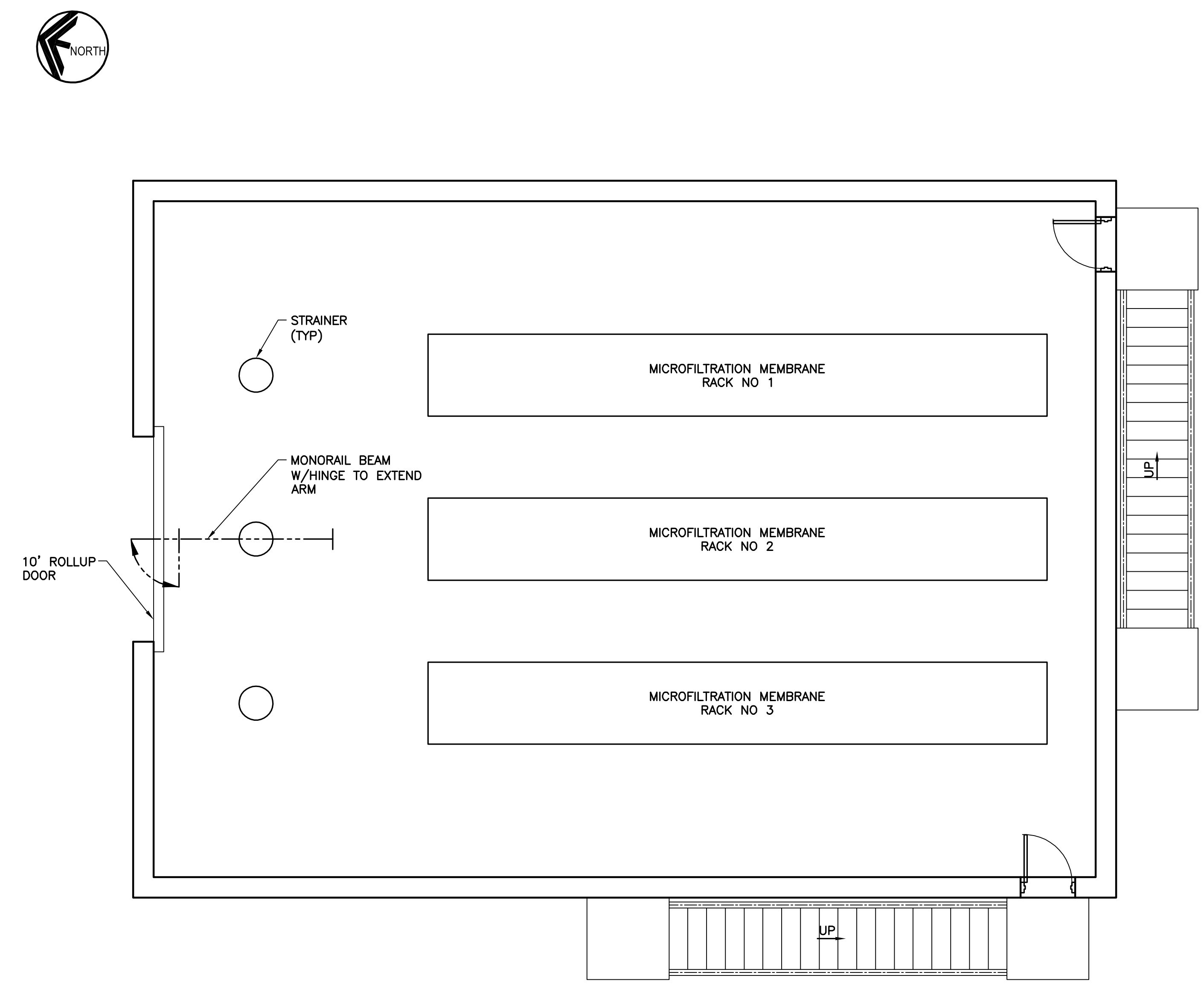
C:\pw_working\projectwise\mahrens\dms56836\FIG-4.6 8-11-08 09:06am MAhrens XREFS: DalyCityBase; 00-M-100; 00-M-101; 00-M-103; WMDC102rev DalyCityAerial;



A TERTIARY BUILDING 1ST FLOOR PLAN
SCALE: 1/8" = 1'-0"
FILE: 00-M-102



B TERTIARY BUILDING 2ND FLOOR PLAN
SCALE: 1/8" = 1'-0"
FILE: 00-M-103

ALTERNATIVE NO 2 - TERTIARY BUILDING LAYOUT

FIGURE 4.7

City of Daly City
Feasibility Study for Tertiary Expansion at the Daly City Wastewater Treatment Plant

4.2.1 <u>Tertiary Facility Alternative 2a</u>

After the feasibility workshop meeting on July 1, 2008, Carollo was asked to evaluate another layout alternative. This alternative involved housing the MF membranes and HiPOx™ disinfection system in a tertiary building located at the location of the existing plant Administration Building. A new Administration Building would then be constructed at the location of the Tertiary Building in Alternative 2. Carollo evaluated this option and determined that the existing pre-1975 Administration Building is not large enough to house the units and would need to be demolished and replaced with a new two-story Tertiary Building, with a footprint of about 27 feet by 75 feet, for this option to be feasible. This would result in a significantly higher cost than Alternative 2 since it would require construction of both a Tertiary Building and an Administration Building in addition to demolition of the existing Administration Building. The City has elected not to pursue this alternative any further.

4.3 Cost Comparison of Tertiary Facility Layout Alternatives

A cost comparison of layout Alternatives 1 and 2 is provided in Table 4.1. The costs listed in the table include only the building costs for each alternative and not the total facility costs. Total costs are presented in Chapter 6. The cost of seismically retrofitting the existing Generator Building in Alternative 1 to meet the existing code will likely result Alternative 2 being the more cost effective alternative. There were also several concerns about the feasibility of Alternative 1, which were expressed by the City during the feasibility workshop. These issues included the lack of access to the membrane ancillary equipment, which would be located over the existing primary sedimentation tanks and routing of the standby generator exhaust system.

Table 4.1 Cost Comparison of Layout Alternatives
Feasibility Study for Tertiary Treatment Expansion
City of Daly City

Item	Alternative 1	Alternative 2
Retrofit of Existing Generator Building and Second Story Addition	$1,000,000	---
Single Story Disinfection Building	$414,000	---
Two Story Tertiary Building	---	$828,000
Total Building Cost for Alternative	**$1,414,000**	**$828,000**

4.4 Recycled Effluent Pump Station

As shown in Figure 4.6, the new Recycled Effluent (RE) Pump Station would be located adjacent to the new Tertiary Building and north of the existing No.2 Water System Hydropneumatic Tank. The disinfected tertiary effluent would flow into a below-grade RE Pump Station Wet Well. Three vertical turbine pumps, two duty plus one standby, would be used to pump the recycled water to the distribution system. The distribution system is outside the scope of this project and the end point of use is yet to be determined. Therefore, the pump TDH requirements were assumed to be 200 feet based on the range of head requirements of the existing RE pumps. At these assumed conditions, the design operating point for each pump will be 2 mgd at 200 feet TDH, equivalent to 100 Hp motors for each pump. The pump motors will have VFDs to allow flexibility in operating flows.

4.5 Chemical Systems

In addition to the membrane CIP chemicals and LOX for the HiPOx™ disinfection system, the following chemicals will be required for the tertiary treatment system expansion.

4.5.1 <u>Chlorination</u>

A chlorine residual should be provided to minimize microbial and algal growth in the recycled water distribution system. The WWTP currently uses Sodium Hypochlorite (NaOCl) solution to chlorinate the existing recycled water system. It is anticipated that a new chemical feed pump can be added to the existing chlorination system to provide NaOCl to the new recycled effluent water. The NaOCl will be injected directly into the RE pipeline. An in-line static mixer would be used to properly distribute the solution into the recycled water.

4.5.2 <u>Poly Aluminum Chloride (PACl)</u>

Poly Aluminum Chloride (PACl) is currently used at the WWTP as a coagulant for secondary effluent water prior to the Dynasand™ filters. It is anticipated that this coagulant may also be required prior to the membrane filtration process due to the characteristics of the secondary effluent from the pure oxygen activated sludge process described in Chapter 3. Coagulant addition will likely reduce the CIP frequency and extend the life of the membranes. The amount of coagulant required will be determined during pilot testing of the membrane system.

4.6 Other Optional Chemicals

The following optional chemicals may also be required for the tertiary treatment system.

4.6.1 <u>Gypsum</u>

Gypsum (calcium sulfate) is currently added to the existing recycled water system after disinfection to condition the water for turf grass irrigation. Gypsum is used to adjust the sodium absorption ratio (SAR) to a value of 3.0 or less. Depending on the end use of the recycled water produced by the new tertiary facility, gypsum addition may be desirable. The existing gypsum injection system consists of a silo, batch mixing tank, a diaphragm feeder pump, and a mixer. The gypsum is currently injected into the tertiary system after chlorination and prior to entering the RE Pump Station. The existing silo and batch-mixing tank have sufficient capacity to provide gypsum for the additional 4 mgd of recycled water that will be produced. A second diaphragm pump would need to be installed in the existing silo to pump gypsum through a new feed line for direct injection to the RE pipeline near the same point of injection as the NaOCl solution. The in-line static mixer would be used to properly mix the gypsum solution into the recycled water.

4.7 Summary Of Recommended Design Alternative

In summary, the recommended design alternative consists of site layout Alternative 2, Microfiltration Membranes, a HiPOx™ ozone disinfection system, and a RE Pump Station. Table 4.2 provides a summary of the design criteria for this alternative.

Table 4.2 Summary of Tertiary System Design Criteria
Feasibility Study for Tertiary Treatment Expansion
City of Daly City

Description	Criteria
Secondary Effluent Water Quality	
Turbidity, NTU	5
Total Suspended Solids (TSS), mg/L	10
Tertiary System Capacity	
Minimum Base Secondary Effluent Flow, mgd	4
Internal Recycle Flow of Backwash Water, mgd	0.32
Coagulant Flash-Mix	
Goal: Control membrane fouling	
Type: Static Mixer	
PACl, Assumed Average Dose, mg/L	10
Membranes	
Goal: Turbidity < 0.1 NTU, Title 22 Compliant Filtration	
Type: Microfiltration (MF), Pressure-Driven	
Design Temperature, degrees F	68
Maximum Instantaneous Flux, gfd	45
Minimum Recovery	92%
On-Line Factor	86%
Number of Unit	3
Number of Modules per Unit	104
Membrane Area per Module, sf	538
Maximum Backwash Flowrate, gpm	832
Membrane Feed/Secondary Effluent Pumps	
Goal: Feed membrane units at constant pressure	
Type: Vertical Turbine, VFD	

Table 4.2 Summary of Tertiary System Design Criteria Feasibility Study for Tertiary Treatment Expansion City of Daly City	
Description	**Criteria**
Number	1+1
Capacity, Each	
Flow, gpm	2,800
TDH, psi	45
Horsepower	200
<u>Membrane Strainers</u>	
Goal: Protect membranes	
Type: Inverted Wedgewire	
Number	2+1
Capacity, each, gpm	1,500
Head loss, max psi	5
Strainer Size, microns	300
<u>Membrane CIP System</u>	
<u>Caustic/Hypo CIP/EMF Tank</u>	
Volume, gallons	2,500
Diameter, feet	8
<u>Acid CIP Tank</u>	
Volume, gallons	2,500
Diameter, feet	8
<u>Neutralization Tank</u>	
Volume, gallons	5,000
Diameter, feet	12
<u>Tank Immersion Heaters</u>	
Number	2
Wattage, Each, kW	45
<u>CIP Recirculation Pump</u>	
Number	1
Type: In-Line	
Capacity	
Flow, gpm	310
TDH, psi	30.3
Horsepower	7.5
Pump Speed, rpm	3500
<u>CIP Drain Pump</u>	
Number	1

Table 4.2 Summary of Tertiary System Design Criteria Feasibility Study for Tertiary Treatment Expansion City of Daly City	
Description	**Criteria**
Type: In-Line	
Capacity	
Flow, gpm	310
TDH, psi	30.3
Horsepower	7.5
Pump Speed, rpm	3500
<u>CIP Chemical Feed Pumps</u>	
Number	3
Flow, gpm	11
TDH, psi	26
Air Requirement, psi	80
<u>Reverse Flush System</u>	
Backwash Supply Tank	
Volume, gallons	1,500
Diameter, feet	8
Reverse Flush Pump Station	
Type: End Suction Centrifugal, VFD	
Number	2
Capacity, Each	
Flow, gpm	850
TDH, psi	28
Horsepower	25
<u>Compressed Air System</u>	
Type of Compressor:	
Number	2
Capacity, Each	
Flow, cfm	78
TDH, psig	150
Horsepower	20
Receiver Tank	
Capacity, gallons	620
Diameter, feet	3
<u>HiPOx^{TM} Disinfection System</u>	
Flow, mgd	4
Applied Ozone Dose. mg/L	3-5

Table 4.2 Summary of Tertiary System Design Criteria Feasibility Study for Tertiary Treatment Expansion City of Daly City	
Description	**Criteria**
Ozone Demand, ppd	170
Oxygen Flow Rate, scfm	14.9
Horsepower	120
Recycled Effluent Pumps	
Goal: Deliver Recycled Water to Distribution System	
Type: Vertical Turbine, VFD	
Number	2+1
Capacity, Each	
Flow, gpm	1,400
TDH, feet	200
Horsepower	100

Notes:
(1) Assumes CIP operation every 30 days, 8 hours/clean/skid.
(2) Assumes one skid in RF, 30 percent of the time.
(3) Assumes 25 percent online time.

4.8 Power Supply

The existing switchgear at the WWTP was installed in 1975 and is near the end of its useful life. Additionally, there is insufficient room in the existing Switchgear Building to house the new electrical and instrumentation components for the new tertiary equipment. It is therefore recommended that a new electrical building be constructed adjacent to the existing Switchgear Building as shown in Figure 4.6. The new electrical building will house the new 12 KV switchgear for the entire WWTP, RE Pump VFD panels, a new Motor Control Center (MCC) for the new equipment, PLCs, HVAC equipment, and a new PG&E meter. Equipment remaining in the existing Switchgear Building will be fed from the new electrical building. The building footprint will be approximately 35 feet by 20 feet. The only new equipment not fed from the new electrical building will be the new 200 Hp SE pumps. There is space available in the existing MCC-R, located in the MCC Building adjacent to Headworks No.2, for installation of two new VFDs and power feed for the SE pumps. Table 4.3 provides a summary of the major equipment and their power requirements.

Table 4.3 Summary of Tertiary System Major Equipment Power Requirements
Feasibility Study for Tertiary Treatment Expansion
City of Daly City

Description	Quantity	Motor Size (Hp)	Connected Load (Hp)	Typical Power Usage (Hp)
Membrane Feed/SE Pumps	1+1	200	400	200
CIP Recirculation Pump	1	7.5	7.5	0.25(1)
CIP Drain Pump	1	7.5	7.5	0.1(2)
Reverse Flush Pump Station	1+1	25	50	7.5(3)
Air Compressors	1+1	20	40	5(4)
Hi-POX Disinfection System	1	120	120	120
RE Pumps	2+1	100	300	200
Miscellaneous Equipment	-	<5	150	50
Total Loads			**1075**	**583**

Notes:
(1) Assumes CIP operation every 30 days, 8 hours/clean/skid.
(2) Assumes minimal drain time.
(3) Assumes one skid in RF, 30 percent of the time.
(4) Assumes 25 percent online time.

5.0 TERTIARY SYSTEM COST ANALYSIS

A summary of the conceptual level estimate of construction costs for the recommended alternative is presented in Table 5.1, based on the design criteria listed above. An allowance for modifications to the existing outfall was included since there is some uncertainty as to whether the end of the outfall pipe will need to be capped. The existing outfall currently has duckbill type check valves on the diffuser risers to prevent inflow of seawater and sediment during low discharge flows. However, it appears that the end of the outfall diffuser pipe is not sealed, which could allow for sediment to flow in and possibly plug the pipeline due to reduced flows to the outfall. This will need to be evaluated further during design.

Table 5.1	Summary of Tertiary System Construction Costs Feasibility Study for Tertiary Treatment Expansion City of Daly City		
Item No.	**Description**		**Total**
01	Secondary Effluent Pump Station		$340,000
02	Membranes		$3,064,000
03	Disinfection		$965,000
04	Tertiary Building		$869,000
05	Recycled Effluent Pump Station		$295,000
06	Sitework and Yard Piping		$753,000
07	EI&C		$1,920,000
08	Outfall Modifications Allowance		$200,000
	TOTAL DIRECT COST		**$8,406,000**
	Contingency	30.0%	$2,522,000
	Subtotal		**$10,928,000**
	General Contractor Overhead, Profit & Risk	12.0%	$1,311,000
	Subtotal		**$12,239,000**
	Escalation to Mid-Point(1)	22.5%	$2,754,000
	Subtotal		**$14,993,000**
	Sales Tax(2)	8.25%	$618,000
	Subtotal		**$15,611,000**
	General Conditions	15.0%	$2,342,000
	TOTAL ESTIMATED CONSTRUCTION COST		**$17,953,000**

Notes:
(1) 7% escalation to midpoint added per year. Assumed construction midpoint date is in 2011.
(2) Sales tax based on San Mateo County sales tax.

Table 5.2 provides estimated operation and maintenance costs for the recommended alternative including O&M labor, chemical, and electrical costs.

Table 5.2	Summary of Tertiary System Operation and Maintenance Costs Feasibility Study for Tertiary Treatment Expansion City of Daly City
Process	**Cost**
MF Membrane CIP Chemicals	$7,000
Process Chemicals	$41,000
HiPOx^{TM} Process	$75,000
Total Energy Costs	$210,000
O&M Labor	$62,000
Membrane Module Replacement	$24,000
TOTAL ANNUAL O&M COST (years 1 to 10)	**$419,000**
TOTAL ANNUAL O&M COST (years 11 to 20)	**$395,000**
PRESENT WORTH O&M COST(1)	**$4,710,000**
Notes: (1) Interest rate assumed to be 6 percent. Life cycle is 20 years.	

6.0 CONCLUSIONS AND NEXT STEPS

Based on the evaluations performed during this study, it appears to be feasible to construct a new tertiary treatment facility at the existing WWTP that is capable of producing up to 4 mgd of recycled water. However, based on current average dry weather flows, there is only about 3.4 mgd of additional wastewater available for tertiary treatment. The proposed tertiary treatment facility could therefore be constructed to produce 3.4 mgd with provisions to expand to 4 mgd capacity if flows increase.

Prior to pre-design and design of the new tertiary treatment facilities, the following steps are recommended:

- Decide how equipment selection and procurement will be handled.
- Pilot test the Pall MF Membrane system, or other applicable system, to determine the coagulant dosing and optimize the operating parameters.
- Pilot and bench-scale testing of the HiPOx^{TM} disinfection system including ozone demand and decay studies.