City of Daly City and
San Francisco Public Utilities Commission

Feasibility of Expanded Tertiary Recycled Water Facilities

PRELIMINARY DESIGN REPORT

DRAFT • SEPTEMBER 2017
VOLUME TWO

Engineers...Working Wonders With Water®

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

PRELIMINARY DESIGN REPORT

VOLUME 1 OF 3

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EXECUTIVE SUMMARY

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CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

TECHNICAL MEMORANDUM NO. 2
COLMA DELIVERY SYSTEM

DRAFT
September 2017

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CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

TECHNICAL MEMORANDUM
NO. 2
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RECYCLED WATER CONVEYANCE SYSTEM

1.0 INTRODUCTION

1.1 Purpose

The purpose of this technical memorandum (TM) is to summarize the preliminary design of the conveyance system for the Feasibility of Expanded Tertiary Recycled Water Facilities Project (Project). The conveyance system will deliver recycled water from the City of Daly City's (City) wastewater treatment plant (WWTP) to customers in Daly City, the Town of Colma (Colma), and the City of South San Francisco (SSF) for irrigation.

1.2 Background

The San Francisco Public Utilities Commission (SFPUC) is partnering with Daly City on the Project to reduce irrigation demands on the South Westside Groundwater Basin. The groundwater basin includes areas from San Francisco to Burlingame. The Project increases the treatment capacity at Daly City's WWTP and delivers recycled water to cemeteries, schools, parks, and other facilities in Colma, SSF, and Daly City for irrigation.

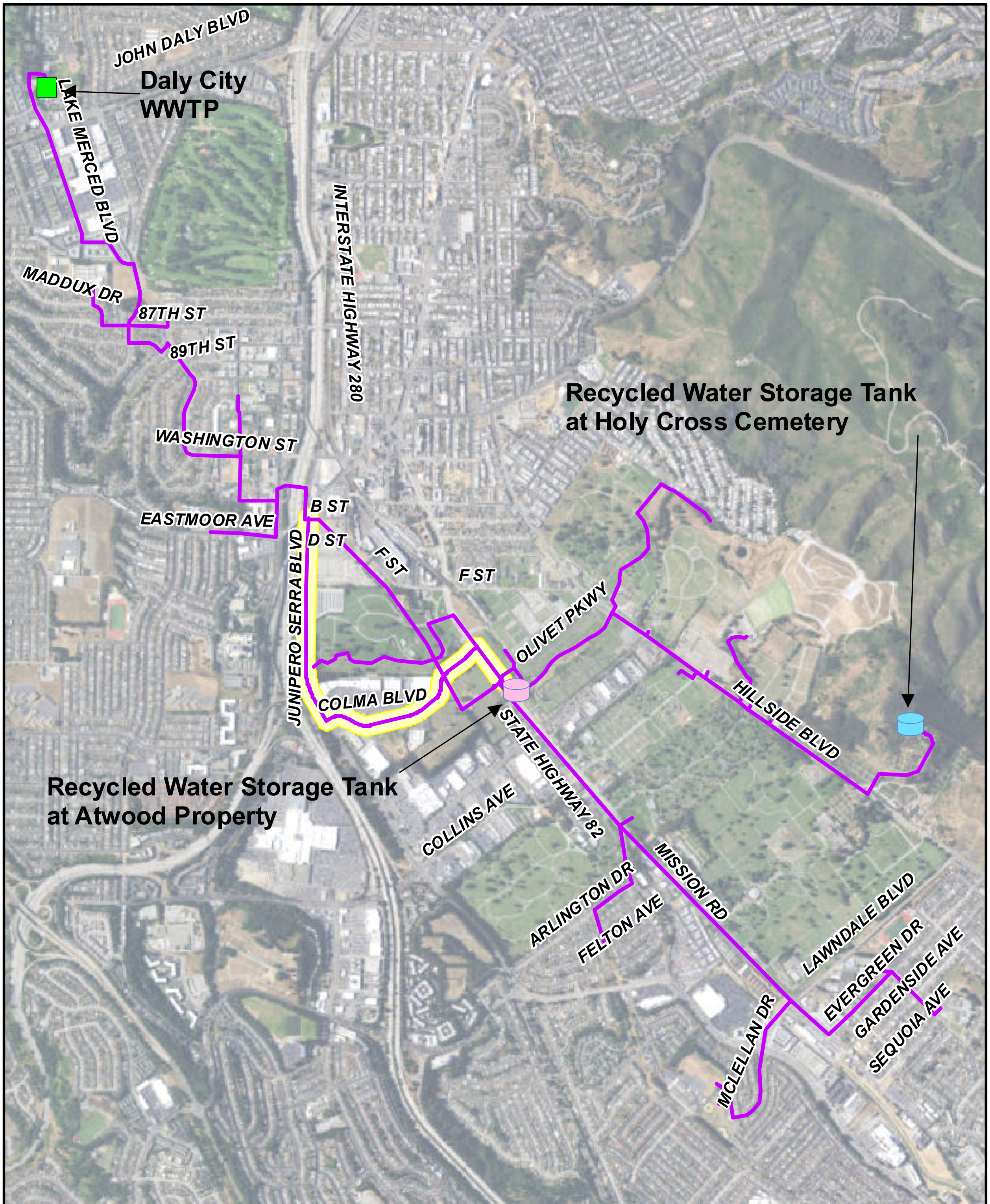
The feasibility of this project was established in the 2009 Recycled Water Treatment and Delivery System Expansion Feasibility Study (Feasibility Study) (Carollo, 2009).

1.3 Project Description

The conveyance system includes all facilities required to deliver recycled water from the WWTP to the proposed users' service connections. This conveyance system will deliver water to cemeteries, schools, parks, and other facilities in Colma, SSF, and Daly City for irrigation. The recycled water conveyance system includes the following elements:

- Recycled Water Effluent Pump Station located at the WWTP.
- Transmission main from WWTP to storage tank site.
- Storage tank.
- Distribution system pump station located at the storage tank site.
- Distribution system from storage tank site to recycled water customers.

Figure 2.1 shows the storage tank sites, transmission pipeline, distribution system, and overview of the Project.



Daly City WWTP

Atwood Property Storage Tank and PS

Holy Cross Cemetery Storage Tank

Pipeline Alignment

Colma Boulevard Alignment

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N

Feet

0 1,250 2,500

PROJECT OVERVIEW

FIGURE 2.1

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

1.4 Storage Tank Site Evaluation

The location of the recycled water storage tank was originally identified as the Italian Cemetery during the Feasibility Study (Carollo, 2009). During the public outreach process for this Project, Carollo discussed the potential of locating the recycled water storage tank at the Italian Cemetery with the cemetery management staff. The management staff explained that the site is not a feasible location because the cemetery is planning to expand in this area.

Carollo evaluated several potential storage tank sites in Project Memorandum (PM) 4 titled, "Daly City Storage Tank Site Initial Screening" (Carollo, 2016) (Appendix B). The purpose of the evaluation was to identify and screen potential storage tank sites since the preliminary design of the recycled water conveyance system (pipeline alignment and system hydraulics) depends highly on the storage tank location. PM 4 evaluated six storage tank locations and recommended further evaluation of the Atwood Property, Salem Memorial Park, and Holy Cross Cemetery sites.

Carollo evaluated the Atwood Property, Salem Memorial Park, and Holy Cross Cemetery sites in PM 5 titled, "Recycled Water Storage Tank Site Evaluation" (Carollo, 2017) (Appendix C). The purpose of the evaluation was to identify the preferred storage tank site based on site characteristics, conveyance system, land owner feedback, geotechnical considerations, and cost. The Holy Cross site was found to be the most favorable because it does not require a distribution system pump station or booster pump station, the tank can be located above grade, the site has adequate space, and the site is not located near BART. The Atwood Property site was also found to be feasible; however, it is less favorable because it requires a distribution system pump station and booster pump station, the tank would be located below grade, and the site is located near BART.

The Salem Memorial Park site is not recommended because the proposed tank site is small and requires a tank depth of 70 feet, which is cost prohibitive. However, if it is possible to utilize the adjacent parking lot during construction, the tank dimensions could be adjusted to accommodate a tank depth of 33 feet. The shallower tank depth is feasible, but it would require renegotiations with Lucky Chances Casino who currently leases the parking lot from the Salem Memorial Cemetery. Since the feasibility of this site is contingent upon negotiating the use of the parking lot, it was eliminated from further consideration at this time. If the two preferred sites become unavailable, the Salem Memorial Park site could be re-evaluated. It should also be noted that the Salem Memorial Park site is included in the CEQA analysis.

This TM summarizes the preliminary design of the conveyance systems for the Holy Cross and Atwood Property storage tank sites because these sites were found to be the most feasible. PM 5 titled, "Recycled Water Storage Tank Site Evaluation" (Carollo, 2017) (Appendix C) discusses the Salem Memorial Park Cemetery storage tank site in detail.

2.0 CUSTOMER OUTREACH

The potential recycled water customers in Daly City, SSF, and the San Francisco Lake Merced area were originally identified in the Recycled Water Treatment and Delivery System Expansion Feasibility Study (Feasibility Study) (Carollo, 2009). The Project team further refined the customer list by conducting several outreach efforts with potential customers in the form of meetings, site visits, and questionnaires. The purpose of the outreach was to provide information about the Project and to obtain information regarding each customer's on-site irrigation systems.

As discussed during the Project Kick-Off Meeting on October 19, 2015, only customers in Colma and SSF were considered for the Project. Based on the City's request, the Project team also included additional recycled water customers due to their proximity to the pipeline alignment. The outreach efforts are summarized in PM 2 titled, "Recycled Water Customer Outreach" (Carollo, 2016) (Appendix D) and are also described in further detail in the following subsections.

The customer outreach efforts focused on gathering information and assessing interest in the Project. Carollo did not negotiate with the potential customers regarding any aspect of the Project and did not discuss the potential price of recycled water. The SFPUC and City stated they would lead the negotiations, if required.

Figure 2.2 shows the potential recycled water customers in Daly City, SSF, and Colma.

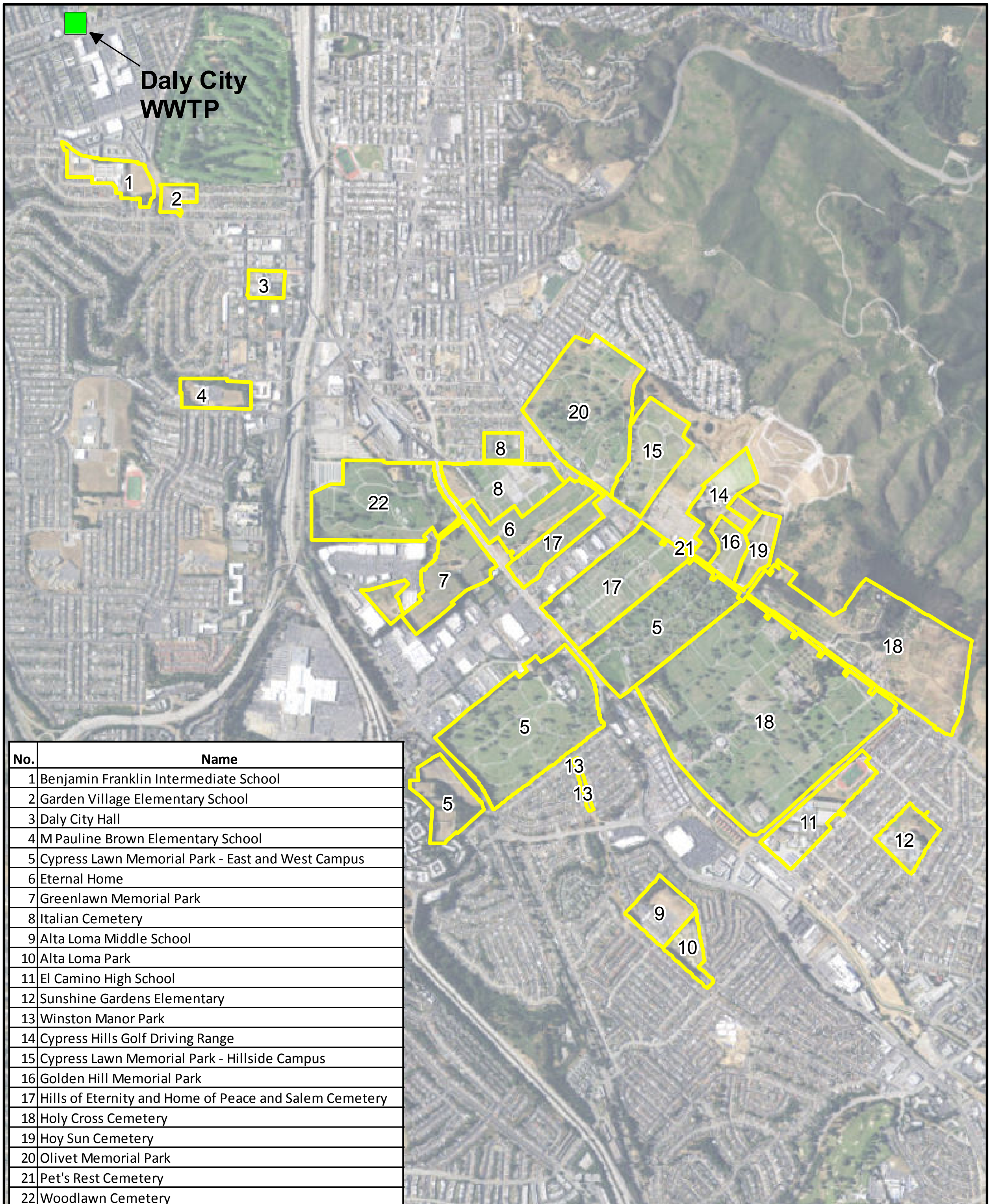
2.1 Customer Meetings

Carollo conducted meetings with potential recycled water customers on December 22, 2015 and October 14, 2016. The meetings were also attended by the project stakeholders: the City, SFPUC, Colma, Cal Water, and SSF. Cal Water is the current water service provider for several of the potential customers. Six of the 22 potential customers were in attendance for the two meetings.

The 2015 customer meeting provided basic information regarding the Project and addressed potential customer questions and concerns. The 2016 customer meeting provided a Project progress update and the anticipated schedule moving forward.

2.2 Customer Site Visits

Carollo conducted site visits with potential recycled water customers in January 2016. Carollo visited fourteen cemeteries and spoke with cemetery personnel to gather information about each facility. The information included property boundaries, irrigated areas, existing storage tank volume and location, potential connection locations for recycled water irrigation lines, and existing irrigation system layout.



No.	Name
1	Benjamin Franklin Intermediate School
2	Garden Village Elementary School
3	Daly City Hall
4	M Pauline Brown Elementary School
5	Cypress Lawn Memorial Park - East and West Campus
6	Eternal Home
7	Greenlawn Memorial Park
8	Italian Cemetery
9	Alta Loma Middle School
10	Alta Loma Park
11	El Camino High School
12	Sunshine Gardens Elementary
13	Winston Manor Park
14	Cypress Hills Golf Driving Range
15	Cypress Lawn Memorial Park - Hillside Campus
16	Golden Hill Memorial Park
17	Hills of Eternity and Home of Peace and Salem Cemetery
18	Holy Cross Cemetery
19	Hoy Sun Cemetery
20	Olivet Memorial Park
21	Pet's Rest Cemetery
22	Woodlawn Cemetery

Daly City WWTP
Potential Customers

Feet
0 1,250 2,500

POTENTIAL CUSTOMERS

FIGURE 2.2

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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The key findings from the site visits were as follows:

- Two cemeteries, the Japanese Benevolent Society and Serbian Cemetery, have minimal irrigation potential and were removed from the Project.
- Several cemeteries have existing storage tanks/ponds.
- The majority of the cemeteries have hose bibs. The Water Recycling Act of 2013 minimizes the retrofit requirements associated with the hose bibs (i.e., the hose bibs can remain in place and use tertiary recycled water with proper signage).
- The retrofit required for each cemetery will be different considering the unique aspects of each site.

2.3 Customer Questionnaire

Carollo developed a questionnaire for the potential recycled water customers. The purpose of the questionnaire was to gain more information (i.e., irrigation schedule, irrigable acreage, storage volume, peak water use, etc.) regarding each customer's irrigation system. The information obtained from these questionnaires has been incorporated into the preliminary design of the Project.

2.4 Potential Recycled Water Customers

The current list of potential recycled water customers is presented in Table 2.1. The relevant information obtained from the customer outreach conducted is also summarized in the table.

3.0 RECYCLED WATER DEMAND AND SUPPLY

3.1 Overview

The recycled water conveyance system is sized based on the potential customers' recycled water demands and the availability of supply from the WWTP (i.e., secondary effluent). This section summarizes the recycled water demand and supply study used to design the transmission main, distribution system, and the recycled water storage tank.

Table 2.1 Recycled Water Customers
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Name	Type	Location	Existing Irrigated Acreage	Irrigation Water Supply	Potable Water Supply	Storage Available (gallons)	Assumed Retrofit Requirement
1	Benjamin Franklin Intermediate School	School	Broadmoor	9.5	Cal Water	Cal Water	-	Cut and cap line from Cal Water service.
2	Garden Village Elementary School	School	Broadmoor	2.3	Daly City Water	Daly City Water	-	Cut and cap line from Daly City Water service.
3	Daly City Hall	Other	Daly City	1.7	Daly City Water	Daly City Water	-	Cut and cap line from Daly City Water service.
4	M Pauline Brown Elementary School	School	Daly City	9.0	Daly City Water	Daly City Water	-	Cut and cap line from Daly City Water service.
5	Cypress Lawn Memorial Park - East and West Campus	Cemetery	Colma	124.0	Private Well	Cal Water	1,000,000	Irrigation system is already separated.
6	Eternal Home	Cemetery	Colma	12.6	Private Well	Cal Water	65,000	Irrigation system is already separated.
7	Greenlawn Memorial Park	Cemetery	Colma	31.5	Cal Water	Cal Water	-	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.
8	Italian Cemetery	Cemetery	Colma	21.3	Private Well	Private Well	-	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.
9	Alta Loma Middle School	School	South San Francisco	8.5	Cal Water	Cal Water	-	Cut and cap line from Cal Water service.
10	Alta Loma Park	School	South San Francisco	5.4	Cal Water	Cal Water	-	Cut and cap line from Cal Water service.
11	El Camino High School	School	South San Francisco	13.0	Cal Water	Cal Water	-	Cut and cap line from Cal Water service.
12	Sunshine Gardens Elementary	School	South San Francisco	3.4	Cal Water	Cal Water	-	Cut and cap line from Cal Water service.
13	Winston Manor Park	School	South San Francisco	1.4	Cal Water	Cal Water	-	Cut and cap line from Cal Water service.
14	Cypress Hills Golf Driving Range	Driving Range	Colma	8.0	Cal Water	Cal Water	-	Cut and cap line from Cal Water service.
15	Cypress Lawn Memorial Park - Hillside Campus	Cemetery	Colma	28.0	Cal Water	Cal Water	-	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.
16	Golden Hill Memorial Park	Cemetery	Colma	9.8	Cal Water	Cal Water	-	Cut and cap line from Cal Water service and well.
17	Hills of Eternity and Home of Peace and Salem Cemetery	Cemetery	Colma	43.2	Private Well	Private Well	500,000	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.
18	Holy Cross Cemetery	Cemetery	Colma	250.0	Private Well	Cal Water	1,000,000	Irrigation system is already separated.
19	Hoy Sun Cemetery	Cemetery	Colma	8.8	Cal Water	Cal Water	-	Cut and cap line from Cal Water service.
20	Olivet Memorial Park	Cemetery	Colma	56.7	Private Well	Cal Water	1,000,000	Irrigation system is already separated.
21	Pet's Rest Cemetery	Cemetery	Colma	0.6	Cal Water	Cal Water	-	Cut and cap line from Cal Water service.
22	Woodlawn Cemetery	Cemetery	Colma	49.5	Private Well	Cal Water	-	Irrigation system is already separated.

3.2 Recycled Water Demands

The estimated recycled water demands are presented in Table 2.2. The recycled water demands are also summarized in PM 3 titled, "Recycled Water Storage Tank Volume" (Carollo, 2016) (Appendix E). The demand calculations are based on the following formulas:

- $Average\ Annual\ Demand = Existing\ Irrigated\ Acreage * 1.7\ \frac{acre-feet}{acre-year}$
- $Average\ Day\ Demand = Ex.Irr.Acre * 0.33\ \frac{acre-feet}{acre-month} * \frac{325{,}851\ Gallons}{1\ acre-feet} * \frac{1\ MG}{1{,}000{,}000\ Gallons} * \frac{1\ Month}{30.417\ Days}$
- $Peak\ Day\ Demand = Average\ Day\ Demand * Peaking\ Factor\ of\ 1.33$
- $Peak\ Day\ Demand\ Over\ 8\ Hour\ Period = Peak\ Day\ Demand * \frac{24\ hours}{8\ hours}$

The annual average irrigation requirement of 1.7 acre-feet/acre/year, the average daily irrigation requirement of 0.33 acre-feet/acre/month, the peaking factor of 1.33, and an 8-hour irrigation period are based on the values used in the Feasibility Study (Carollo, 2009). The diurnal pattern for the peak day demand is shown in Figure 2.3.

3.3 Recycled Water Supply and Tertiary System Capacity

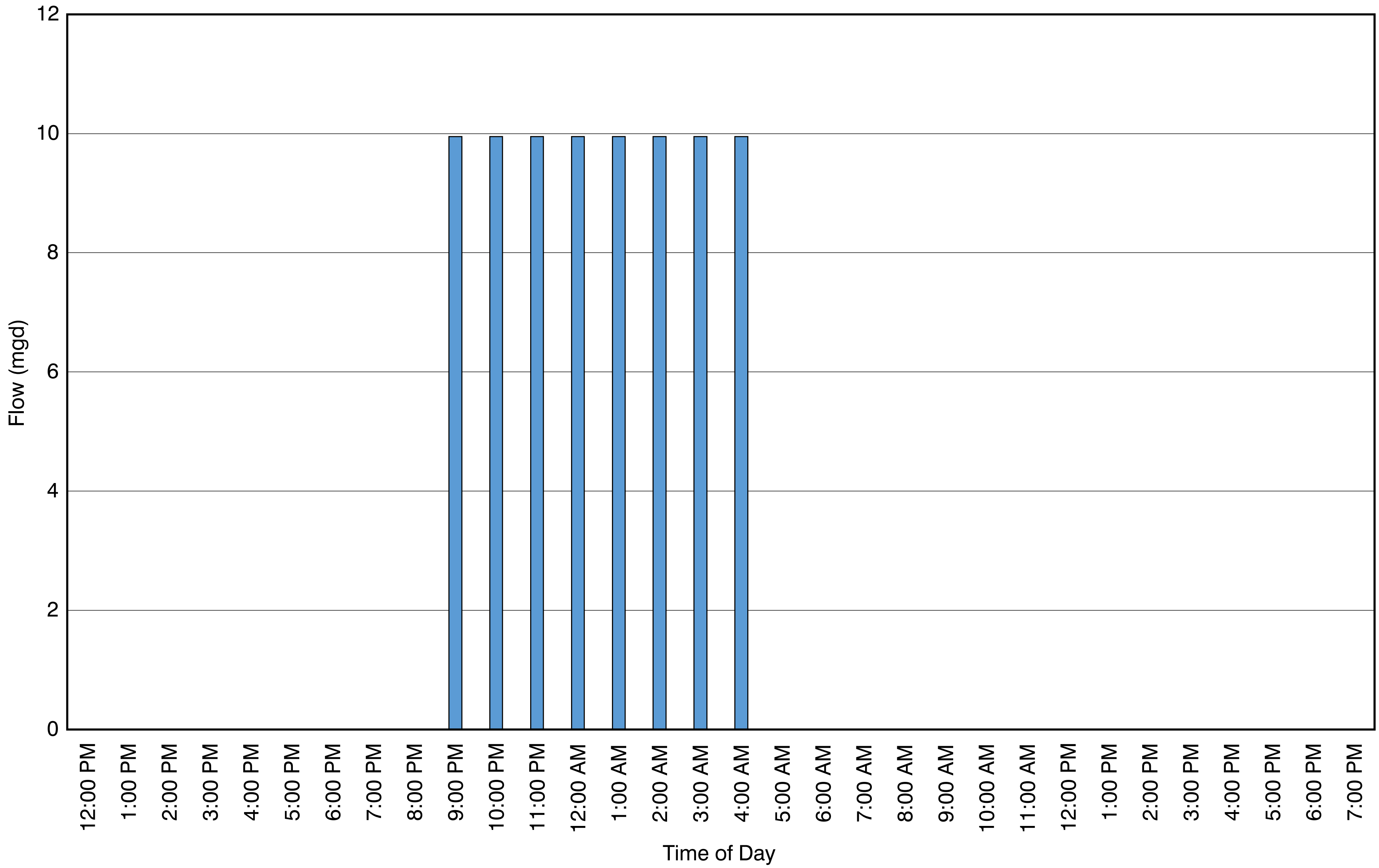
The amount of recycled water available for the new tertiary system is limited by the influent flow to the Daly City WWTP and operation of the existing tertiary treatment system. The City is currently permitted to produce up to 2.77 million gallons per day (mgd) of recycled water with its existing tertiary treatment facility. The remaining secondary effluent is disinfected and discharged to the Pacific Ocean.

PM 7 titled, "Tertiary Expansion Capacity Assessment" (Carollo, 2016) (Appendix F) provides a detailed assessment of the tertiary system capacity. The Project team used hourly plant influent flow data from 2012 and 2015 to estimate the flow available for recycled water supply. The data from 2015 is considered representative of recent dry years and the data from 2012 is considered representative of more typical, average rainfall years.

The plant equalizes the diurnal influent flow to provide a more consistent flow to the secondary treatment process. The membrane system will be capable of ramping up and down based on the available equalized flow. Since the membrane building is constrained by footprint, the maximum instantaneous flow supported by the membrane system is 3.60 mgd. Therefore, instantaneous flows in excess of 6.37 mgd (2.77 mgd + 3.60 mgd) would be diverted to the outfall.

Table 2.2 Recycled Water Demands
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Name	Existing Irrigated Acreage	Average Annual Demand (afy)	Average Day Demand (mgd)	Peak Day Demand (mgd)	Peak Day Demand over 8 hrs (mgd)
1	Benjamin Franklin Intermediate School	9.5	16	0.03	0.05	0.14
2	Garden Village Elementary School	2.3	4	0.01	0.01	0.03
3	Daly City Hall	1.7	3	0.01	0.01	0.02
4	M Pauline Brown Elementary School	9.0	15	0.03	0.04	0.13
5	Cypress Lawn Memorial Park - East and West Campus	124.0	211	0.44	0.59	1.77
6	Eternal Home	12.6	21	0.04	0.06	0.18
7	Greenlawn Memorial Park	31.5	54	0.11	0.15	0.45
8	Italian Cemetery	21.3	36	0.08	0.10	0.30
9	Alta Loma Middle School	8.5	14	0.03	0.04	0.12
10	Alta Loma Park	5.4	9	0.02	0.03	0.08
11	El Camino High School	13.0	22	0.05	0.06	0.19
12	Sunshine Gardens Elementary	3.4	6	0.01	0.02	0.05
13	Winston Manor Park	1.4	2	0.01	0.01	0.02
14	Cypress Hills Golf Driving Range	8.0	14	0.03	0.04	0.11
15	Cypress Lawn Memorial Park - Hillside Campus	28.0	48	0.10	0.13	0.40
16	Golden Hill Memorial Park	9.8	17	0.03	0.05	0.14
17	Hills of Eternity and Home of Peace and Salem Cemetery	43.2	73	0.15	0.21	0.62
18	Holy Cross Cemetery	250.0	425	0.89	1.19	3.56
19	Hoy Sun Cemetery	8.8	15	0.03	0.04	0.13
20	Olivet Memorial Park	56.7	96	0.20	0.27	0.81
21	Pet's Rest Cemetery	0.6	1	0.00	0.00	0.01
22	Woodlawn Cemetery	49.5	84	0.18	0.24	0.71
	TOTAL	**698.2**	**1,186**	**2.49**	**3.32**	**9.95**



DIURNAL PATTERN FOR PEAK DAY DEMANDS

FIGURE 2.3

CITY OF DALY CITY

TM 2 COLMA DELIVERY SYSTEM

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Based on the historical influent flow data and the existing tertiary treatment system capacity (2.77 mgd), the average flow available for the new tertiary system is 3.11 mgd during a typical year and 2.80 mgd during a dry year. The average daily recycled water demand from the cemeteries and other irrigation users is estimated at 2.49 mgd. In order to meet this demand, the membrane facility will be required to ramp up to a maximum instantaneous flow of 3.60 mgd at certain times of the day. Therefore, Carollo recommends sizing the tertiary system to meet the maximum instantaneous flow of 3.60 mgd.

3.4 Summary of Recycled Water Demand and Supply

Table 2.3 presents a summary of the recycled water demand and supply. There is sufficient recycled water supply to meet average day demands. However there is insufficient recycled water supply to meet the peak day demands so a storage tank is required. The storage tank volume was determined in PM 3 titled, "Recycled Water Storage Tank Volume" (Carollo, 2016) (Appendix E), and is discussed further in Section 7.0.

Table 2.3 Recycled Water Demand and Supply Flows
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Description	Flow (mgd)
Demand	
Average Day Demand, Over 24 Hours	2.49
Peak Day Demand, Over 24 Hours	3.32
Peak Day Demand, Over 8 Hours	9.95
Supply	
Max Instantaneous Flow Available to New Tertiary System (1)	3.60
Average Daily Flow Available to New Tertiary System(2)	2.80 - 3.11
Average Daily Recycled Water Produced(3)	2.49 - 2.77
Maximum Daily Recycled Water Produced(4)	3.00

Notes:
(1) Maximum instantaneous flow of the membrane system based on the membrane building footprint constraints.
(2) Based on 2012 and 2015 hourly flow data.
(3) Based on average daily flow available to the new tertiary system and estimated efficiency of the membrane system.
(4) Maximum daily recycled water production assuming that the membrane system is not limited by supply.

The City is permitted to produce 2.77 mgd of recycled water at the existing tertiary treatment facility based on its current National Pollutant Discharge Elimination System (NPDES) Permit. The City would need to modify its existing NPDES permit to allow for a tertiary treatment permitted capacity of 5.77 mgd (2.77 mgd + 3.00 mgd).

4.0 RECYCLED WATER EFFLUENT PUMP STATION

4.1 Overview

The purpose of the recycled water effluent pump station is to pump water from the WWTP to the storage tank in Colma. The pump station includes 3 pumps (2 duty and 1 standby) with variable frequency drives (VFDs) to meet intermediate demands. The pump station preliminary design is presented in TM 1 - Tertiary Treatment (Carollo, 2017) since the pump station is located at the WWTP.

4.2 Design Criteria

The design criteria for the recycled effluent pump station vary depending on the location of the storage tank. The following section summarizes the design criteria for the pump station based on the two preferred storage sites; the Atwood Property and the Holy Cross site.

4.2.1 Atwood Property

Table 2.4 summarizes the design criteria for the recycled effluent pump station assuming the storage tank is located at the Atwood Property. The pumping criteria are shown for the two transmission main alignments. The two different transmission main alignments are summarized in PM 14 titled, "Colma Boulevard Alignment" (Carollo, 2017) (Appendix J) and are also described in further detail in Section 5.3.

Table 2.4 Atwood Property: Recycled Effluent Pump Station
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Parameter	Units	Feasibility Study Alignment Criteria	Colma Boulevard Alignment Criteria
Pumps			
Type	--	Vertical Turbine	Vertical Turbine
Number of Pumps	No.	3 (2 duty, 1 standby)	3 (2 duty, 1 standby)
TDH	ft	230	310
Motor Horsepower, each	HP	100	130
Flow, Maximum	mgd	3.6	3.6
Flow, During Storage Tank Filling	mgd	2.73	2.73
Flow, Average	mgd	2.49	2.49
Pump Station Wet Well			
Type	--	Below-grade Rectangular Concrete Tank	Below-grade Rectangular Concrete Tank
Capacity	gallons	37,000	37,000
Dimensions (L x W)	ft x ft	25 X 20	25 X 20
Water Depth	ft	13.6	13.6

4.2.2 Holy Cross Cemetery

Table 2.5 summarizes the design criteria for the recycled effluent pump station assuming the storage tank is located at the Holy Cross Cemetery. The pumping criteria is nearly identical for the two transmission main alignments. More information regarding the two transmission main alignments is presented in Section 5.3.

Table 2.5 Holy Cross Cemetery: Recycled Effluent Pump Station
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Parameter	Units	Feasibility Study Alignment Criteria	Colma Boulevard Alignment Criteria
Pumps			
Type	--	Vertical Turbine	Vertical Turbine
Number of Pumps	No.	3 (2 duty, 1 standby)	3 (2 duty, 1 standby)
TDH	ft	540	545
Motor Horsepower, each	HP	200	200
Flow, Maximum	mgd	3.6	3.6
Flow, During Storage Tank Filling	mgd	2.73	2.73
Flow, Average	mgd	2.49	2.49
Pump Station Wet Well			
Type	--	Below-grade Rectangular Concrete Tank	Below-grade Rectangular Concrete Tank
Capacity	gallons	37,000	37,000
Dimensions (L x W)	ft x ft	25 X 20	25 X 20
Water Depth	ft	13.6	13.6

5.0 TRANSMISSION MAIN

5.1 Overview

The transmission main conveys water from the WWTP to the storage tank. Similar to the recycled effluent pump station, the transmission main alignment depends on the storage tank location. The alignment for the Atwood Property and Holy Cross cemetery sites are included in this discussion.

5.2 Design Criteria

The pipeline design criteria are presented in Table 2.6.

**Table 2.6 Transmission Main Pipeline Design Criteria
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City**

Criteria	Value
Material	DI
Maximum Operating Pressure[(1)]	220 psi for the Holy Cross Cemetery Alignment 95 psi for the Atwood Property Alignment
Minimum Turnout Pressure[(1)]	Less than 40 psi for the Atwood Property Alignment 50 psi for the Holy Cross Cemetery Alignment
Pipeline Roughness (C Factor)	130
Pipe Diameter	14-inch
Design Condition[(2)]	2.73 mgd
Pipeline Velocity	2.5 to 4.0 feet per second (fps)

Notes:

(1) Based on the current pump station design, two customers along the Atwood Property Transmission Main Alignment will need booster pumps or three customers along the Holy Cross Cemetery Transmission Main Alignment will need pressure reducing valves.
(2) Average flow required 24-hour a day to meet the peak day demand

5.3 Transmission Main Alignment

The Feasibility Study (Carollo, 2009) identified a preferred transmission pipeline alignment from the WWTP to the storage tank. The preferred alignment was selected because it was the most favorable route in terms of construction cost as well as non-economic criteria, including: ease of permitting, community acceptance, constructability, access to easements, utility conflicts, traffic, and operation and maintenance. Figure 2.4 shows the preferred transmission main alignment identified in the Feasibility Study.

The Project team re-evaluated the transmission main pipeline alignment selected during the Feasibility Study at Daly City's request in the PM 6 titled, "Northern Pipe Alignment Evaluation" (Carollo, 2016) (Appendix G). Daly City requested that Carollo consider several "Northern Alignments," which cross I-280 at the John Daly Boulevard Bridge and repurpose an existing 12-inch recycled water pipeline. Compared to the alignment developed in the Feasibility Study, the Northern Alignments are advantageous because they are not routed through the SFPUC easement along the Baden-Merced Pipeline. However, PM 6 found that the Feasibility Study alignment had the lowest annual amortized cost. Daly City and SFPUC requested the Project team proceed with the field investigations (geotech and surveying) for the Feasibility Study alignment. Figure 2.5 shows the Northern Alignments evaluated in PM 6.

Daly City WWTP

Feasibility Study Storage Tank

Transmission Main

Feet

0 550 1,100

FEASIBILITY STUDY
TRANSMISSION MAIN ALIGNMENT

FIGURE 2.4

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FEASIBILITY OF EXPANDED
TERTIARY RECYCLED WATER FACILITIES

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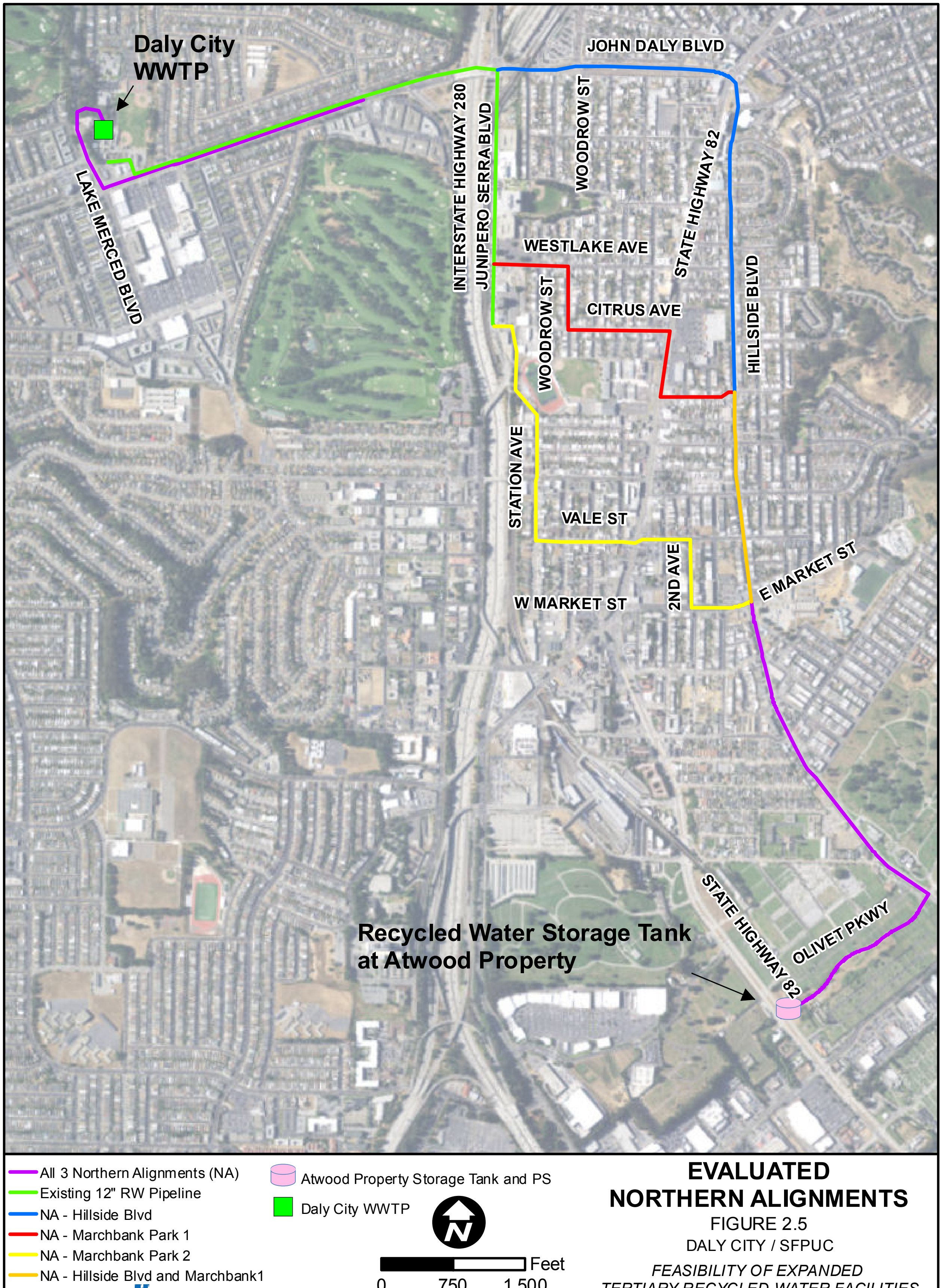

EVALUATED NORTHERN ALIGNMENTS

FIGURE 2.5

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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In addition to the Northern Alignments, the Project team reconsidered the portion of the Feasibility Study alignment along Washington Street at Daly City's request. Based on the evaluation, it was determined that the alignment along Washington Street is the preferred alternative since it has a reduced potential for utility conflicts. A detailed analysis of the evaluation is provided in PM 1 titled, "Colma Transmission Pipeline Alignment" (Carollo, 2016) (Appendix H).

In PM 14, the Project team evaluated another alignment at the request of SFPUC and the City. The additional alignment is routed outside of SFPUC's easement. Figure 2.6 shows the new pipeline alignment, which is called the Colma Boulevard Alignment. The purpose of this additional alignment is to avoid installing the new pipeline in SFPUC's easement.

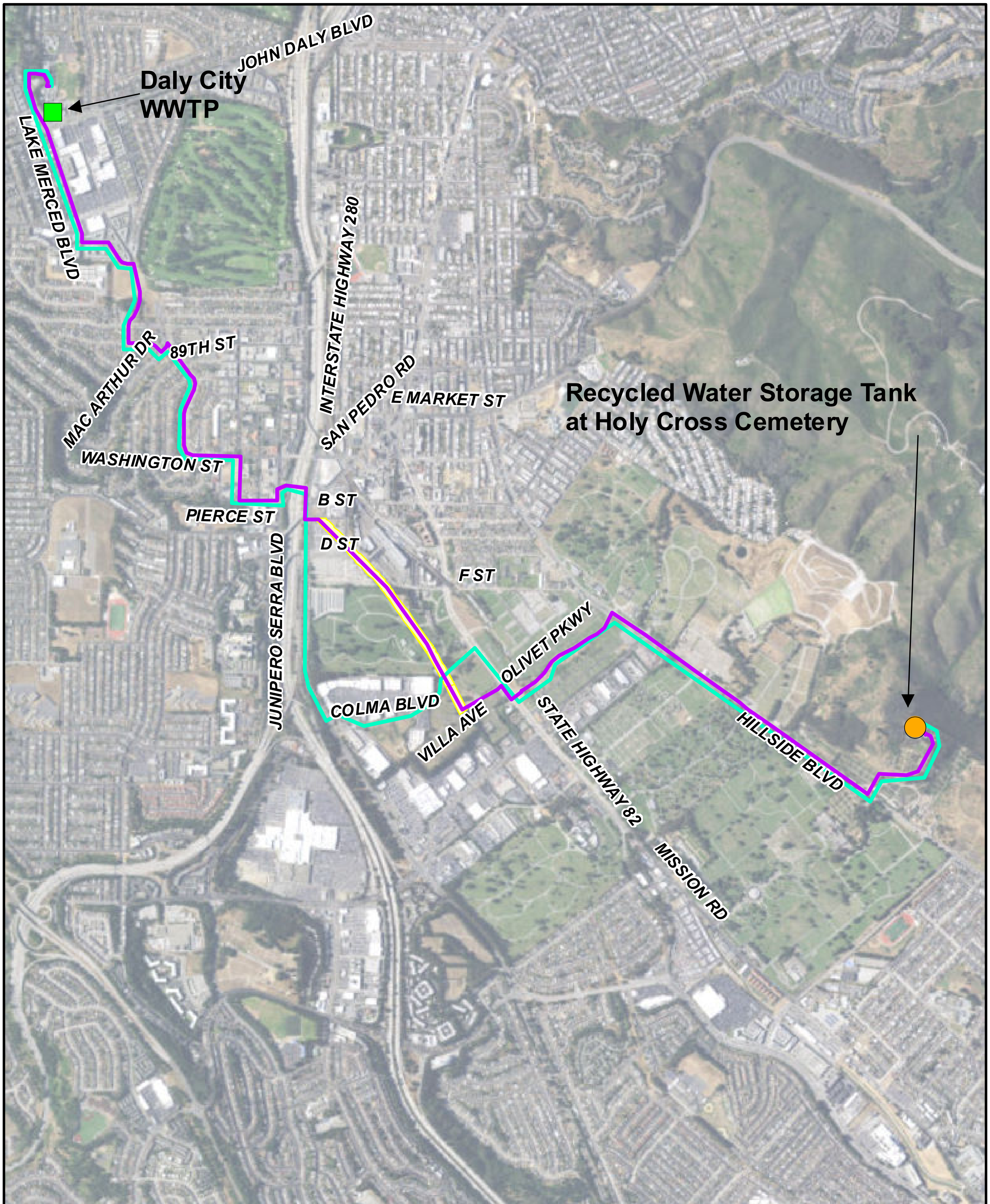
The Colma Boulevard Alignment is the preferred transmission main alignment since it avoids the installation of a pipeline along SFPUC's easement. For the preferred transmission main alignment, the distribution pipe alignment varies slightly for both the Atwood and Holy Cross alternatives. Each alignment is discussed further in the sections below. Each tank site alternative has an option for using the Feasibility Study Alignment, which is routed through SFPUC's easement, and the Colma Boulevard Alignment, which is routed through Junipero Serra Boulevard and Colma Boulevard.

5.3.1 Atwood Property

Figure 2.7 shows the transmission main alignment assuming the storage tank is located at the Atwood Property. From the WWTP to I-280, the transmission main would be installed in public roadways owned by Daly City and/or San Mateo County. The transmission pipeline crosses I-280 by connecting to an existing 16-inch pipe located on a utility bridge maintained by the California Department of Transportation (Caltrans). The 16-inch pipe is owned by Daly City and not in service. From I-280 to State Highway 82, the transmission main crosses Junipero Serra Boulevard and B Street, and then is installed in SFPUC owned property or along Junipero Serra Boulevard and Colma Boulevard. The transmission main eventually crosses State Highway 82 (owned by Caltrans) and an underground rail line (owned by Bay Area Rapid Transit (BART)) to reach the storage tank.

5.3.2 Holy Cross Cemetery

Figure 2.8 shows the transmission main alignment assuming the storage tank is located at the Holy Cross Cemetery. The transmission pipeline alignment for the Holy Cross Cemetery storage tank location is similar to the Atwood Property pipeline alignment except for areas around the intersection of El Camino Real and Olivet Parkway. The alignment around this area differs because there is no additional piping for a storage tank and pump station.



Daly City WWTP
Storage Tank
Feasibility Study Alignment
Colma Blvd Alignment
SFPUC Easement

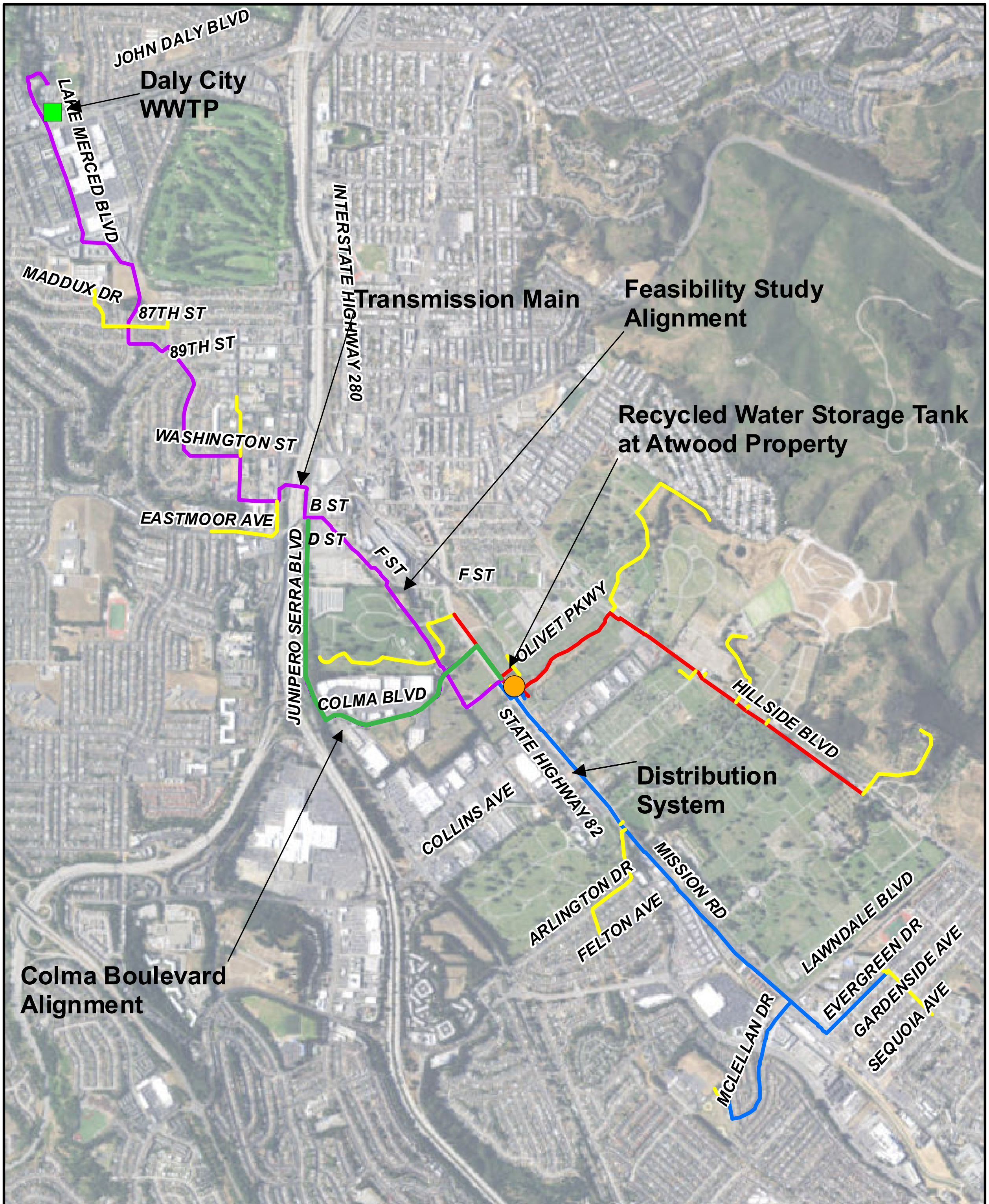
Feet
0 1,150 2,300

COLMA BLVD ALIGNMENT

FIGURE 2.6
DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

carollo



Daly City WWTP
Storage Tank and Pump Station
Service Laterals
El Camino Real Distribution System
Hillside Blvd Distribution System
Transmisson Main
Transmission Main-
Colma Blvd. Alignment

Feet
0 1,250 2,500

ATWOOD PROPERTY TRANSMISSION MAIN AND DISTRIBUTION SYSTEM
FIGURE 2.7
DALY CITY / SFPUC
FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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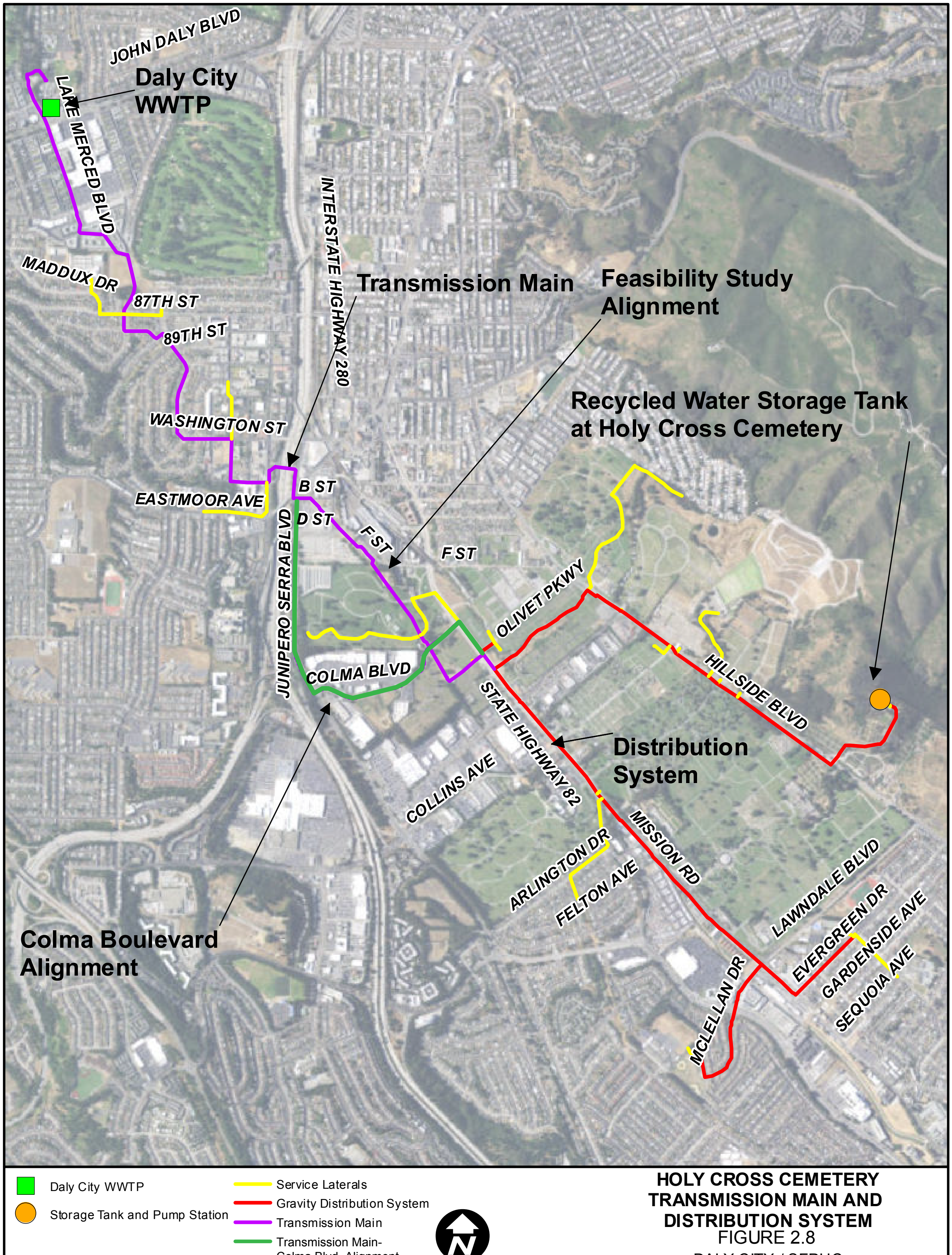
carollo



HOLY CROSS CEMETERY TRANSMISSION MAIN AND DISTRIBUTION SYSTEM
FIGURE 2.8
DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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carollo

5.4 Utility Information

The Project team obtained utility information from the agencies/utilities listed in Table 2.7. This utility information was not collected for the Colma Boulevard Alignment. The topographic survey also captured utility surface features located along the alignment. These two sources of information were incorporated into the 30 percent Drawings and were used to design the preliminary alignment to minimize conflicts with existing utilities. The 30 percent Drawings will be sent to the utilities in the Project area for their review during final design. If a potential conflict is identified, the affected utility or agency will be notified and a plan will be developed to avoid or mitigate the conflict.

Table 2.7 Utility Information Received
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Agency/Utility Name	Information Received
AT&T	Drawings of AT&T facilities
Cal Water	Drawings of water lines
Daly City	Drawings of sanitary, sewer, storm and recycled water lines
Kinder Morgan	Drawings of large diameter gas lines
PG&E	Drawings of PG&E facilities
SFPUC	Drawings of large-diameter water lines and right-of-ways (ROWs)
SSF	Drawings of sanitary and storm lines

5.5 Pipe Material

Carollo recommends ductile iron (DI) pipe for the large diameter pipelines (i.e., greater than or equal to 4-inch diameter) and polyvinyl chloride (PVC) for pipelines less than 4-inch diameter.

5.5.1 Polyvinyl Chloride Pipe

PVC Schedule 80 Pipe, which is manufactured to American Society for Testing and Materials (ASTM) D1785 specifications, is anticipated for pipe sizes less than 4 inches in diameter. The maximum operating pressure for PVC Schedule 80 pipe with a diameter less than 4 inches is 300 pounds per square inch (psi).

5.5.2 Ductile Iron Pipe

Ductile Iron (DI) pipe is anticipated for pipe sizes greater than or equal to 4 inches in diameter. DI pipe is manufactured to AWWA C151 specifications (3 inches to 64 inches in diameter). The DI pipe would have gasketed push-on joints and DI pipe fittings. For restrained sections of pipe, mechanically restrained joints and/or pipe would be used.

Because corrosion is possible with any metallic pipe, a corrosion protection system may be required. Depending on the pipe size, DI pipe has a maximum operating pressure of 350 psi.

5.6 Pipeline Construction Methods

The pipelines would be installed with open cut construction or trenchless methods. The following section summarizes the two potential construction methods.

5.6.1 Open Cut Construction

Open cut construction would be specified along the majority of the pipeline alignment. This type of pipeline construction is the most common method of pipeline installation and involves excavating, bedding, laying, and backfilling the pipeline. Installing the pipeline with open cut construction is the most economical and reasonable method for this Project.

5.6.2 Trenchless Construction

It may be necessary to install the pipeline with trenchless methods at busy intersections, deep utility crossings, or other locations deemed necessary during final design. If the crossings are less than 300 feet, and groundwater is not found, the crossings would likely be installed with jack and bore construction.

Jack and bore construction uses an auger boring machine that simultaneously jacks a casing pipe through the earth while also removing earth spoils by means of a rotating auger. Once the casing pipe is installed, a carrier pipe can be installed through the casing. The excavation associated with a typical jack and bore pipeline installation would be a jacking pit, approximately 35-feet by 12-feet, and a receiving pit, approximately 8 feet by 8 feet. It is anticipated that jack and bore construction would be used for the two BART crossings, and any utility crossings that would encounter significant issues if open cut pipeline installation was to be used.

If high groundwater is found, or trenchless crossings greater than 300 feet are required, the Project team would consider other trenchless installation methods. The recommended trenchless installation method will be determined during final design.

6.0 BOOSTER PUMP STATIONS

6.1 Overview

If the Feasibility Study Alignment is used, two booster pump stations are required along the transmission main for the Atwood Property alternative to pump water to City Hall and to the Margaret Pauline Brown Elementary School. If the Colma Boulevard Alignment is used, only one booster pump station is required for the Atwood Property alternative. Since the demand at these sites is low, it is more economical to install booster pump stations than to design the pump station at the Daly City WWTP for the higher pressures. Due to the high elevation of the Holy Cross Cemetery tank location, booster pump stations are not required for this alternative.

Each booster system includes 2 pumps (1 duty and 1 standby) and a hydro-pneumatic tank. Sufficient land would need to be acquired for installation of the pumps and hydro-pneumatic tank. The site would need to be protected to limit public access. It is also possible to install the booster pumps in an underground vault within the public right-of-way. Details about the booster system are discussed in PM 5 titled, "Recycled Water Storage Tank Site Evaluation" (Carollo, 2017) (Appendix C).

7.0 STORAGE TANK

7.1 Overview

Carollo evaluated the Atwood Property, Salem Memorial Park, and Holy Cross Cemetery sites in PM 5 titled, "Recycled Water Storage Tank Site Evaluation (Carollo, 2017) (Appendix C). The evaluation found the Holy Cross site to be the most favorable because it ranked the highest based on the evaluation criteria. The Atwood Property site is also a feasible alternative and does not have any fatal flaws. This section summarizes the design criteria and site layout for the Holy Cross and Atwood Property alternatives. PM 5 provides additional information regarding the storage tank sites and sizing calculations.

7.2 Design Criteria

7.2.1 Atwood Property

Table 2.8 summarizes the design criteria for the Atwood Property storage tank. The tank will have approximately 3 feet thick walls, 10 feet of clearance in the excavation pit, and 30 feet of clearance around the excavation pit for shoring.

Table 2.8 Atwood Property: Storage Tank Design Criteria
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Parameter	Units	Criteria
Pump Station Wet Well		
Type	--	Below-grade Rectangular Concrete Tank
Capacity	million gallons	2.41
Dimensions (L x W)	ft x ft	200 x 55
Water Depth	ft	29

7.2.2 Holy Cross Cemetery

Table 2.9 summarizes the design criteria for the Holy Cross Cemetery storage tank site alternative. The site design is based on an above-ground circular tank with a diameter of 118.5 feet and a height of 30 feet. The tank will have 20 feet of clearance around it for construction.

Table 2.9 Holy Cross Cemetery: Storage Tank Design Criteria
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Parameter	Units	Criteria
Pump Station Wet Well		
Type	--	Above-grade Circular Prestressed Concrete Tank
Capacity	million gallons	2.41
Diameter	ft	118.5
Water Depth	ft	30

7.3 Site Design

7.3.1 Atwood Property

Figure 2.9 shows the Atwood Property tank site layout overview. A more detailed layout can be found in the drawings included in Appendix A.

7.3.2 Holy Cross Cemetery

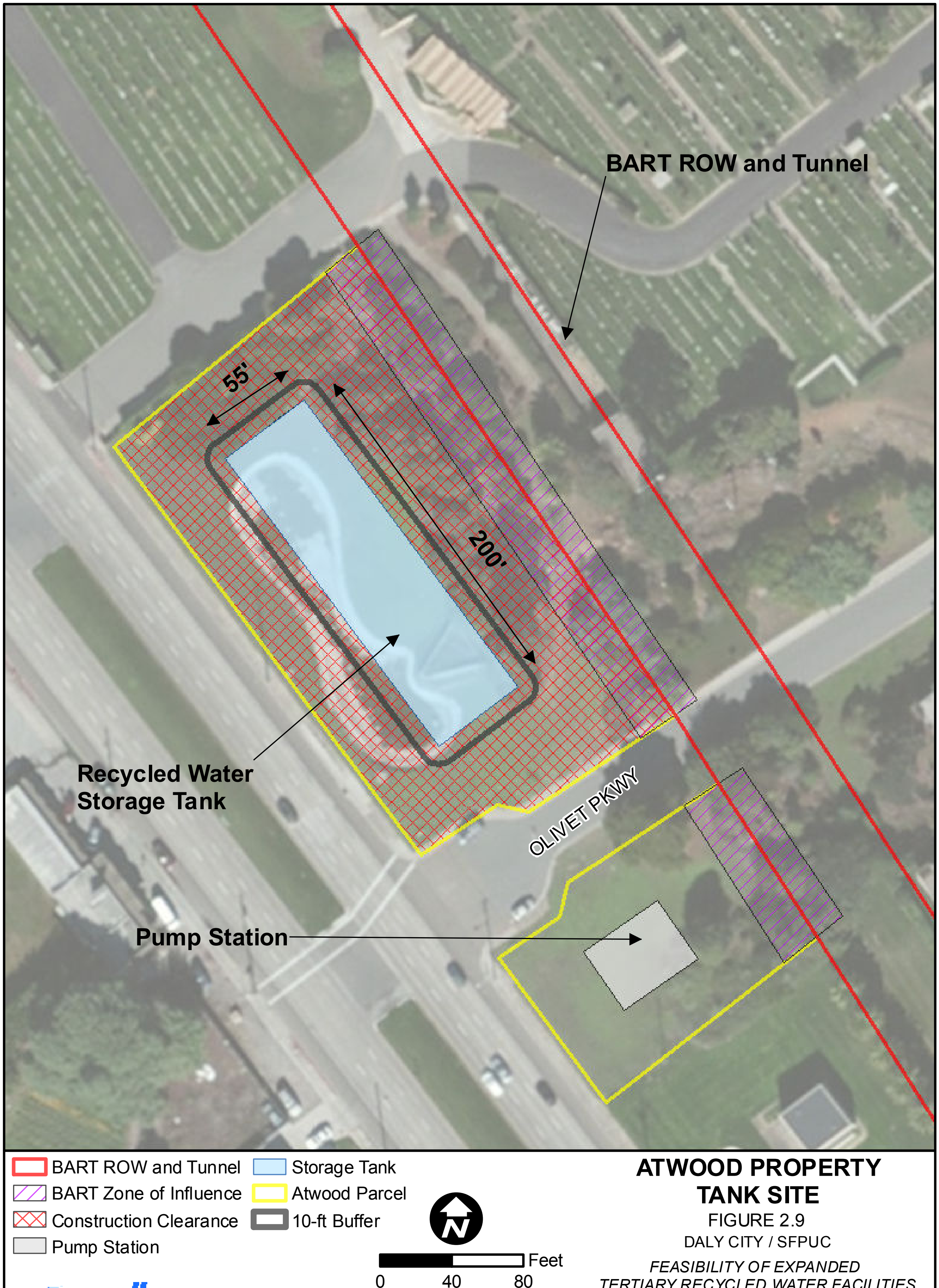
Figure 2.10 shows the Holy Cross Cemetery tank site layout overview. A more detailed layout can be found in the drawings included in Appendix A.

8.0 DISTRIBUTION SYSTEM PUMP STATION

8.1 Overview

A distribution system pump station is needed for the Atwood Property alternative to pump water from the Atwood Property storage tank to customers at higher elevations in the water distribution system. Due to the high elevation of the Holy Cross Cemetery tank location, a distribution system pump station is not needed for this alternative.

The distribution system pump station at the Atwood Property will include 4 pumps (2 duty and 2 standby) with VFDs to meet intermediate demands. Details about this distribution system pump station are discussed in PM 5 titled, "Recycled Water Storage Tank Site Evaluation" (Carollo, 2017) (Appendix C).



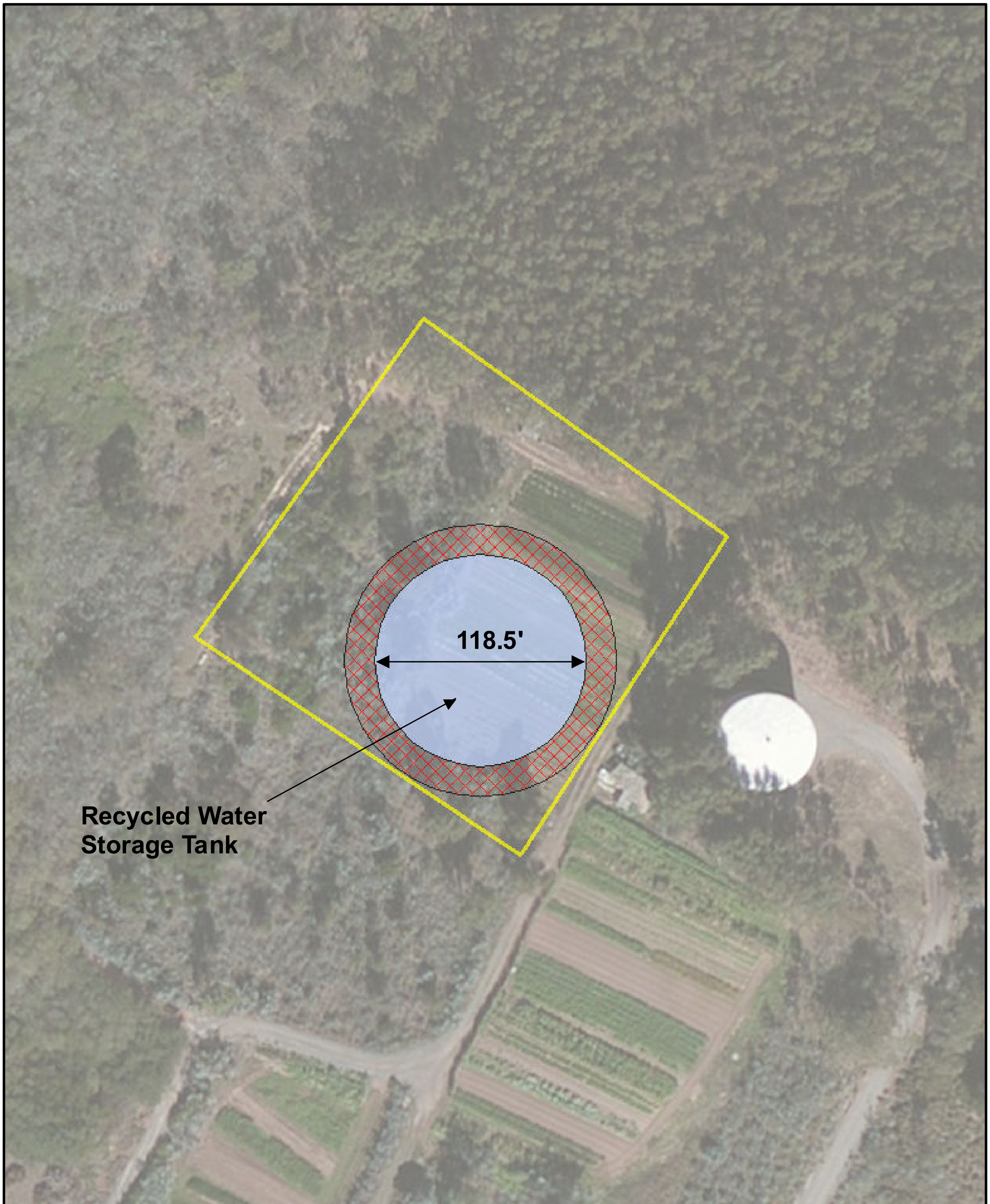
ATWOOD PROPERTY TANK SITE

FIGURE 2.9

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

carollo



Construction Clearance Storage Tank
Holy Cross Site

Feet
0 50 100

HOLY CROSS CEMETERY TANK SITE

FIGURE 2.10

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

carollo

8.2 Design Criteria

Table 2.10 summarizes the design criteria for the distribution system pump station for the Atwood alternative. The pump station will serve two distribution systems: the El Camino Real distribution system and the Hillside Boulevard distribution system. The separate distribution systems are required because of the varying elevations. The El Camino Real distribution system will serve customers at elevations 120 feet to 160 feet and the Hillside Boulevard distribution system will serve customers at elevations 230 feet to 450 feet. There are four customers located upstream of the storage tank that do not need to be served by the distribution pump station.

Table 2.10 Atwood Property: Distribution System Pump Station
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Parameter	Units	El Camino Real Distribution System	Hillside Boulevard Distribution System
Type	--	Vertical Turbine	Vertical Turbine
Number of Pumps	No.	2 (1 duty, 1 standby)	2 (1 duty, 1 standby)
TDH	ft	255	444
Motor Horsepower, each	HP	200	700
Total Pump Capacity	mgd	3.15	6.50

9.0 DISTRIBUTION SYSTEM PIPING

9.1 Overview

The distribution system piping conveys recycled water from the storage tank to customers. As with the transmission main, the distribution system alignments differ depending on the location of the storage tank. The following section summarizes the distribution systems for both the Atwood Property and Holy Cross sites. As discussed, these sites were determined as the most feasible in PM 5 titled, "Recycled Water Storage Tank Site Evaluation" (Carollo, 2017) (Appendix C).

9.2 Design Criteria

The design criteria for the distribution system are the same as the design criteria for the transmission main and are presented in Table 2.11. Refer to Section 5.2 for further details.

Table 2.11	Distribution System Pipeline Design Criteria Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City
Criteria	**Value**
Material	DI or PVC
Maximum Operating Pressure	130 psi for the Holy Cross Cemetery Alignment 190 psi for the Atwood Property Alignment
Minimum Turnout Pressure[(1)]	50 psi
Pipeline Roughness (C Factor)	130
Pipe Diameter	1-inch to 18-inch
Design Condition[(2)]	9.95 mgd for 8 hours a day
Pipeline Velocity	2 - 7 feet per second (fps)

Notes:

(1) For customers without on-site storage.
(2) Peak hour demand

9.3 Distribution System Alignment

There is one fundamental difference between the two alternatives that affects the distribution system alignment. For the Holy Cross alternative, no distribution system pump station is needed due to the high elevation of the storage tank. Instead, customers are fed off of the transmission main by gravity flow from the storage tank. Figures 2.11 and 2.12 show schematics of the hydraulic systems for each tank site alternative. This difference in hydraulics affects the alignment for each alternative discussed in the sections below.

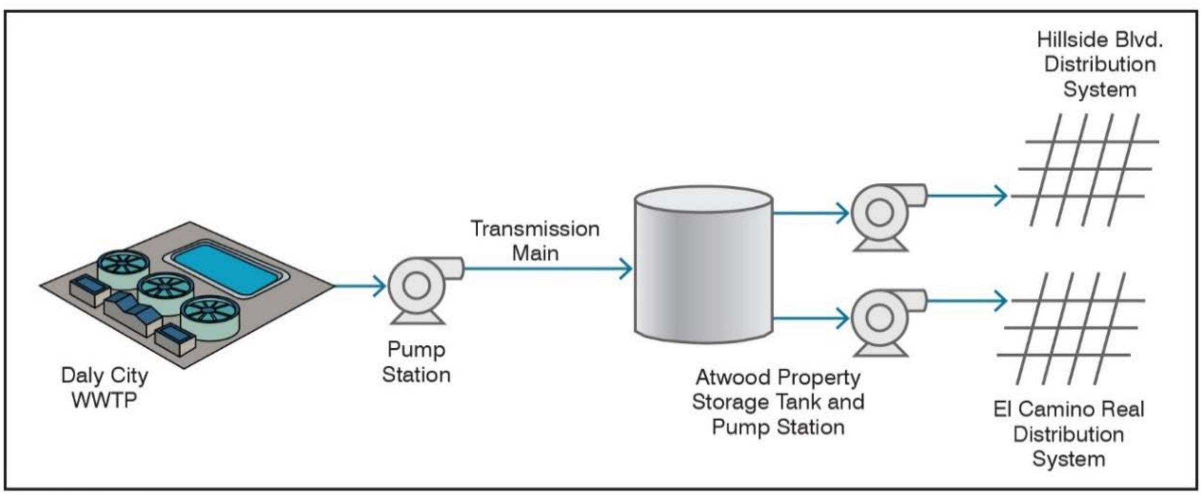


Figure 2.11 Atwood Property Hydraulic System Schematic

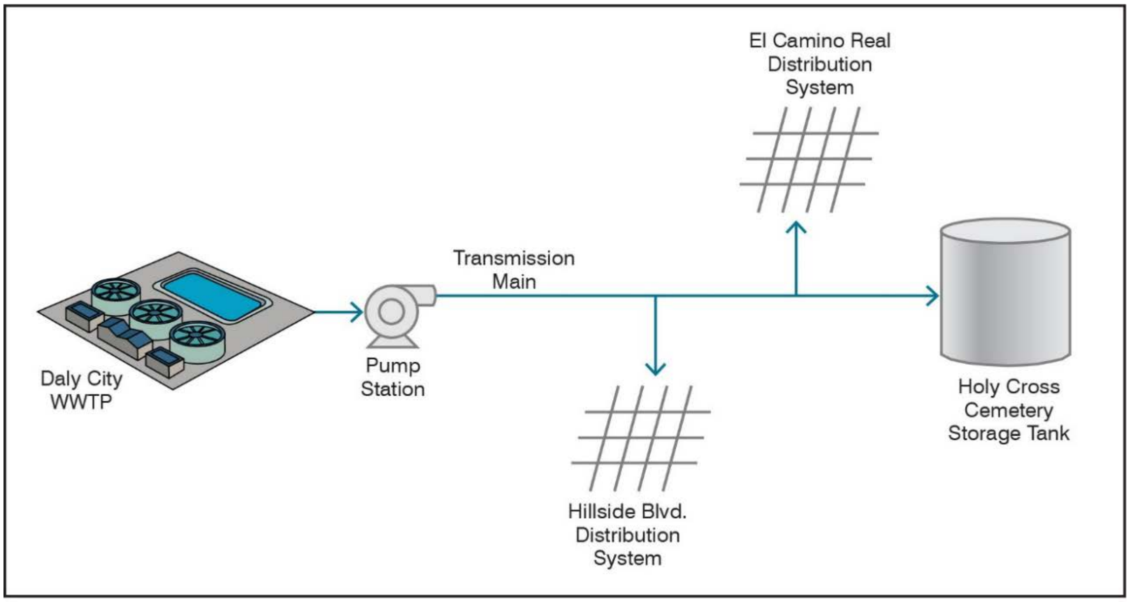


Figure 2.12 Holy Cross Cemetery Hydraulic System Schematic

9.3.1 Atwood Property

Recycled water from the storage tank on the Atwood Property is pumped to customers through a distribution system located in Colma and SSF. The distribution system pipeline alignments are primarily located along Hillside Boulevard and El Camino Real. The distribution system for Hillside crosses two BART underground rail lines. The service laterals for the potential customers are located on each user's private property. Figure 2.7 shows the Atwood Property distribution system.

9.3.2 Holy Cross Cemetery

As discussed, the fundamental hydraulics and point of connection to the transmission main for the Holy Cross alternative is different from the Atwood alternative because water is gravity fed from the storage tank. However, except for the Woodlawn Cemetery connection, the location of the distribution system and the service laterals for the potential customers is similar to the alignment for the Atwood Property. Similar to the Atwood Property distribution system alignment, the Holy Cross distribution system alignment crosses a total of two BART underground rail lines. Figure 2.8 shows the Holy Cross distribution system.

9.4 User Service Connections

Based on the site visits conducted during customer outreach, the majority of the cemeteries have hose bibs. The Water Recycling Act of 2013 minimizes the retrofit requirements associated with hose bibs. The key legislation regarding retrofits is summarized below:

- Hose bibs can be used at cemeteries supplied with disinfected tertiary treated recycled water.
- If a hose bib is installed in a public area of the cemetery, the cemetery shall post visible signage and labeling indicating the water is non-potable.

Depending on the customer's irrigation water supply, the following measures may be required to establish a connection to the new recycled water system:

- The customer's irrigation system would need to be separated from the potable water system (restrooms, offices, handwash system) by cutting and capping service lines.
- The line from the current irrigation water supply source would be cut and capped and a new connection would be established from the new recycled water service line to the irrigation system.
- For customers with storage, an air gap would be required between the storage pond and distribution system.

10.0 ELECTRICAL

10.1 Daly City WWTP

The recycled water effluent pump station's electrical load will be supplied by the Daly City WWTP since the pump station is located in the new tertiary building at the WWTP. Details regarding the electrical system for this pump station can be found in TM 1 titled, "Tertiary Treatment" (Carollo, 2017).

10.2 Storage Tank Site

A new utility service is required at the tank site. The PG&E costs for providing service to the selected site will depend on the expected demand load and the available PG&E resources near the site. Estimating costs for PG&E construction will not be possible until a site is selected, a PG&E application is completed, and the PG&E engineering group is engaged. This process can take several months to complete.

The Holy Cross Cemetery site electrical load consists of a PLC, radio, and instrumentation. A 120/240-volt, single-phase, or 120/208 volt three-phase PG&E service should suffice at this location. A small structure should be provided both to protect the electrical equipment and blend in with the cemetery.

The pump load at the Atwood Property site requires a 480-volt three-phase service. The 700 horsepower pump is in the range where using 4160-volt three-phase (medium voltage) power is common. An electrical building should be constructed to house the electrical equipment. The building can be either CMU or a prefabricated electrical power-house depending on cost and aesthetic requirements.

11.0 INSTRUMENTATION AND CONTROLS

A communication link between the storage tank site and the WWTP will be established to monitor the water level in the recycled water storage tank. PM 10 titled, "Daly City Wireless Virtual Analysis" (Carollo, 2017) (Appendix I) recommends that a cellular radio system be considered. A cellular radio system is recommended for either tank site because the data transmission needs are limited, i.e., there is no video or high bandwidth voice data, and the local terrain makes it impossible to establish a line of sight without constructing impractically tall antenna towers. A cellular radio system will require a monthly recurring cost, which is typically negotiable.

12.0 SYSTEM OPERATION

It is assumed that Daly City will operate the treatment and distribution system. However, the Owner of the treatment and distribution system has not been determined and additional discussions are required between Daly City and SFPUC.

13.0 PERMITTING

The potential permits and/or approvals that may be needed for the Project are presented in Table 2.12.

Table 2.12 Potential Permits and Approvals
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Agency/Entity	Type of Approval
BART	Construction Permit for Facilities Adjacent to BART Structures
Caltrans	Encroachment Permit - El Camino Real / Hwy 82
California Division of Drinking Water	Updated Engineer's Report
California Division of Occupational Safety and Health (CAL/OSHA)	Construction activities in compliance with CAL/OSHA safety requirements
City of South San Francisco	Encroachment Permit - South San Francisco Roads
Daly City	Encroachment Permit - Daly City Roads
Recycled Water Customers	Recycled Water Use Agreement Temporary Construction and/or Permanent Easement
San Francisco Bay Regional Water Quality Control Board	National Pollutant Discharge Elimination System General Permit for Stormwater Discharge Associated with Construction Activities Updated Recycled Water Use Permit
SFPUC	Encroachment Permit - SFPUC Right-of-Way
San Mateo County	Encroachment Permit - Broadmoor and County Roads
Town of Colma	Encroachment Permit - Colma Roads

14.0 SCHEDULE

14.1 Design and Construction Schedule

It is anticipated that final design would start in 2018 and last for approximately 18 months. Construction would then begin in 2019 and last for approximately 24 months. A Project schedule is shown in Figure 2.13. As shown in the schedule, discussions with customer and agencies should begin soon to finalize recycled water agreements. The permitting process should also begin soon to make sure the permitting process does not delay construction.

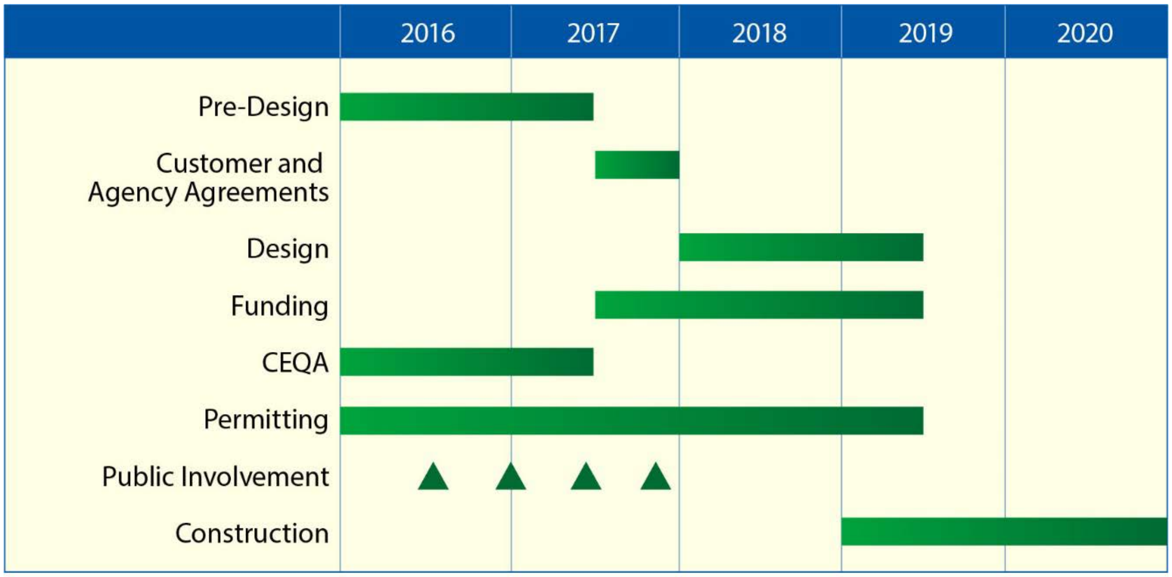


Figure 2.13 Project Schedule

14.2 Project Constraints and Sequencing Requirements

The Project does not appear to have major scheduling constraints and/or sequencing requirements. It is anticipated that the Project will be constructed during the normal working hours of 8 AM 5 PM Monday through Friday. However, it may be necessary for the Contractor to work night and/or weekends if required to meet critical schedule deadlines, or accelerate the schedule. When constructing connections to the schools, consideration will be given to school operating hours. Additionally, if this Project is funded through an SRF loan, American Iron and Steel Institute (AISI) materials will need to be used.

15.0 COST ESTIMATE

15.1 Basis for Estimate

The Project is currently in the preliminary design phase and the design has not been developed in detail. The construction cost estimates are consistent with the Association for the Advancement of Cost Engineering (AACE) International Class 4 budget estimate with an accuracy range of +50 percent to -30 percent of the actual Project cost.

15.1.1 ENR Benchmark

Providing a cost benchmark for construction estimates is useful in documenting the time of estimate preparation and in allowing for projections and escalations to later dates using the equivalent index value.

This preliminary design cost estimate is benchmarked to the Construction Cost Indices (CCI) published by the Engineering News Record (ENR) for August 2017, which is the most current ENR. We recommend using the ENR San Francisco CCI for the Daly City region, which was 12037 for August 2017.

15.1.2 Unit Costs

Unit costs have been developed for the major pipeline and structure components of the Project. These major components include water piping, pumps, valving, structures, and appurtenances. Unit costs were developed using budgetary quotations received from equipment and material manufacturers, available recent bid data, and unit costs derived from estimating guides such as the 2017 RS Means Heavy Construction Data publication.

15.1.3 Contingencies

Contingencies are typically applied to a construction estimate at the design development phase to account for construction items not yet identified and design unknowns. As the design is refined and finalized, the contingency will be reduced to approximately 5 to 10 percent. At the completion of the design, the contingency should represent only a reasonable construction change order allowance. Agencies typically retain contingency within their project budgets, even when construction contract award values are known, to cover the cost or deal with unforeseen conditions.

The cost estimate presented in this PM includes 30 percent contingency, calculated based on the raw construction cost. This is in alignment with the recommendations for a project at an AACE Class 4 level of development.

15.2 Cost Estimates

Tables 2.13 and 2.14 present a summary of the delivery system cost estimate for each alternative. PM 5 titled, "Recycled Water Storage Tank Site Evaluation" (Carollo, 2017) (Appendix C) and PM 14 titled, "Colma Boulevard Alignment" (Carollo, 2017) (Appendix J) include detailed breakdowns of the construction cost estimates.

Table 2.13 Atwood Property Alternative - Construction Cost Summary Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City

No.	Item		Feasibility Study Alignment Cost	Colma Blvd Alignment Cost
01	Transmission Pipeline		$3,606,000	$4,090,000
02	Pump Station at WWTP		$490,000	$524,000
03	Storage Tank		$4,069,000	$4,069,000
04	Distribution System		$7,616,000	$7,560,000
05	Distribution System Pump Station		$725,000	$725,000
	TOTAL DIRECT COST		**$16,506,000**	**$16,968,000**
	Contingency	30%	$4,952,000	$5,090,000
	Subtotal		$21,458,000	$22,058,000
	General Contractor Overhead, Profit & Risk	12%	$2,575,000	$2,647,000
	Subtotal		$24,033,000	$24,705,000
	Escalation to Mid-Point(1)	12.6%	$3,033,000	$3,118,000
	Subtotal		$27,066,000	$27,823,000
	Sales Tax (Applied to 50% of Total Direct Cost)	9.0%	$743,000	$764,000
	Subtotal		$27,809,000	$28,587,000
	General Conditions	12.0%	$3,337,000	$3,430,000
	TOTAL ESTIMATED CONSTRUCTION COST		**$31,146,000**	**$32,017,000**
	Cost Range		***$21,802,000 - $46,719,000***	***$22,411,000 - $48,024,000***
	Engineering, Legal & Administration Fees	20%	$6,229,000	$6,403,000
	Owner's Reserve for Change Orders	5%	$1,557,000	$1,601,000
	TOTAL ESTIMATED PROJECT COST		**$38,932,000**	**$40,021,000**

Notes:

(1) Based on a compound annual escalation rate of 4%, a design duration of 18 months starting in January 2018, and a construction duration of 24 months starting in June 2019.

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

**Table 2.14 Holy Cross Cemetery Alternative - Construction Cost Summary
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City**

No.	Item		Feasibility Study Alignment Cost	Colma Blvd Alignment Cost
01	Transmission Pipeline		$3,599,000	$4,074,000
02	Pump Station at WWTP		$562,000	$562,000
03	Storage Tank		$2,431,000	$2,431,000
04	Distribution System		$6,748,000	$7,039,000
05	Distribution System Pump Station		$0	$0
		TOTAL DIRECT COST	**$13,340,000**	**$14,106,000**
	Contingency	30%	$4,002,000	$4,232,000
	Subtotal		$17,342,000	$18,338,000
	General Contractor Overhead, Profit & Risk	12%	$2,081,000	$2,201,000
	Subtotal		$19,425,000	$20,539,000
	Escalation to Mid-Point(1)	12.6%	$2,451,000	$2,592,000
	Subtotal		$21,874,000	$23,131,000
	Sales Tax (Applied to 50% of Total Direct Cost)	9.0%	$600,000	$635,000
	Subtotal		$22,474,000	$23,766,000
	General Conditions	12.0%	$2,697,000	$2,852,000
		TOTAL ESTIMATED CONSTRUCTION COST	**$25,171,000**	**$26,618,000**
	Cost Range		***$17,620,000 - $37,757,000***	***$18,633,000 - $39,927,000***
	Engineering, Legal & Administration Fees	20%	$5,034,000	$5,324,000
	Owner's Reserve for Change Orders	5%	$1,259,000	$1,331,000
		TOTAL ESTIMATED PROJECT COST	**$31,464,000**	**$33,273,000**

Notes:

(1) Based on a compound annual escalation rate of 4%, a design duration of 18 months starting in January 2018, and a construction duration of 24 months starting in June 2019.

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

15.3 Cost Estimate Comparison to 2009 Feasibility Study

Table 2.15 provides a comparison of the conveyance system cost estimate developed in the 2009 Feasibility Study (Carollo, 2009) and the cost estimates for the Holy Cross and Atwood Property alternatives developed in this TM. The cost estimates for the Holy Cross and Atwood Property alternatives are comparable to the 2009 Feasibility Study. The Holy Cross site is more economical than the Atwood Property site because the storage tank is above grade and a distribution system pump station is not required.

16.0 DRAWINGS

The drawings of both the Atwood Property and Holy Cross Cemetery alignments are included in Appendix A.

Table 2.15 Colma Delivery System Cost Comparison Table
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

	2009 Feasibility Study Cost Estimate (Sept. 2009 Dollars)	Escalated 2009 Feasibility Study Cost Estimate (Aug. 2017 Dollars)	Holy Cross 2017 TM 2 Cost Estimate (Aug. 2017 Dollars)		Atwood 2017 TM 2 Cost Estimate (Aug. 2017 Dollars)	
			Feasibility Study Alignment	Colma Blvd Alignment	Feasibility Study Alignment	Colma Blvd Alignment
Total Estimated Direct Cost	$12,395,000	$15,343,000	$13,340,000	$14,106,000	$16,506,000	$16,968,000
Total Estimated Construction Cost	$23,972,000	$29,674,000	$25,171,000	$26,618,000	$31,146,000	$32,017,000
Total Estimated Project Cost	$29,965,000	$37,093,000	$31,464,000	$33,273,000	$38,932,000	$40,021,000

APPENDIX A – DRAWINGS

Provided as a separate document.

APPENDIX B – PROJECT MEMORANDUM 04 - DALY CITY STORAGE TANK SITE INITIAL SCREENING

Engineers...Working Wonders With Water®

DRAFT PROJECT MEMORANDUM - 04

Project Name:	Recycled Water Facilities Expansion Predesign Project (Project)	**Updated Date:**	April 1, 2016
Client:	City of Daly City	**Project Number:**	10076 A.10
Prepared By:	Darren Baune and Ron Papa		
Reviewed By:	Tracy Clinton		
Subject:	Daly City Storage Tank Site Initial Screening		

1.0 PURPOSE

The purpose of this memorandum is to perform an initial screening of potential storage tank locations and recommend sites for further evaluation. It is important to establish the storage tank location as soon as possible to begin the field investigations (geotechnical and surveying). The tank location is also a critical element to define the pipeline alignment.

2.0 BACKGROUND

The Recycled Water Facilities Expansion Predesign Project (Project) would increase the tertiary treatment capacity at the City of Daly City's wastewater treatment plant (WWTP) and deliver recycled water for irrigation to sites in Daly City, South San Francisco, and cemeteries in Colma. The Project includes treatment process upgrades at the WWTP, a transmission pipeline to Colma/South SF, a storage tank, and distribution system. Figure 1 provides an overview of the project facilities recommended in the Feasibility Study.

The Recycled Water Treatment and Delivery System Expansion Feasibility Study (Carollo, 2009) (Feasibility Study) identified a storage tank site at the Italian Cemetery located in the Town of Colma. The project team contacted the Italian Cemetery during the preliminary design and the site may not be a feasible storage tank location because the site is planned for future expansion of the cemetery. The purpose of this memorandum is to summarize recent discussions with the Italian Cemetery, identify and screen other potential storage tank locations, and identify next steps.

3.0 INITIAL SITE SCREENING CRITERIA

Figure 2 shows the tank site identified in the Feasibility Study and six alternate tank locations. The alternate locations were developed by the project team based on discussions with the Town of Colma, Daly City, and site reconnaissance. This section establishes the criteria to perform a preliminary evaluation of the alternatives.

Daly City WWTP

Storage Tank Location

Recycled Water Transmission Main

carollo

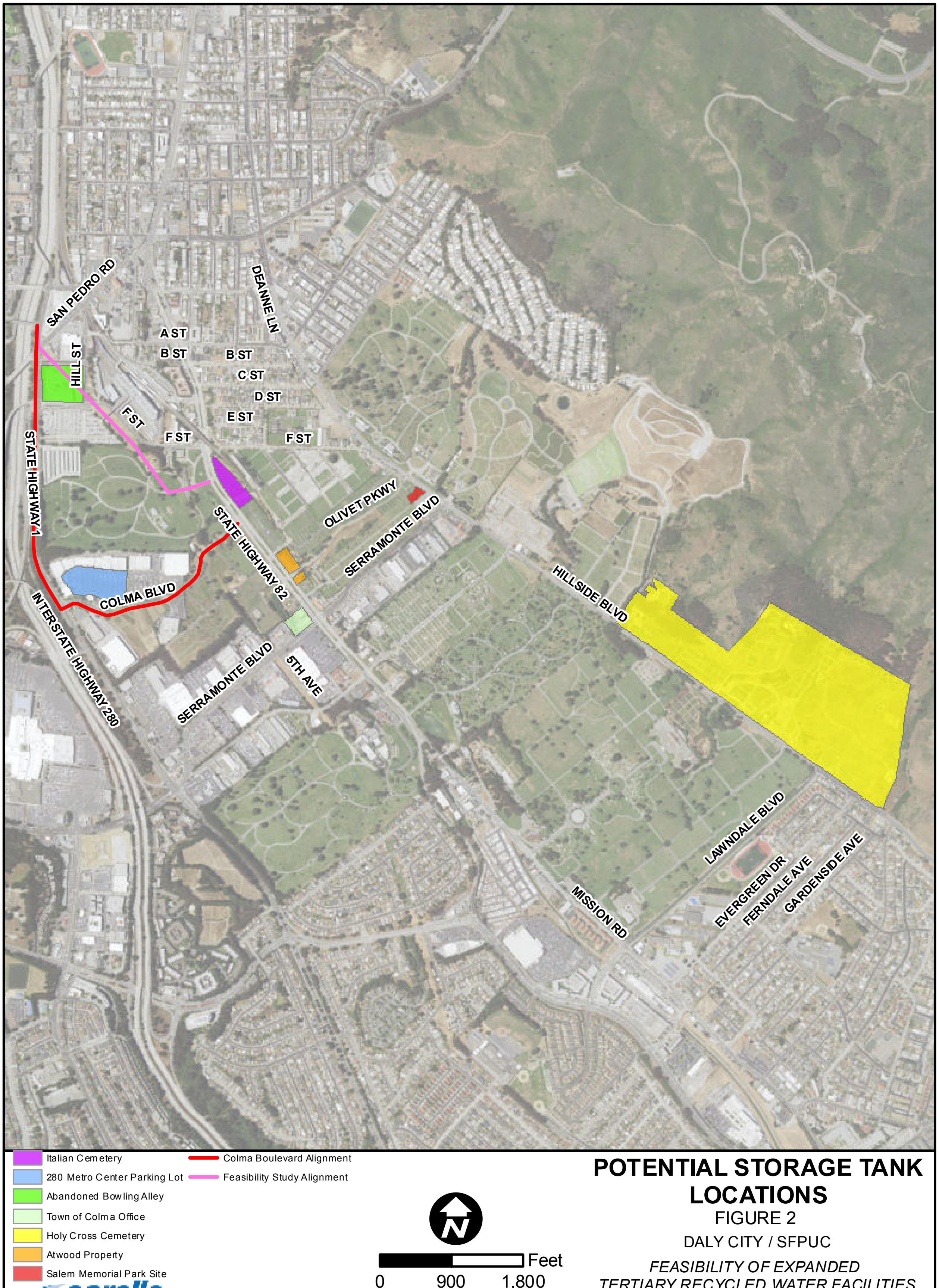
0 750 1,500 Feet

FEASIBILITY STUDY RECOMMENDED PROJECT

FIGURE 1

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES



carollo

POTENTIAL STORAGE TANK LOCATIONS

FIGURE 2

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

3.1 Available Space

The site must have adequate space for the recycled water storage tank and pump station. The storage tank could be located above or below grade and designed as a circular or rectangular tank. If the tank is located below grade, it is possible to install a parking lot and/or sports field above the tank. For example, the Daly City WWTP has a below grade tank with a baseball field over the facility.

The pump station is required to deliver water to the cemetery sites and is assumed to have a plan view dimension of approximately 30 feet x 70 feet. The pump station would most likely be located above grade. The pump station can be located on top of the tank or as a separate structure adjacent to the tank. Locating the pump station on top of the tank reduces the overall site size but requires additional structural reinforcement of the tank.

Based on preliminary layouts, we estimate the total land needed for the storage tank and pump station to be approximately 0.5 - 1.25 acres. The smaller area requires a deep tank while a larger area requires a shallower tank. The half-acre site is the minimum area required because reducing the site further causes the tank to be excessively deep.

3.2 Pipeline Alignment

The site should be compatible with a reasonable pipeline alignment. Figure 2 shows the pipeline alignment identified in the Feasibility Study (i.e., along the Baden-Merced alignment) which is located in an easement owned by the SFPUC. Figure 2 also shows an alternate alignment along Colma Boulevard.

3.3 Tank Elevation

The storage tank site should be located at the highest elevation possible to reduce long-term pumping cost. The Feasibility Study located the storage tank at the Italian Cemetery at an approximate elevation of 100 feet. Based on this elevation, a pump station would be required to deliver recycled water to the cemeteries. The pump station would be designed to operate on two hydraulic grade lines (HGL) to deliver water to the cemeteries along El Camino Real (i.e., the lower HGL) and the cemeteries along Hillside Boulevard (i.e., the upper HGL). If the tank site elevation was adequate, and based on the elevations in the surrounding area, it may be possible to gravity-feed the cemeteries along El Camino Real (i.e., the lower HGL) depending on the tank elevation.

3.4 Land Owner Feedback

The landowner will need to be willing to work with the project owner(s) and allow construction, installation, and long-term access of the tank on their property. Construction duration is expected to last about 18 months. The landowner may prefer to sell the property to the Project agencies. The Project design team has initiated discussions with the potential tank site owners identified and has received feedback from several.

4.0 INITIAL SCREENING RESULTS

4.1 Italian Cemetery Site

Figure 3 shows the tank site recommended in the Feasibility Study located at the Italian Cemetery (corner of El Camino Real and F Street in the Town of Colma). This location was selected during the Feasibility Study because of its proximity to the potential Colma recycled water customers, the pipeline alignment identified in the Feasibility Study (i.e., Baden-Merced Pipeline), and because the site has adequate space for the storage tank and pump station.

However, based on preliminary discussions with the Italian Cemetery the location may not be feasible, the manager of the Italian Cemetery has stated the following:

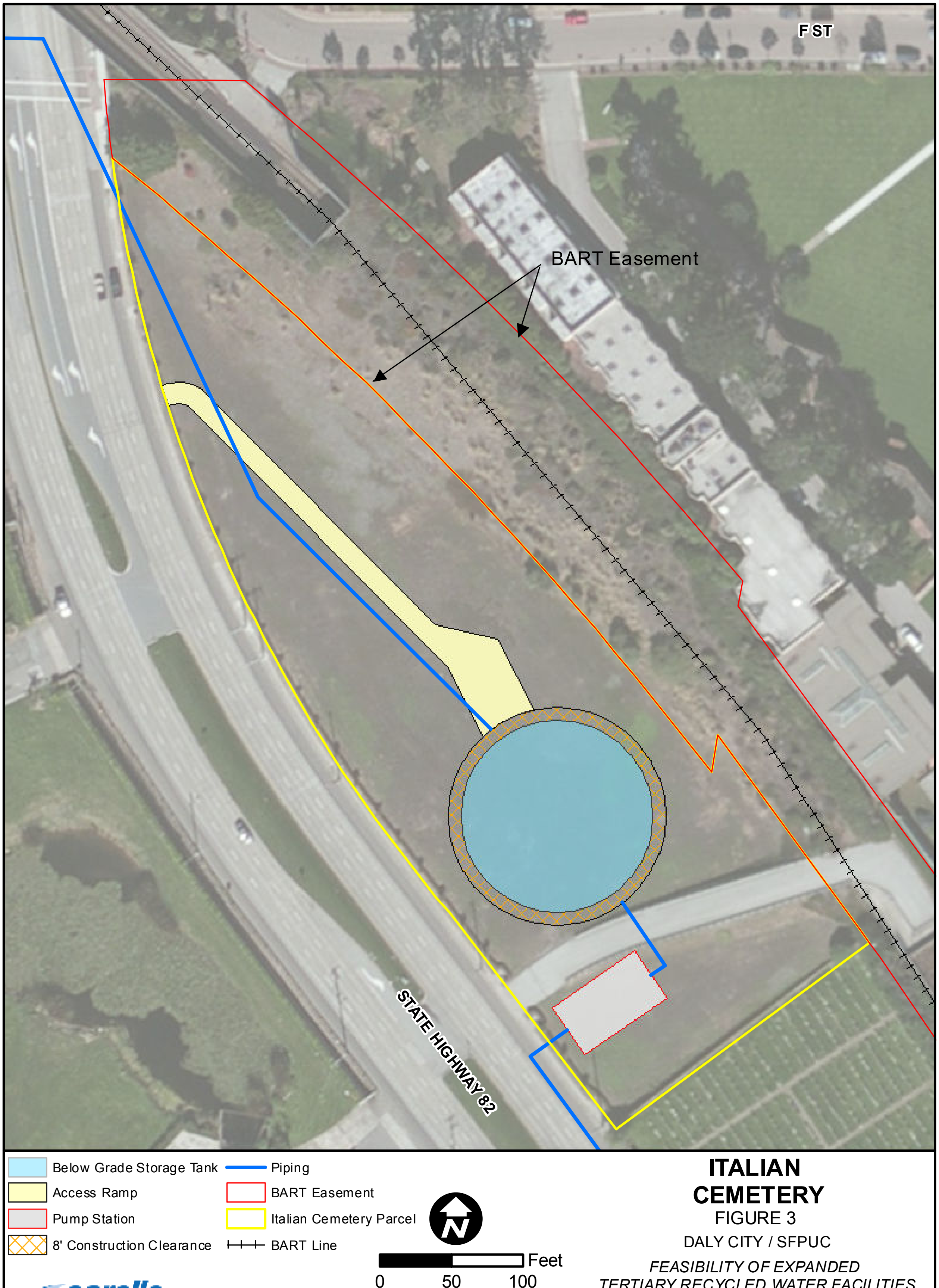
- The site identified in the Feasibility Study is slated for future cemetery expansion.
- The Board of Directors has allowed the cemetery manager to have discussions with the Project team and they are willing to talk/listen. However, the Italian Cemetery Board of Directors is not fully supportive of their site being used for a storage tank.
- The Italian Cemetery has "dedicated" the site identified in the Feasibility Study for future use as grave sites to the State of California. The cemetery manager stated it's possible to "un-dedicate" the property, but it's a lengthy legal process and the Italian Cemetery may be liable for past property taxes.

Based on the landowner feedback summarized above, we have eliminated the Italian Cemetery site from further consideration.

4.2 280 Metro Center Parking Lot

Figure 4 shows a location for the storage tank in the parking lot of the 280 Metro Center open-air strip shopping center. The shopping center is located to the north of the intersection of Junipero Serra Boulevard and Colma Boulevard in the Town of Colma. The parcel (APN 008322999) is owned by the Kimco Realty Corporation and is large enough for the storage tank and the pump station. If this site is selected, the pipeline alignment would likely be revised to be along Colma Boulevard as shown in Figure 2.

Carollo received feedback from the landowner that he would consider locating the tank in the parking lot of the 280 Metro Center. However, based on feedback from the town of Colma and Daly City, the site is likely not feasible because it would have a large impact on the parking available at the 280 Metro Center during construction. Based on the temporary impacts during construction, we have eliminated this site from further consideration.

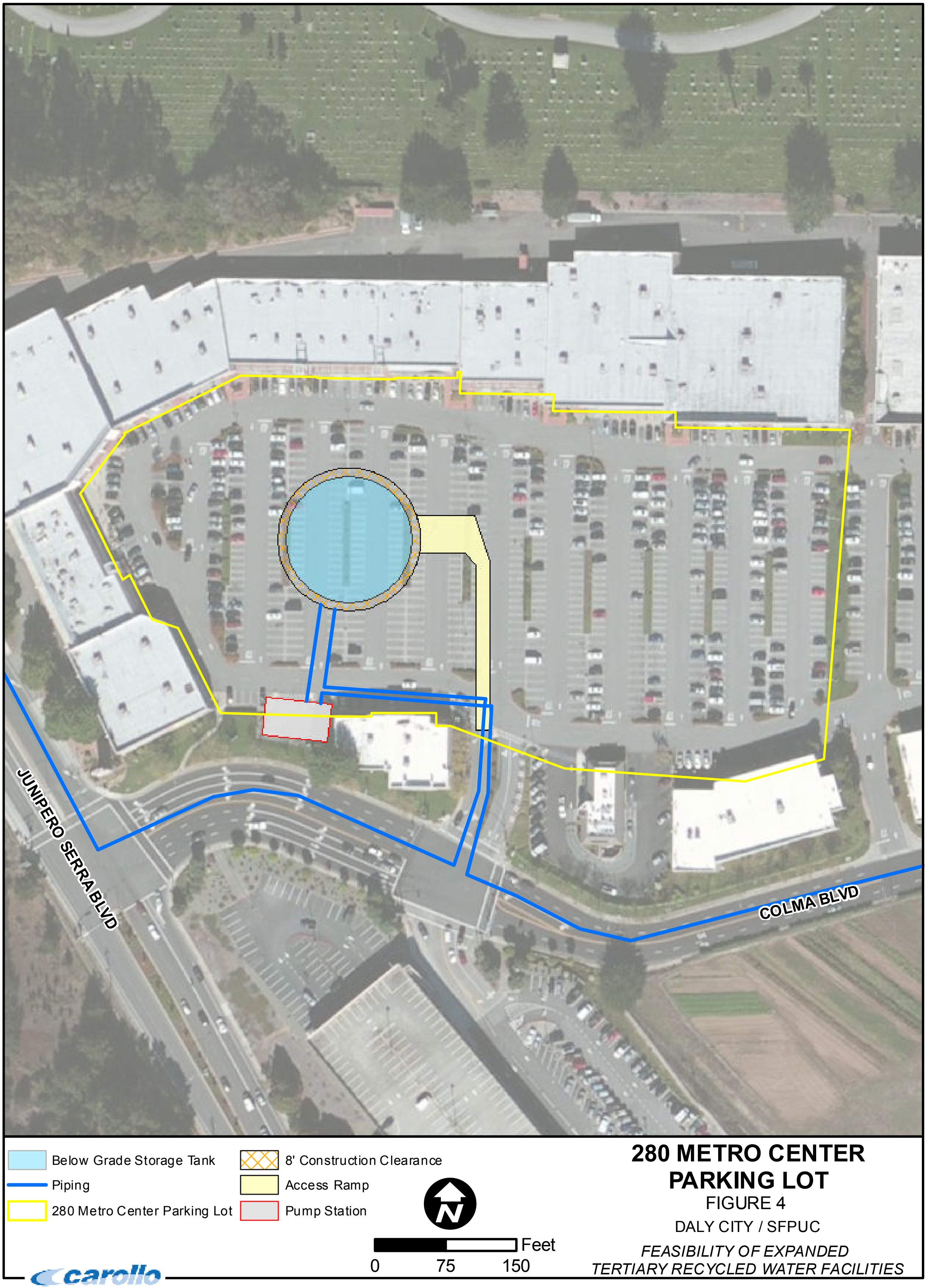


ITALIAN CEMETERY

FIGURE 3

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES



280 METRO CENTER PARKING LOT

FIGURE 4

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

4.3 Abandoned Bowling Alley

Figure 5 shows a location for the storage tank in the abandoned bowling alley located at 3301 Junipero Serra Boulevard, Daly City. The property is large enough for the storage tank and the pump station. The site includes several parcels (APNs 008111080, 008111090, 008116020, 008116030, and 008116040) which are believed to be under the same ownership. The San Francisco Public Utilities Commission (SFPUC) also owns a 140-foot wide easement (APN 093270020) adjacent to this site. The easement cuts diagonally through the site as shown in Figure 5.

The Project team has not contacted the landowner of the site. Based on discussions with Daly City, the landowner is planning a significant development of the site, and the site is likely not available. We have therefore eliminated this site from further consideration.

4.4 Town of Colma Office

Figure 6 shows a location for the storage tank at the current location of the Town of Colma office buildings. This site was considered initially based on a suggestion from the Town of Colma. However, after reviewing the site in detail and further discussions with the Town of Colma, this site was eliminated because the site space is not adequate.

4.5 Salem Memorial Park Site

Figure 7 shows a location for the storage tank at a vacant parcel near the Lucky Chances parking lot. The land is located along Serramonte Boulevard near the intersection of Hillside Boulevard in the Town of Colma. The property is owned by Congregation Sherith Israel. The Executive Director, James Carlson, of the Hills of Eternity Memorial Park, Home of Peace Cemetery, and Salem Memorial Park suggested we consider this as a potential site.

The Project team discussed this site with James Carlson and he believes his Board of Directors would be supportive of the Project. Figure 7 shows a rectangular tank layout on the site with a pump station located on top of the tank.

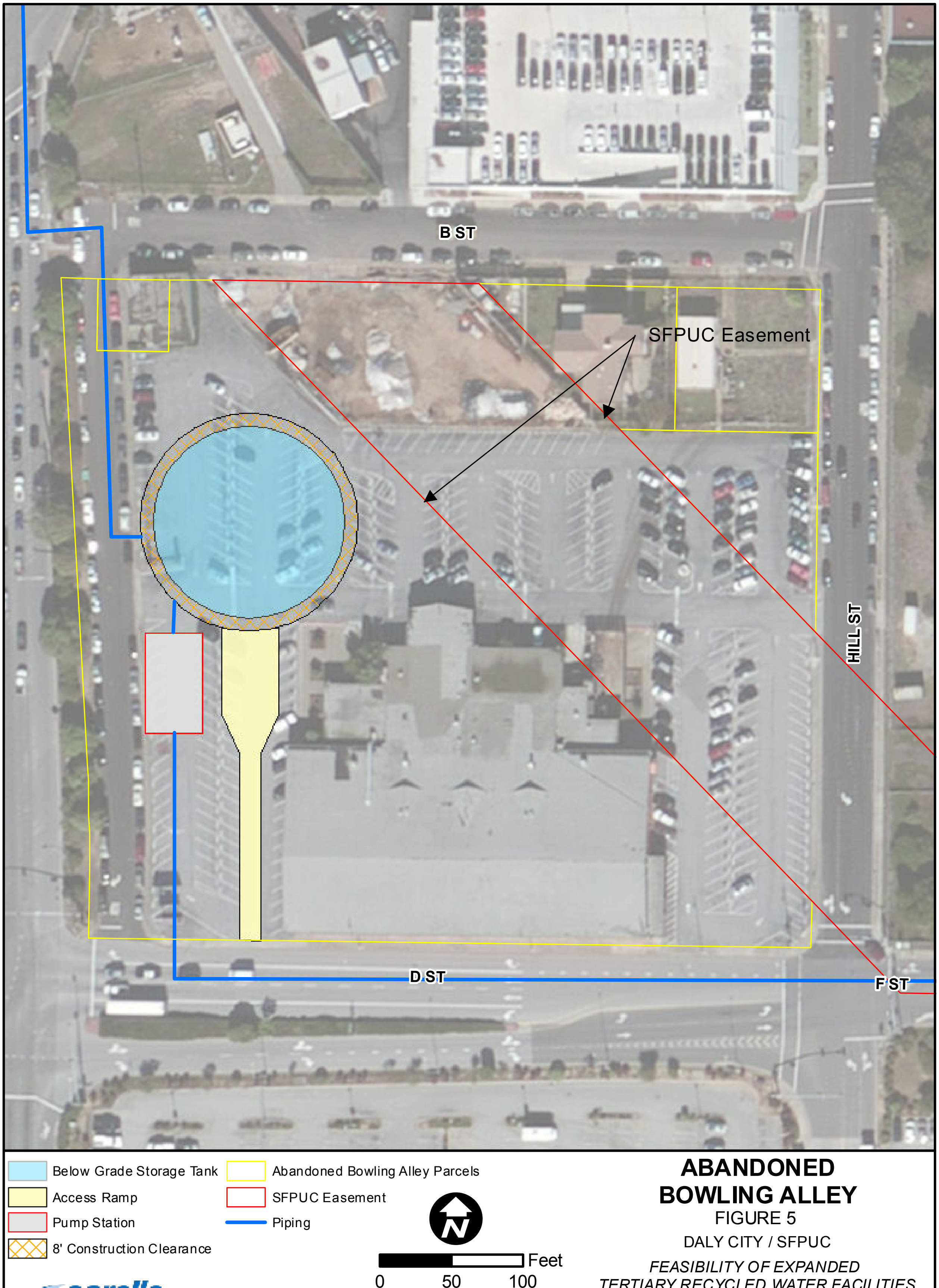
This site is recommended for further consideration.

4.6 Atwood Property

Figure 8 shows a location for the storage tank at two vacant parcels north of the intersection of El Camino Real and Olivet Parkway in the Town of Colma. The property is owned by Tom Atwood. There is a buried adjacent BART line to the northeast of the site and the property owner owns the lots on each side of Olivet Parkway.

The Project team has discussed siting a storage tank at this site with the owner. The landowner is amenable to selling the property. Figure 8 shows a rectangular tank layout on the site and the pump station located on the property adjacent to Olivet Parkway.

This site is recommended for further consideration.



ABANDONED BOWLING ALLEY
FIGURE 5
DALY CITY / SFPUC
FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

carollo

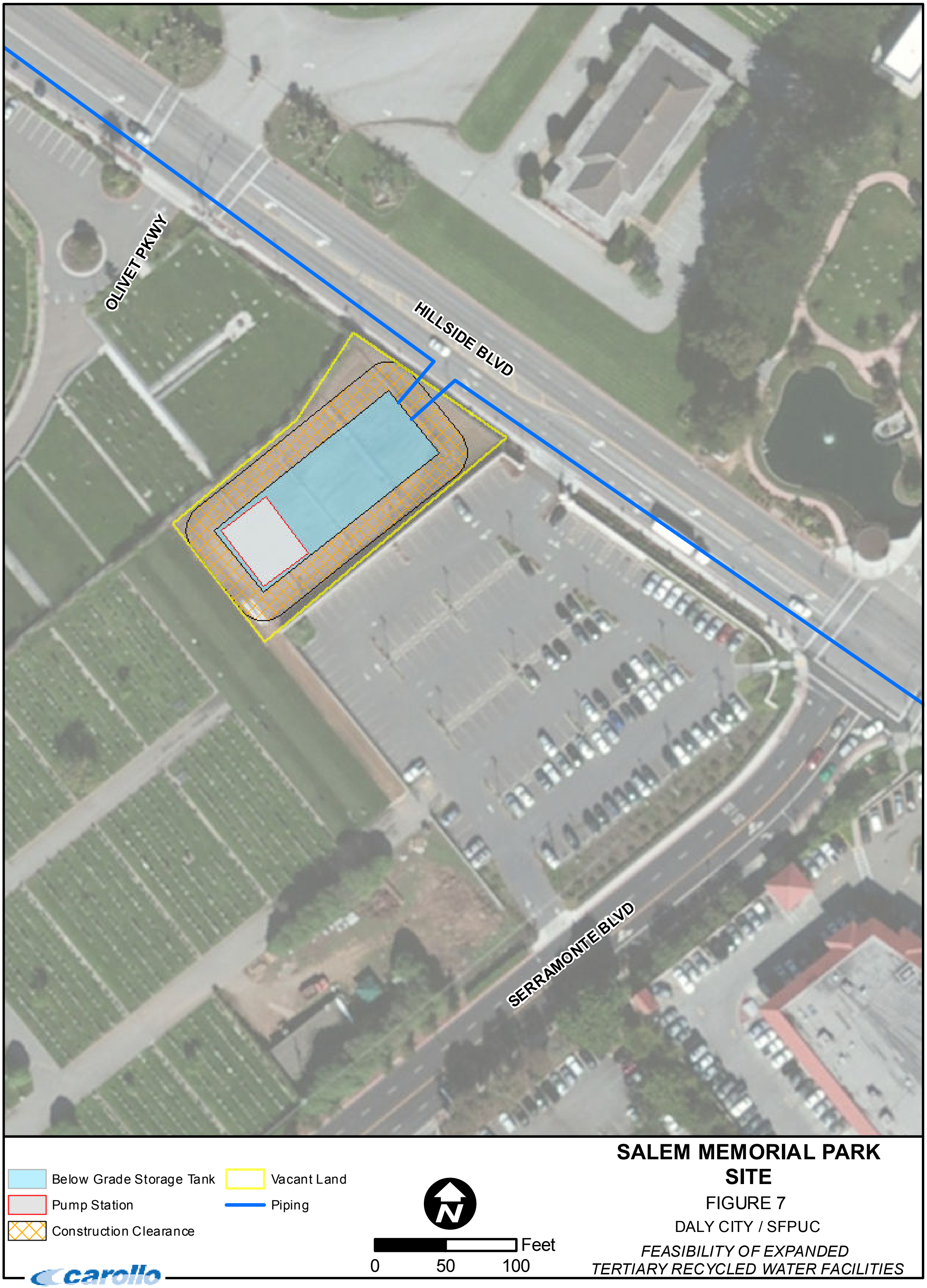
TOWN OF COLMA OFFICES

FIGURE 6

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

carollo



SALEM MEMORIAL PARK SITE

FIGURE 7

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

ATWOOD PROPERTY

FIGURE 8

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

4.7 Holy Cross Cemetery

Figure 9 shows a location for a storage tank at the Holy Cross Cemetery. Based on conversations with Holy Cross Cemetery management, they are open to the storage tank being located on their property on the east side of Hillside Boulevard. The site has adequate space for the storage tank and has an added benefit of being at the highest elevation of the alternatives considered. The additional elevation has the potential to eliminate the need for an additional pump station at the storage tank site. The drawback of the site is that it is located the farthest from the recycled water source and the cemeteries, and may require a transmission pipeline to the tank and additional piping back to the demand sites. The project team is also reviewing the potential of providing water to the cemeteries from the main distribution pipeline and eliminating the additional piping.

This site is recommended for further consideration.

4.8 Initial Screening Summary

Table 1 provides a summary of the sites screening.

5.0 NEXT STEPS

We recommend the following next steps based on the information presented above and in Table 1:

- Eliminate the Italian Cemetery, 280 Metro Center parking lot, Abandoned Bowling Alley, and Town of Colma Office site from consideration.
- Further evaluate the Salem Memorial Park Site, Atwood Property, and Holy Cross Cemetery sites.

Below Grade Storage Tank
Access Ramp
Pump Station
8' Construction Clearance
Holy Cross Cemetery
Piping

Feet
0 100 200

HOLY CROSS CEMETERY
FIGURE 9
DALY CITY / SFPUC
FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

carollo

Table 1 Alternatives Screening Summary
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Criteria	Italian Cemetery	280 Metro Center Parking Lot	Abandoned Bowling Alley	Town of Colma Office	Salem Memorial Park Site	Atwood Property	Holy Cross Cemetery
Space Available	Adequate	Adequate	Adequate	Not Adequate	Adequate	Adequate	Adequate
Pipeline Alignment	Compatible with potential alignments	Compatible with potential alignments	Compatible with potential alignments	Compatible with potential alignments	Compatible with potential alignments	Compatible with potential alignments	Compatible with potential alignments
Elevation	Tank elevation requires pumping to the El Camino Real and Hillside systems. LW EL = 103 ft.	Tank elevation may allow the sites along El Camino Real to be gravity fed but requires pumping to the Hillside system. LW EL = 230 ft.	Tank elevation requires pumping to the El Camino Real and Hillside systems. LW EL = 175 ft.	Tank elevation requires pumping to the El Camino Real and Hillside systems. LW EL = 105 ft.	Tank elevation requires pumping to the El Camino Real and Hillside systems. LW EL = 177 ft.	Tank elevation requires pumping to the El Camino Real and Hillside systems. LW EL = 91 ft.	Tank elevation may allow the sites along El Camino Real and Hillside to be gravity fed. LW EL = 440 ft.
Land Owner Feedback	Landowner has indicated that due to future expansion and land dedication reasons the site is not feasible	Landowner is open to installing a storage tank/PS on the site	Landowner not contacted due to Daly City input	Landowner is open to installing a storage tank/PS on the site	Landowner is open to installing a storage tank/PS on the site	Landowner is open to selling the lots	Landowner is open to installing a storage tank/PS on the site
Results	Do not consider further based on landowner feedback	Do not consider further based on input from Daly City because of parking impacts during construction	Do not consider further based on input from Daly City because site is being redeveloped	Do not consider further because site size is not adequate	Recommend further evaluation	Recommend further evaluation	Recommend further evaluation

Notes:
(1) LW EL = Low Water Elevation in the Storage Tank.

APPENDIX C – PROJECT MEMORANDUM 05 - RECYCLED WATER STORAGE TANK SITE EVALUATION

This document is released for the purpose of information exchange review and planning only under the authority of Darren G. Baune, 5/23/2017, California P.E. No. 68899.

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES PROJECT

PROJECT MEMORANDUM NO. 5
RECYCLED WATER STORAGE TANK SITE EVALUATION

DRAFT
May 2017

2700 YGNACIO VALLEY ROAD, SUITE 300 • WALNUT CREEK, CALIFORNIA 94598 • P. 925.932.1710 • F. 925.930.0208

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES PROJECT

PROJECT MEMORANDUM
NO. 5
RECYCLED WATER STORAGE TANK SITE EVALUATION

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RECYCLED WATER STORAGE TANK SITE EVALUATION

1.0 INTRODUCTION

The purpose of this memorandum is to evaluate and rank the Atwood Property, Salem Memorial Park, and Holy Cross Cemetery storage tank sites based on the following characteristics:

- Site Description.
- Recycled Water Conveyance System.
- Land Owner Feedback.
- Geotechnical Considerations.
- Project Cost.

This project memorandum builds on the memorandum titled "Daly City Storage Tank Site Initial Screening" (Carollo, 2016) which evaluated six potential storage tank sites and recommended further evaluation of the Atwood Property, Salem Memorial Park, and Holy Cross Cemetery storage tank sites. Figure 1 shows the locations of the storage tank sites.

2.0 ATWOOD PROPERTY

2.1 Site Description

The Atwood Property is located near the intersection of El Camino Real and Olivet Parkway in the Town of Colma and includes two parcels that are intersected by Olivet Parkway. The parcel to the north of Olivet Parkway is approximately 1.17 acres and the parcel to the south of Olivet Parkway is approximately 0.37 acres. Figure 2 shows conceptual locations for the tank and pump station at the Atwood Property site.

The property is located adjacent to a below grade Bay Area Rapid Transit (BART) train tunnel. The BART tunnel is approximately 38 feet (ft.) wide and 18 ft. tall. The top of the tunnel is approximately 1 to 10 ft. deep along the Atwood Property and Olivet Parkway. At Olivet Parkway, the ground cover for the BART tunnel is approximately 1 to 2 ft. BART record drawings are included in Appendix B.

Holy Cross Cemetery
Atwood Property
Salem Memorial Park

Feet
0 650 1,300

RECYCLED WATER STORAGE TANK SITES

FIGURE 1

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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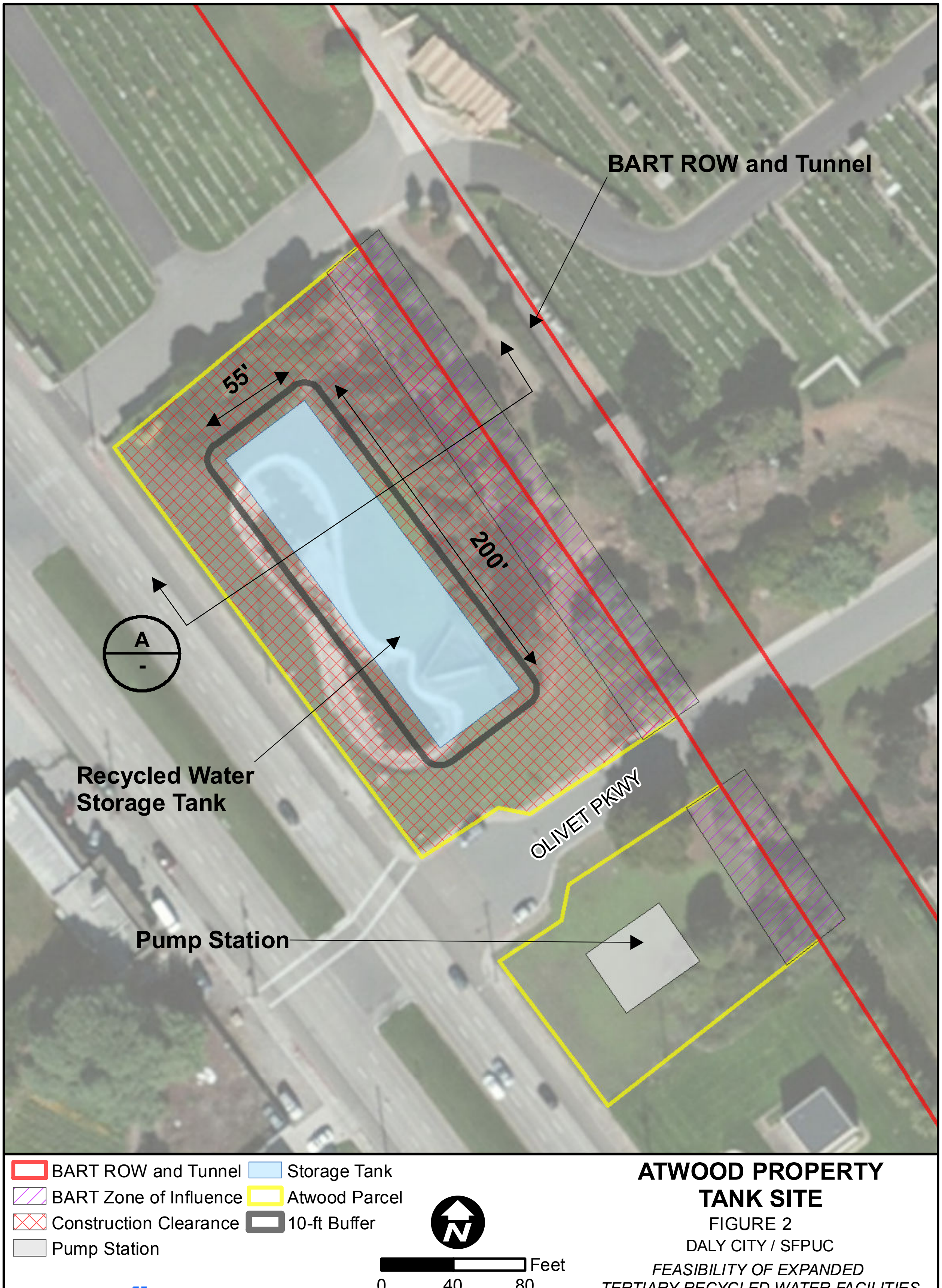

ATWOOD PROPERTY TANK SITE

FIGURE 2

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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Based on discussions with BART staff, a plan review by BART is required for all construction projects adjacent to BART facilities and a permit is required for any construction projects within BART's Zone of Influence. BART defines Zone of Influence as the area above a Line of Influence which is a line from the critical point (lowest point) of the substructure (i.e., tunnel) at a slope of 1-1/2 horizontal to 1 vertical (line sloping towards ground level).

Figure 3 shows a cross-section of the tank, BART tunnel, and Zone of Influence at the Atwood Property. The tank would not be located within the Zone of Influence, as shown in yellow. If more separation is needed between the tank and the BART tunnel, the storage tank can potentially be made deeper. The Construction Guidelines and BART Application for Permit and Plan Review are included in Appendix C and D.

Based on discussion with the Town of Colma (Colma), the storage tank should be located below-grade if it is located along El Camino Real to limit any visual impacts. Colma also stated that any on-site facilities (such as a pump station) should not be visible from behind a 6 ft. fence/wall that is set back at least 30 ft. from the property line. In front of this fence or wall, Colma expects high quality landscape design to hide the facility.

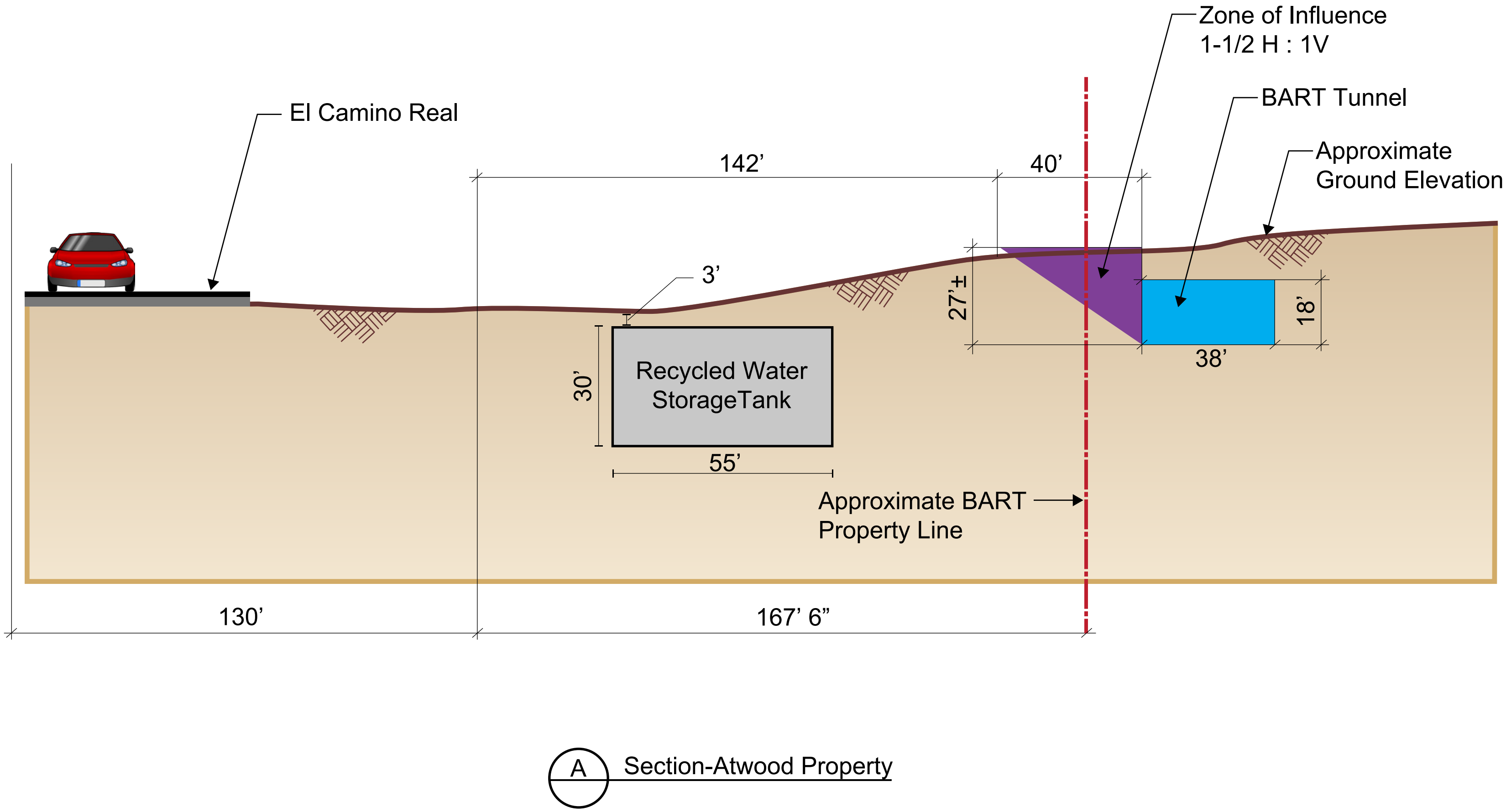
The Atwood property is currently zoned as "E", which does not allow for the construction of a storage tank or pump station at the Atwood Property. Based on discussions with Colma, if they agree with the project design, the zoning can be converted to a "P" Zoning, which will allow for the storage tank and pump station to be constructed at the Atwood Property.

Olivet Parkway is a private road owned by the Eternal Home Cemetery. Based on discussions with Eternal Home Cemetery, they would be willing to provide an easement for a pipeline along Olivet Parkway. An official agreement would have to be made between the cemetery, SFPUC and Daly City. The cemetery brought up the following questions and concerns in relation to the tank site and using Olivet Parkway for the pipeline route:

- The cemetery uses the road year-round for funerals. If the road is to be closed during construction, the length of time for the road closure should be minimized.
- The cemetery requested that if the roadway is replaced, the roadway section be improved.

2.2 Recycled Water Conveyance System

The recycled water conveyance system for each alternative is unique because each of the proposed tank sites are at different locations and elevations within the City. The pump station size, transmission and distribution pipe route, and pipe size all vary based on the storage tank site.



BART ZONE OF INFLUENCE

FIGURE 3

DALY CITY/SFPUC
FEASIBILITY OF EXPANDED
TERTIARY RECYCLED WATER FACILITIES

carollo

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The recycled water transmission system for the Atwood Property includes the elements listed below. Figure 4 provides an overall plan view of the system while Figure 5 shows the hydraulic system schematic.

- Pump Station at Daly City Wastewater Treatment Plant (WWTP).
- Transmission Main from Daly City WWTP to the storage tank.
- Storage tank.
- Pump Station.
- Distribution system, including booster system.

2.2.1 Pump Station at Daly City WWTP

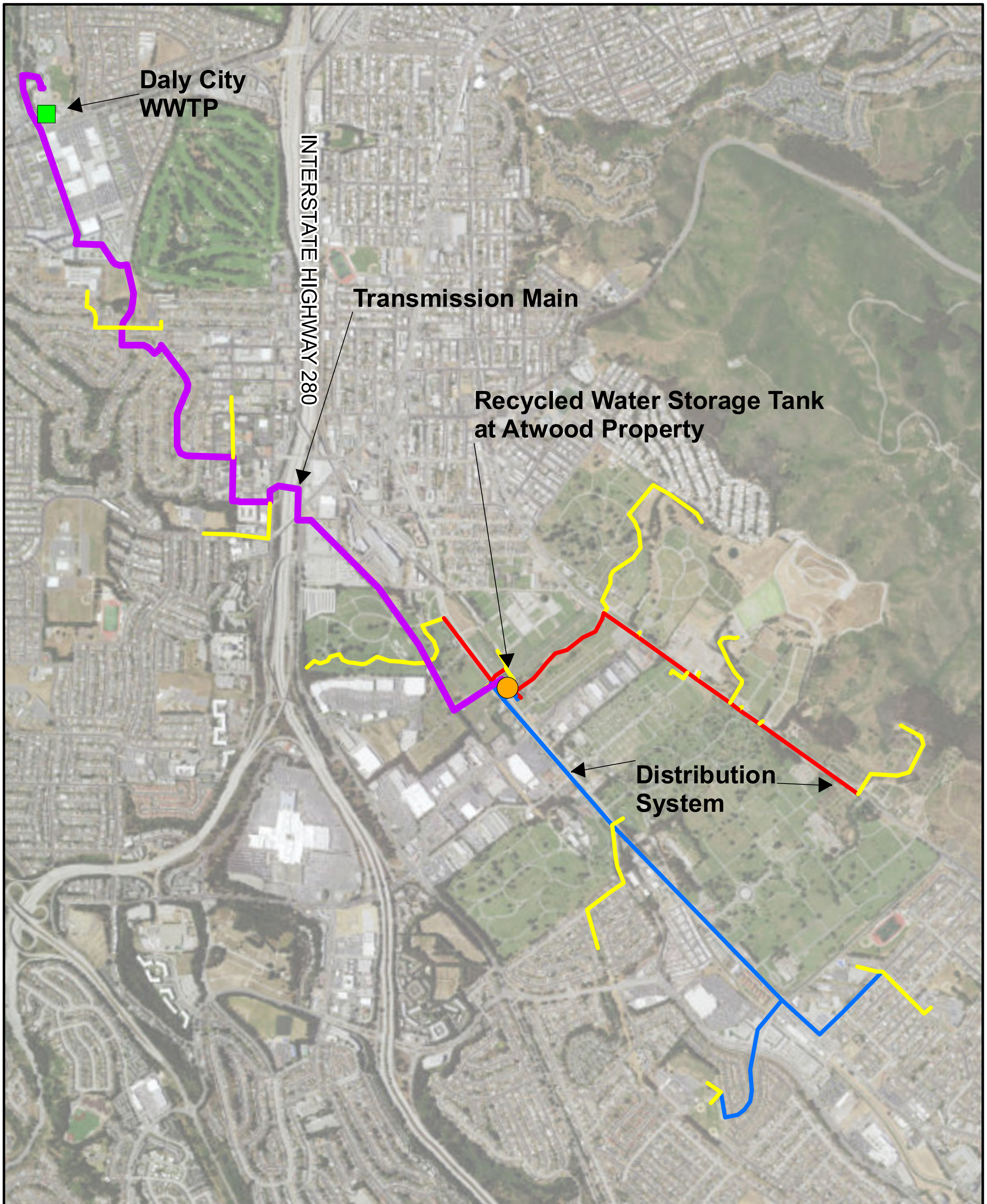
A new pump station is required at the Daly City WWTP to deliver recycled water to the storage tank in Colma. The pump station at the Daly City WWTP was sized based on the following:

- The average supply for the expanded tertiary recycled water facilities is 2.73 million gallons per day (mgd).
- The minimum pressure needed for any customer is 50 pounds per square inch (psi).

The pump station at the Daly City WWTP is recommended to be a three-pump system with two duty and one standby pump. The system curve is presented in Appendix E. The pump design criteria are presented in Table 1.

Table 1 Atwood Alternative - Pump Station at Daly City WWTP
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Item	Description
Configuration	2 duty + 1 standby
Pump Capacity (each pump)	1.78 mgd
Total Dynamic Head (feet)	230
Assumed Pump Efficiency	85 percent minimum
Motor horsepower (HP), each pump	60 HP minimum



Daly City WWTP
Storage Tank and Pump Station
Service Laterals
El Camino Real Distribution System
Hillside Blvd Distribution System
Transmisson Main

Feet
0 1,150 2,300

ATWOOD PROPERTY
RECYCLED WATER
CONVEYANCE SYSTEM

FIGURE 4

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED
TERTIARY RECYCLED WATER FACILITIES

carollo

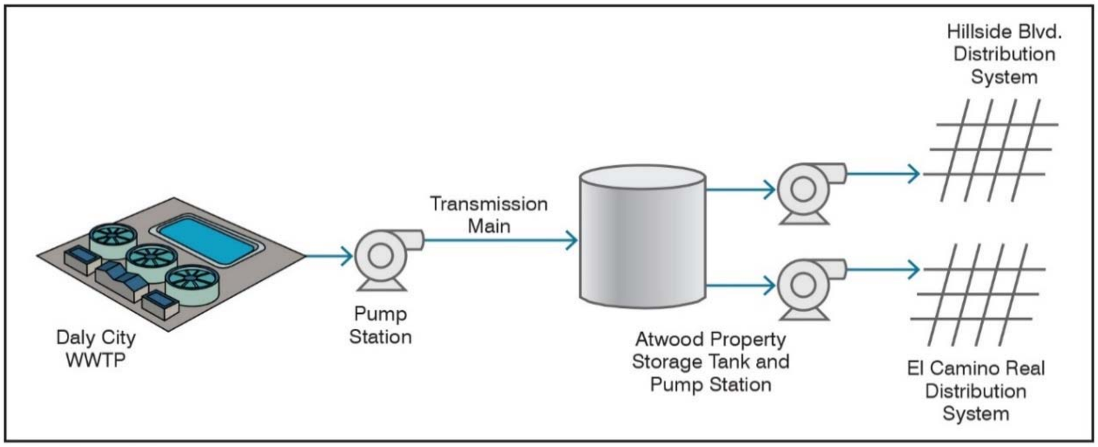


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Figure 5 Atwood Property Hydraulic System Schematic

2.2.2 Transmission Main

The transmission main delivers recycled water from the Daly City WWTP to the storage tank at the Atwood Property. The pipeline is approximately 16,300 ft. of 14-inch diameter pipe, 13 ft. of 12-inch diameter pipe, and 320 ft. of existing 16-inch diameter pipe (existing pipeline on a utility bridge spanning I-280). There are also four service connections located at the Benjamin Franklin Intermediate School, the Garden Village Elementary School, the City Hall of Daly City, and the Margaret Pauline Brown Elementary School that range from 1.5-inches to 4-inches in diameter, that total 4,160 ft.

2.2.3 Storage Tank

Figure 2 shows a preliminary site design for the storage tank at the Atwood Property based on 2.41 million gallons (MG) of storage volume. The site design is based on a buried rectangular tank with dimensions of 200 ft. long by 55 ft. wide by 30 ft. high. The tank will have approximately 3 ft. thick walls, 10 ft. of clearance in the excavation pit, and 30 ft. of clearance around the excavation pit for shoring. The preliminary storage tank layout does not infringe on BART's Zone of Influence.

2.2.4 Booster System

There are 2 locations along the transmission main where booster pump stations are required. Since the demand at these sites is low, it is more economical to install booster pump stations than to design the pump station at the Daly City WWTP for the higher pressures. The booster pump stations are required at City Hall and the Margaret Pauline Brown Elementary School.

The booster system includes two pumps (one duty and one standby) and a hydro-pneumatic tank. The pump will boost the pressure from the low point of the customer connection to the high point. The hydro-pneumatic tank should ideally be located at the high point of the customer line. The tank will limit pump cycling and also protect against surges when the pump turns on and off.

The pumps and the necessary equipment would be mounted on a skid (3'-6" wide by 3-6" long by 6'-0" high) and would need a power source. The hydro-pneumatic tank is approximately 80 gallons and 24 inches in diameter. The pumps and hydro-pneumatic tank would need land or available space to be installed and would also need to be protected to limit public access. It is also possible to install the booster pumps in an underground vault.

2.2.5 Distribution System Pump Station

The purpose of the pump station located at the storage tank site is to deliver water to the customers. The pump station will serve two distribution systems: the El Camino Real distribution system and the Hillside Boulevard distribution system. The separate distribution systems are required because of the varying elevations. The pump station shown in Figure 2 is approximately 50 ft. by 40 ft.

The El Camino Real distribution system will serve customers at elevations 120 ft. - 160 ft. and the Hillside Boulevard distribution system will serve customers at elevations 230 ft. - 450 ft. The distribution system pump curves are presented in Appendix E and the pump design criteria is presented in Table 2.

Table 2 Atwood Alternative - Distribution System Pump Station
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Item	El Camino Real Distribution System	Hillside Boulevard Distribution System
Configuration	1 duty + 1 standby	1 duty + 1 standby
Total Pump Capacity (mgd)	3.15	6.50
Total Dynamic Head (feet)	255	444
Assumed Pump Efficiency	85 percent minimum	85 percent minimum
Motor horsepower (HP), Each	200 HP minimum	700 HP minimum

2.2.6 Distribution System

The Atwood Property distribution system is approximately 36,100 ft. in length, with pipe sizes ranging in 1-inch to 18-inches in diameter. As discussed, due to elevation differences, there is one distribution system for El Camino Real and one for Hillside Boulevard. The Atwood Property distribution system is shown in Figure 4.

2.3 Land Owner Feedback

Based on a telephone conversation with Mr. Tom Atwood on March 2016, he is willing to sell his property at the current market rate of the land. According to preliminary research, the market rate for Mr. Atwood's property ranges from $50 - $100 per square foot. As mentioned previously, the Atwood property has a total area of 1.5 acres. This is equivalent to a land value between $3.3 million and $6.5 million.

2.4 Geotechnical Considerations

Fugro Consultants Inc. (Fugro) conducted a preliminary geotechnical desktop siting study of the three tank sites. The memorandum developed through this study is included in Appendix F.

Based on the preliminary geotechnical desktop study, Fugro determined that the Atwood Property is a feasible site for a storage tank. The key findings of the study are listed below. Please refer to Appendix F for the complete siting study:

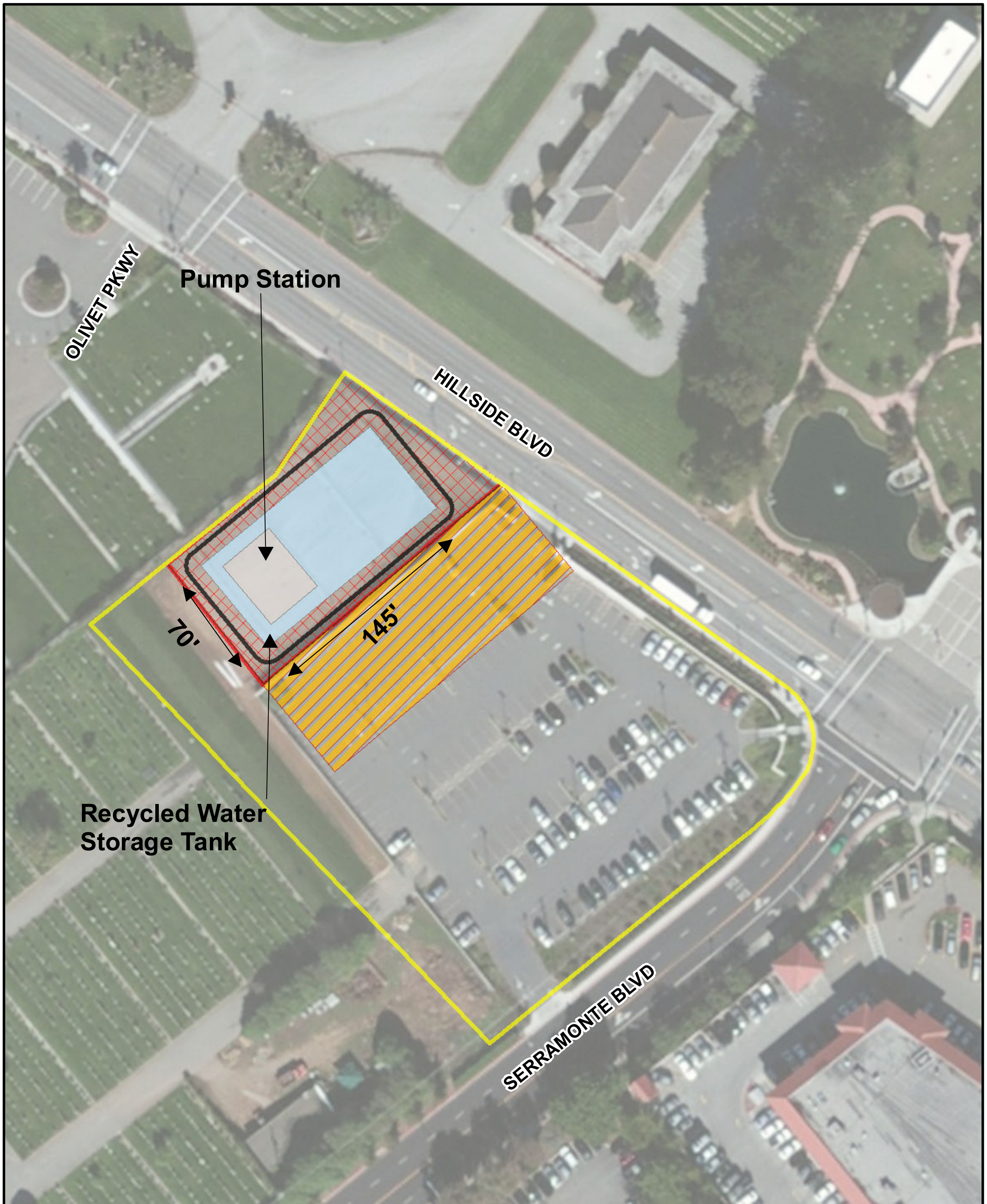
- Liquefaction Potential: Very low.
- Landslide Distribution: Flat land.
- Shaking Potential: High.
- Groundwater: Not anticipated to be encountered during construction.
- Other Considerations: Located near BART.

3.0 SALEM MEMORIAL PARK

3.1 Site Description

The Salem Memorial Park site is located on vacant land along Hillside Boulevard between Olivet Parkway and Serramonte Boulevard in the Town of Colma. The site is surrounded by the Lucky Chances Casino parking lot and grave sites for the Eternal Home Cemetery and Salem Memorial Park. The site ranges from 210 ft. to 220 ft. in elevation. The Salem Memorial Park tank site is shown in Figure 6.

The vacant property at the Salem Memorial Park site is approximately .5 acres. The parcel is located adjacent to a parking lot which is also owned by the Salem Memorial Park. Salem Memorial leases the parking lot to the Lucky Chances Casino for parking. Based on discussions with Salem Memorial Park, it is not possible to utilize the Lucky Chances parking lot for staging, equipment storage, or other purposes during construction of the recycled water project. Based on this, we have assumed a 20-foot corridor around the site to allow construction of the tank. The tank would need to be 70 foot deep to provide the construction corridor. Although possible, constructing a 70-foot deep tank is cost prohibitive and not feasible and we do not recommend moving forward with this alternative.



10-ft Buffer
Construction Clearance
Pump Station
Salem Parcel
Crane / Staging Area
Storage Tank
Vacant Land

N

0 50 100 Feet

SALEM MEMORIAL PARK TANK SITE

FIGURE 6

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

If it is possible to utilize the adjacent parking lot during construction and construct the tank within the .5 acre, the tank size could be adjusted to one 145 feet long by 70 feet wide by 33 feet deep. The tank size and excavation depth would be feasible but would require renegotiations of the parking lot lease with the Lucky Chances Casino. Figure 6 shows the site plan based on the assumption of allowing construction staging in the Lucky Chance parking lot.

3.2 Recycled Water Conveyance System

The previous section identified that if the Lucky Chance parking lot is not available for construction staging the Salem Memorial Park storage tank site is not feasible. This section presents the recycled water conveyance system for this alternative in case the Lucky Chance parking lot becomes available for staging. The recycled water transmission system for the Salem Memorial Park Site includes the elements listed below.

Figure 7 provides an overall plan view of the system and Figure 8 shows the hydraulic system schematic:

- Pump Station at Daly City WWTP.
- Transmission Main from Daly City WWTP to the storage tank.
- Storage tank.
- Pump Station.
- Distribution system, including booster system.

3.2.1 <u>Pump Station at Daly City WWTP</u>

A new pump station is required at the Daly City WWTP to deliver recycled water to the storage tank in Colma. The pump station at the Daly City WWTP was sized based on the following:

- The average supply for the expanded tertiary recycled water facilities is 2.73 million gallons per day (mgd).
- The minimum pressure needed for any customer is 50 pounds per square inch (psi).

The pump station at the Daly City WWTP is recommended to be a three-pump system with two duty and one standby pumps. The system curve is presented in Appendix E. The pump design criteria are presented in

Table 3	Salem Memorial Park Alternative - Pump Station at Daly City WWTP Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City
Item	**Description**
Configuration	2 duty + 1 standby
Pump Capacity (each pump)	1.78 mgd
Total Dynamic Head (feet)	265
Assumed Pump Efficiency	85 percent minimum
Motor horsepower (HP), each pump	100 HP minimum

3.2.2 Transmission Main

The transmission main delivers recycled water from the Daly City WWTP to the storage tank at the Salem Memorial Park site. The pipeline is approximately 16,100 ft. of 14-inch diameter pipe, 15 ft. of 12-inch diameter pipe, and 320 ft. of existing 16-inch diameter pipe (existing pipeline on a utility bridge spanning I-280). There are also four service connections located at the Benjamin Franklin Intermediate School, the Garden Village Elementary School, the City Hall of Daly City, and the Margaret Pauline Brown Elementary School that range from 1.5-inches to 4-inches in diameter, that total 4,160 ft.

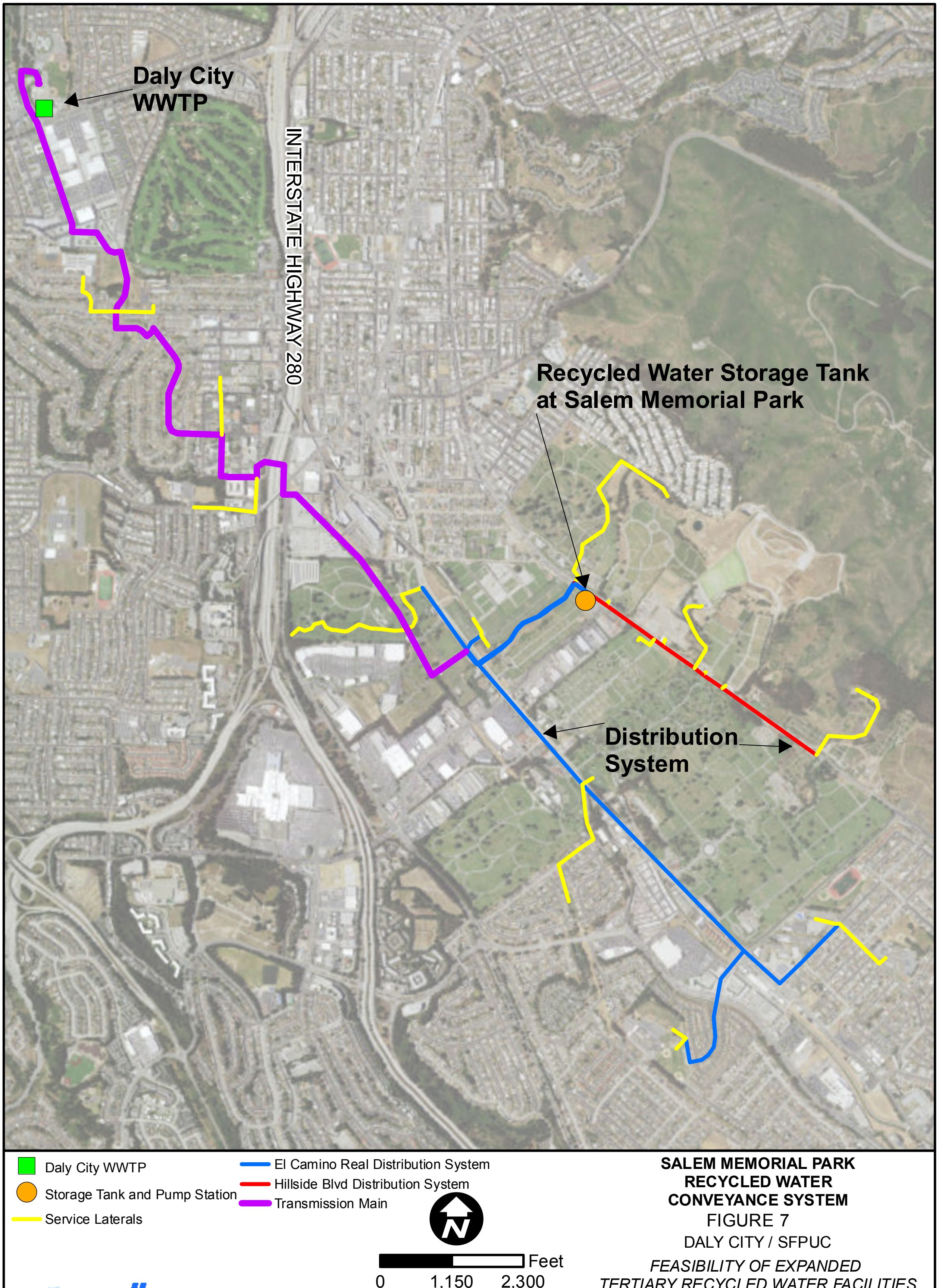
3.2.3 Storage Tank

Figure 6 shows the layout of the storage tank at the vacant land owned by the Salem Memorial Park based on 2.41 MG of recycled water storage. The site design is based on a buried rectangular tank with dimensions of 145 ft. long by 70 ft. wide by 33 ft. high. The tank will have 3 ft. walls, 10 ft. of clearance in the excavation pit, and 5 ft. of clearance around the excavation pit for shoring. Internal bracing was assumed for shoring with this option. Construction staging will need to be located on part of the parking lot being leased to the Lucky Chances Casino. This would require renegotiations of the current lease agreement.

3.2.4 Booster System

There are 2 locations along the transmission main where booster pump stations are required. Since the demand at these sites is low, it is more economical to install booster pump stations than to design the pump station at the Daly City WWTP for the higher pressures. The booster pump stations are required at City Hall and the Margaret Pauline Brown Elementary School.

The booster system includes two pumps (one duty and one standby) and a hydro-pneumatic tank. The pump will boost the pressure from the low point of the customer connection to the high point. The hydro-pneumatic tank should ideally be located at the high point of the customer line. The tank will limit pump cycling and also protect against surges when the pump turns on and off.



SALEM MEMORIAL PARK RECYCLED WATER CONVEYANCE SYSTEM

FIGURE 7

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

carollo

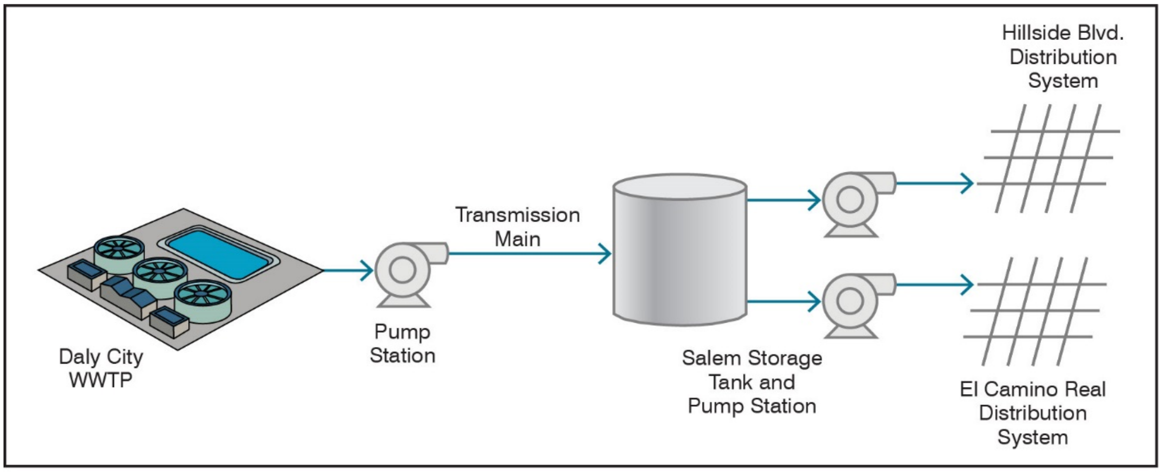


Figure 8 Salem Memorial Park Site Hydraulic System Schematic

The pumps and the necessary equipment would be mounted on a skid (3'-6" wide by 3-6" long by 6'-0" high) and would need a power source. The hydro-pneumatic tank is approximately 80 gallons and 24 inches in diameter. Both components would need land or available space to be installed and would also need to be protected to limit public access. The booster pumps could be installed in an underground vault.

3.2.5 Distribution System Pump Station

The purpose of the pump station located at the storage tank site is to deliver water to the customers. The pump station will serve two distribution systems: the El Camino Real distribution system and the Hillside Boulevard distribution system. The separate distribution systems are required because of the varying elevations. The pump station presented in Figure 6 is approximately 50 ft. by 40 ft. It is also located above the storage tank to minimize the site footprint.

The El Camino Real distribution system will serve customers at elevations 120 ft. - 290 ft. and the Hillside Boulevard distribution system will serve customers at elevations 230 ft. - 450 ft. The distribution system pump curves are presented in Appendix E, and the pump design criteria are presented in Table 4.

Table 4 Salem Memorial Park Alternative - Distribution System Pump Station
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Item	El Camino Real Distribution System	Hillside Boulevard Distribution System
Configuration	1 duty + 1 standby	1 duty + 1 standby
Total Pump Capacity (mgd)	3.85	5.80
Total Dynamic Head (feet)	165	332
Assumed Pump Efficiency	85 percent minimum	85 percent minimum
Motor horsepower (HP), Each	150 HP minimum	450 HP minimum

3.2.6 Distribution System

The Salem Memorial Park distribution system is approximately 38,200 ft. in length, with pipe sizes ranging in 1-inch to 16-inches in diameter. As discussed, due to elevation differences, there is one distribution system for El Camino Real and one for Hillside Boulevard. The Salem Memorial Park distribution system is shown in Figure 6.

3.3 Land Owner Feedback

Based on a telephone conversations with Mr. James Carlson, Executive Director of the Jewish Cemeteries, Salem Memorial Park is willing to locate an underground storage tank and pump station on the vacant property. Negotiations for using the site will need to be conducted with Congregation Sherith Israel and Congregation Emanu-El.

As mentioned previously, the parking lot is currently being leased to the Lucky Chances Casino. Their current lease agreement requires that the parking lot remain open at all times. Based on this, we do not recommend moving forward with the Salem Memorial alternative. The required tank depth is 70 feet, which is cost prohibitive. If it is possible to utilize half of the parking lot during construction, the Salem Memorial alternative would be feasible.

3.4 Geotechnical Considerations

Fugro conducted a preliminary geotechnical desktop siting study of the three tank sites. The memorandum developed through this study is included in Appendix F.

Based on the preliminary geotechnical desktop study, Fugro determined that the Salem Memorial Park location is a feasible site for a storage tank. The key findings of the study are listed below. Please refer to Appendix F for the complete siting study:

- Liquefaction Potential: Very low to high.
- Landslide Distribution: Flat land.
- Shaking Potential: High.
- Groundwater: Not anticipated to be encountered during construction.
- Other Considerations: Unnamed fault located less than 400 ft. away (not active) and deepest shoring required due to space limitations at the site.

4.0 HOLY CROSS CEMETERY

4.1 Site Description

The Holy Cross Cemetery site is located near the intersection of Hillside Boulevard and Lawndale Boulevard in the Town of Colma. The primary benefit of the Holy Cross site is that it is located at a high elevation and it is possible to flow by gravity from the tank to customers. This eliminates the booster pump station required in the other alternatives. Based on this pump configuration, three customers (Benjamin Franklin Intermediate School, Garden Village Elementary School, and the City Hall of Daly City) and along the transmission main will have minimum pressures greater than 100 psi. A pressure reducing valve will be required to reduce the pressure for these three customers.

4.1.1 <u>Transmission Main</u>

The transmission main delivers recycled water from the Daly City WWTP to the storage tank at the Holy Cross Cemetery. The pipeline is approximately 16,300 ft. of 14-inch diameter pipe and 320 ft. of existing 16-inch diameter pipe (existing pipeline on a utility bridge spanning I-280). There are also fifteen service connections along the transmission main that range from 1-inch to 14-inches in diameter, that total 12,200 ft.

4.1.2 <u>Storage Tank</u>

Figure 9 shows the layout of the storage tank at the land owned by the Holy Cross Cemetery based on 2.41 MG of recycled water storage. The site design is based on an above-ground circular tank with a diameter of 118.5 feet and a height of 30 feet. The tank will have 20 ft. of clearance around it for construction. It should be noted that the Holy Cross Cemetery leases this land to several farmers, but Holy Cross Cemetery has indicated that this site can be used for the storage tank.

4.1.3 <u>Distribution System</u>

The primary advantage of the Holy Cross site is that the elevation of the tank allows the distribution system to be fed by gravity and a pump station is not required at the tank to deliver water to customers. The Holy Cross Cemetery distribution system is approximately 24,300 in length, with pipe sizes ranging in 1.5-inches to 18-inches in diameter. The Holy Cross Cemetery distribution system is presented in Figure 10.

Since the storage tank is at a significantly higher elevation compared to the recycled water customers, pressure reducing valves may be required throughout the system.

Figure 9 shows a potential tank and pump station location at the Holy Cross site.

It is assumed an above grade tank is feasible at the Holy Cross site because there are two aboveground storage tanks owned by Cal Water on the site. Based on this pump configuration, three customers (Benjamin Franklin Intermediate School, Garden Village Elementary School, and the City Hall of Daly City) and along the transmission main will have minimum pressures greater than 100 psi. A pressure reducing valve will be required to reduce the pressure for these three customers.

4.1.4 Transmission Main

The transmission main delivers recycled water from the Daly City WWTP to the storage tank at the Holy Cross Cemetery. The pipeline is approximately 16,300 ft. of 14-inch diameter pipe and 320 ft. of existing 16-inch diameter pipe (existing pipeline on a utility bridge spanning I-280). There are also fifteen service connections along the transmission main that range from 1-inch to 14-inches in diameter, that total 12,200 ft.

4.1.5 Storage Tank

Figure 9 shows the layout of the storage tank at the land owned by the Holy Cross Cemetery based on 2.41 MG of recycled water storage. The site design is based on an above-ground circular tank with a diameter of 118.5 feet and a height of 30 feet. The tank will have 20 ft. of clearance around it for construction. It should be noted that the Holy Cross Cemetery leases this land to several farmers, but Holy Cross Cemetery has indicated that this site can be used for the storage tank.

4.1.6 Distribution System

The primary advantage of the Holy Cross site is that the elevation of the tank allows the distribution system to be fed by gravity and a pump station is not required at the tank to deliver water to customers. The Holy Cross Cemetery distribution system is approximately 24,300 in length, with pipe sizes ranging in 1.5-inches to 18-inches in diameter. The Holy Cross Cemetery distribution system is presented in Figure 10.

Since the storage tank is at a significantly higher elevation compared to the recycled water customers, pressure reducing valves may be required throughout the system.

Figure 9 shows the proposed tank and pump station located near the existing 1 MG tank owned by Cal Water. This location was selected based on discussions with the Holy Cross Cemetery during outreach efforts.

4.2 Recycled Water Conveyance System

The recycled water conveyance system for the Holy Cross site includes the elements listed below. Figure 10 provides an overall plan view of the system and Figure 11 shows the hydraulic system schematic.

- Pump Station at Daly City WWTP.
- Transmission Main from Daly City WWTP to the storage tank.
- Storage tank.
- Distribution system.

4.2.1 Pump Station at Daly City WWTP

A new pump station is required at the Daly City WWTP to deliver recycled water to the storage tank in Colma. The pump station at the Daly City WWTP was sized based on the following:

- The average supply for the expanded tertiary recycled water facilities is 2.73 million gallons per day (mgd).
- The minimum pressure needed for any customer is 50 pounds per square inch (psi).

The pump station at the Daly City WWTP is recommended to be a three-pump system including 2 duty pump and 1 standby pumps. The pump and system curve is shown in Appendix E. The pump design criteria are shown in Table 5.

Table 5 Holy Cross Alternative - Pump Station at Daly City WWTP
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Item	Description
Configuration	2 duty + 1 standby
Pump Capacity (each pump)	1.78 mgd
Total Dynamic Head (feet)	540
Assumed Pump Efficiency	85 percent minimum
Motor hp (each pump)	200 hp minimum

Based on this pump configuration, three customers (Benjamin Franklin Intermediate School, Garden Village Elementary School, and the City Hall of Daly City) and along the transmission main will have minimum pressures greater than 100 psi. A pressure reducing valve will be required to reduce the pressure for these three customers.

4.2.2 Transmission Main

The transmission main delivers recycled water from the Daly City WWTP to the storage tank at the Holy Cross Cemetery. The pipeline is approximately 16,300 ft. of 14-inch diameter pipe and 320 ft. of existing 16-inch diameter pipe (existing pipeline on a utility bridge spanning I-280). There are also fifteen service connections along the transmission main that range from 1-inch to 14-inches in diameter, that total 12,200 ft.

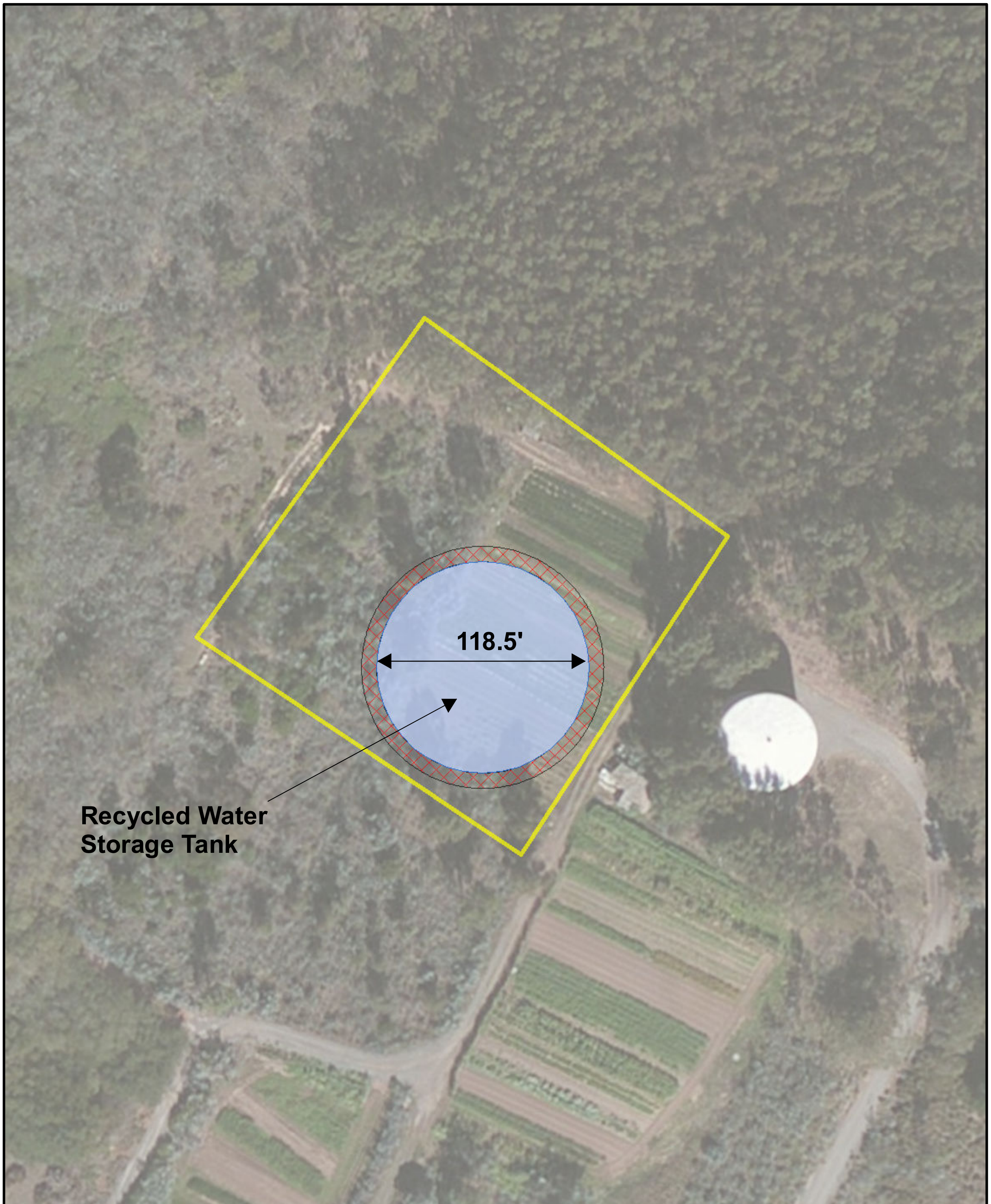
4.2.3 Storage Tank

Figure 9 shows the layout of the storage tank at the land owned by the Holy Cross Cemetery based on 2.41 MG of recycled water storage. The site design is based on an above-ground circular tank with a diameter of 118.5 feet and a height of 30 feet. The tank will have 20 ft. of clearance around it for construction. It should be noted that the Holy Cross Cemetery leases this land to several farmers, but Holy Cross Cemetery has indicated that this site can be used for the storage tank.

4.2.4 Distribution System

The primary advantage of the Holy Cross site is that the elevation of the tank allows the distribution system to be fed by gravity and a pump station is not required at the tank to deliver water to customers. The Holy Cross Cemetery distribution system is approximately 24,300 in length, with pipe sizes ranging in 1.5-inches to 18-inches in diameter. The Holy Cross Cemetery distribution system is presented in Figure 10.

Since the storage tank is at a significantly higher elevation compared to the recycled water customers, pressure reducing valves may be required throughout the system.



Construction Clearance
Storage Tank
Holy Cross Site

0 50 100 Feet

HOLY CROSS CEMETERY TANK SITE

FIGURE 9

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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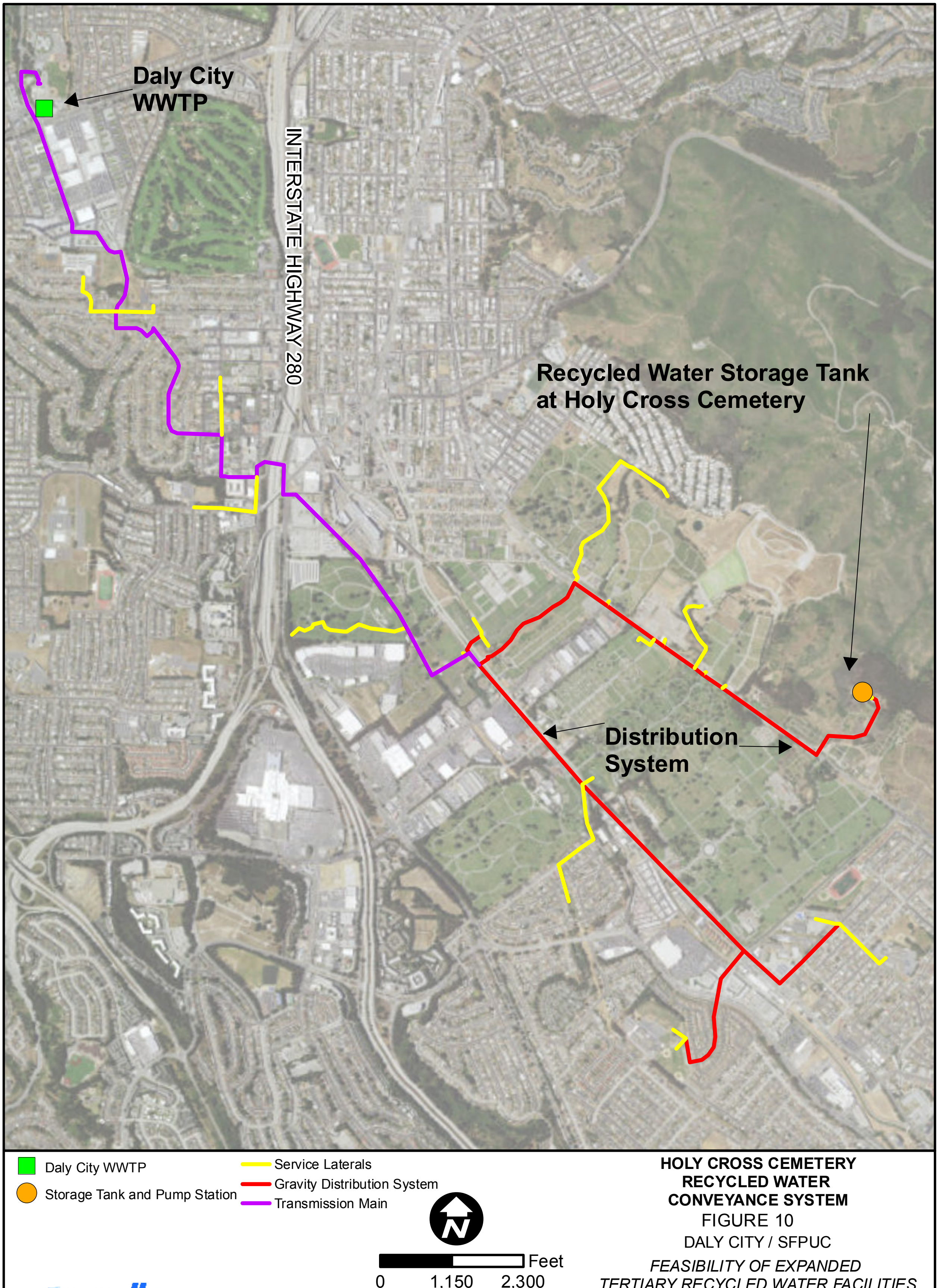

HOLY CROSS CEMETERY
RECYCLED WATER
CONVEYANCE SYSTEM
FIGURE 10
DALY CITY / SFPUC
FEASIBILITY OF EXPANDED
TERTIARY RECYCLED WATER FACILITIES

carollo

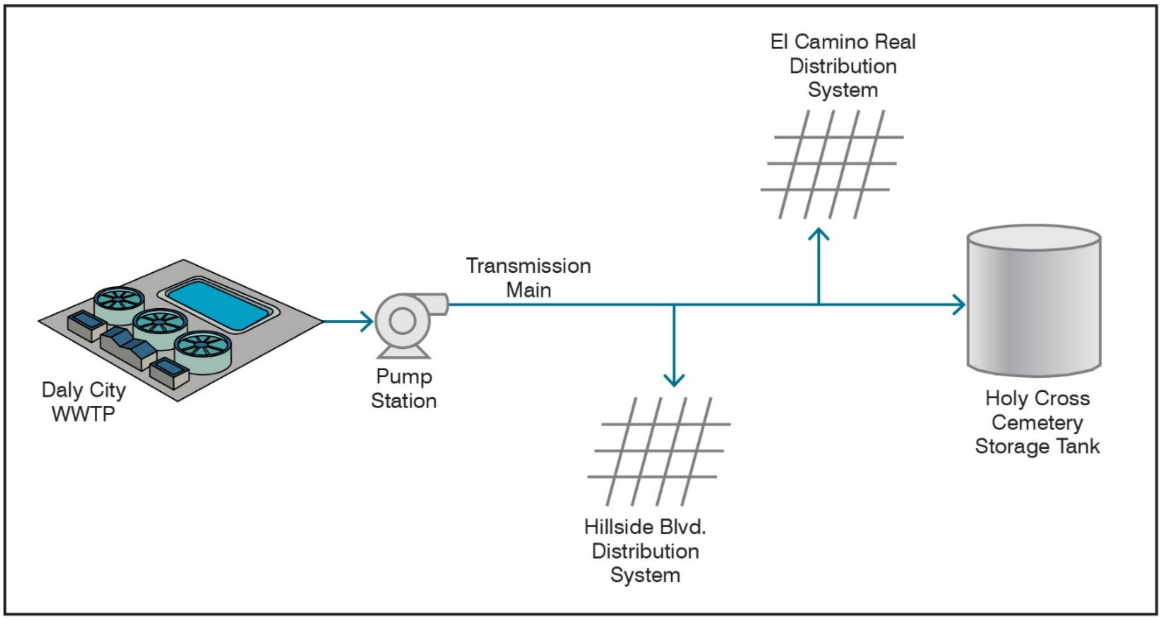

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Figure 11 Holy Cross Hydraulic System Schematic

4.3 Land Owner Feedback

The project team discussed the feasibility of installing the storage tank at the Holy Cross site with the Holy Cross cemetery management several times during 2016. The cemetery management has said they are open to negotiating with Daly City and/or the SFPUC to locate the tank on their property.

4.4 Geotechnical Considerations

Fugro conducted a preliminary geotechnical desktop siting study of the three tank sites. The memorandum developed through this study is included in Appendix F.

Based on the preliminary geotechnical desktop study, the Holy Cross Cemetery location is a feasible site for a storage tank. The key findings of the study are listed below. Please refer to Appendix F for the complete study:

- Liquefaction Potential: Very low.
- Landslide Distribution: Flat land to few landslides.
- Shaking Potential: High.
- Groundwater: Not anticipated to be encountered during construction.
- Other Considerations: Hillside Fault located approximately 900 ft. away.

5.0 COST COMPARISON

5.1 Basis for Estimate

The project is currently in the preliminary design phase and the design has not been developed in detail. The construction cost estimates are consistent with an AACE International Class 4 budget estimate with an accuracy range of +50 percent to -30 percent of the actual project cost.

5.1.1 ENR Benchmark

Providing a cost benchmark for construction estimates is useful in documenting the time of estimate preparation and in allowing for projections and escalations to later dates using the equivalent index value.

This preliminary design cost estimate is benchmarked to the Construction Cost Indices (CCI) published by the Engineering News Record (ENR) for January 2017. It should be noted this is the most current ENR to date. Typically, for the Daly City region, the ENR San Francisco CCI is used. The ENR San Francisco CCI for January 2017 was 11609.

5.1.2 Unit Costs

Unit costs have been researched and used for the major pipeline and structure components of the Project. These major components include water piping, pumps, valving, structures, and appurtenances.

Unit costs have been developed using preliminary quotations received from equipment and material manufacturers supplemented with installation costs based on past experience with similar projects, available recent bid data, or cost estimating guidelines derived from estimating guides such as the 2017 RS Means Heavy Construction Data publication, the most current publication to date.

5.1.3 Contingencies

Contingencies are typically applied to a construction estimate at the design development phase to account for construction items not yet identified, and construction design unknowns. As the design is refined and finalized, the contingency, typically expressed as a percent of the raw construction cost, will trend downward. At the completion of the design, the contingency should represent only a reasonable construction change order allowance. Agencies typically retain contingency within their project budgets, even when construction contract award values are known, to cover the cost or deal with unforeseen conditions.

A 30 percent contingency, calculated based on the raw construction cost, has been included in all three alternatives' cost estimates. This is in alignment with the recommendations for a project at an AACE Class 4 level of development.

5.2 Cost Estimates

The preliminary design construction cost estimates for the three alternatives are summarized in Table 6, Table 7, and Table 8. Appendix A provides details for each estimate including quantities, unit prices, and estimating assumptions. These estimates exclude property costs, which will need to be negotiated with the land owners.

Table 6 Atwood Property Alternative - Construction Cost Summary
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Item		Estimated Cost
01	Transmission Pipeline		$3,606,000
02	Pump Station at WWTP		$490,000
03	Storage Tank		$4,069,000
04	Distribution System		$7,616,000
05	Distribution System Pump Station		$725,000
	TOTAL DIRECT COST		**$16,506,000**
	Contingency	30%	$4,952,000
	Subtotal		$21,458,000
	General Contractor Overhead, Profit & Risk	12%	$2,575,000
	Subtotal		$24,033,000
	Escalation to Mid-Point[(1)]	12.6%	$3,033,000
	Subtotal		$27,066,000
	Sales Tax (Applied to 50% of Total Direct Cost)	9.0%	$743,000
	Subtotal		$27,809,000
	General Conditions	12.0%	$3,337,000
	TOTAL ESTIMATED CONSTRUCTION COST		**$31,146,000**
	Cost Range		***$21,802,000 - $46,719,000***
	Engineering, Legal & Administration Fees	20%	$6,229,000
	Owner's Reserve for Change Orders	5%	$1,557,000
	TOTAL ESTIMATED PROJECT COST		**$38,932,000**

Notes:

(1) Based on a compound annual escalation rate of 4%, a design duration of 18 months starting in January 2018, and a construction duration of 24 months starting in January 2019.

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Table 7	Salem Memorial Park Alternative - Construction Cost Summary Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City		
No.	**Item**		**Estimated Cost**
01	Transmission Pipeline		$3,546,000
02	Pump Station at WWTP		$503,000
03	Storage Tank(1)		$4,107,000
04	Distribution System		$8,004,000
05	Distribution System Pump Station		$598,000
	TOTAL DIRECT COST		**$16,758,000**
	Contingency	30%	$5,027,000
	Subtotal		$21,785,000
	General Contractor Overhead, Profit & Risk	12%	$2,614,000
	Subtotal		$24,399,000
	Escalation to Mid-Point(2)	10.4%	$3,079,000
	Subtotal		$27,478,000
	Sales Tax (Applied to 50% of Total Direct Cost)	9.0%	$754,000
	Subtotal		$28,232,000
	General Conditions	12.0%	$3,388,000
	TOTAL ESTIMATED CONSTRUCTION COST		**$31,620,000**
	Cost Range		***$22,134,000 - $47,430,000***
	Engineering, Legal & Administration Fees	20%	$6,324,000
	Owner's Reserve for Change Orders	5%	$1,581,000
	TOTAL ESTIMATED PROJECT COST		**$39,525,000**

Notes:

(1) If the project is allowed to use the adjoining parking lot for construction, the storage tank would be much shallower and wider, resulting in roughly $1 M of total project cost savings.

(2) Based on a compound annual escalation rate of 4%, a design duration of 18 months starting in January 2018, and a construction duration of 24 months starting in January 2019.

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Table 8 Holy Cross Cemetery Alternative - Construction Cost Summary
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Item		Estimated Cost
01	Transmission Pipeline		$3,599,000
02	Pump Station at WWTP		$562,000
03	Storage Tank		$2,431,000
04	Distribution System		$6,748,000
05	Distribution System Pump Station		$0
	TOTAL DIRECT COST		**$13,340,000**
	Contingency	30%	$4,002,000
	Subtotal		$17,342,000
	General Contractor Overhead, Profit & Risk	12%	$2,081,000
	Subtotal		$19,425,000
	Escalation to Mid-Point(1)	12.6%	$2,451,000
	Subtotal		$21,874,000
	Sales Tax (Applied to 50% of Total Direct Cost)	9.0%	$600,000
	Subtotal		$22,474,000
	General Conditions	12.0%	$2,697,000
	TOTAL ESTIMATED CONSTRUCTION COST		**$25,171,000**
	Cost Range		***$17,620,000 - $37,757,000***
	Engineering, Legal & Administration Fees	20%	$5,034,000
	Owner's Reserve for Change Orders	5%	$1,259,000
	TOTAL ESTIMATED PROJECT COST		**$31,464,000**

Notes:

(1) Based on a compound annual escalation rate of 4%, a design duration of 18 months starting in January 2018, and a construction duration of 24 months starting in January 2019.

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

5.3 Operation and Maintenance Cost

The project team developed estimates for the operation and maintenance (O&M) costs associated with each alternative. The O&M costs include the electricity costs of pumping as well as an annual maintenance of the pipelines and pump stations.

The O&M pumping costs assume that recycled water is delivered 7 months out of the year. During this delivery period, it was assumed that the pump station at the Daly City WWTP is operating 24 hours per day, 7 days per week. It was also assumed that the distribution system pump stations are operational 8 hours per day, 7 days per week. Additionally, an annual maintenance budget was allocated for pump repair and part replacement (1 percent of the project capital cost was assumed for this O&M cost). Table 9 shows the O&M cost for each alternative.

Table 9 O&M Cost Summary
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Alternative	Annual Pumping Cost	Annual Maintenance Cost	Total Annual O&M Cost
Atwood Property	$ 262,000	$389,000	$651,000
Salem Memorial Park	$ 229,000	$395,000	$624,000
Holy Cross Cemetery	$ 152,000	$315,000	$467,000

5.4 Amortized Cost

Given the estimated project cost and annual O&M costs, the project team has developed estimates for the total annualized cost for each of the three alternatives. This total annualized cost was estimated over the 20 year project lifetime based on the capital costs presented in Section 5.1 and annual pumping and maintenance costs presented in Section 5.2. Annualized costs are presented in Table 10 below.

Table 10 Amortized Cost Summary
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Alternative	Annualized Capital Cost	Annual O&M Cost	Total Amortized Cost
Atwood Property	$3,124,000	$651,000	$3,775,000
Salem Memorial Park	$3,172,000	$624,000	$3,796,000
Holy Cross Cemetery	$2,525,000	$467,000	$2,992,000

Notes:
(1) Capital Cost was annualized assuming a 20 year project life and a 5% interest rate.

6.0 ALTERNATIVE EVALUATION

Table 11 summarizes the alternatives evaluation based on the following criteria discussed for each alternative in this memorandum.

- Site.
- Recycled Water Conveyance System.
- Land Owner Feedback.
- Geotechnical Considerations.
- Project Cost.

The evaluation scored each alternative from 1 to 3. A score of 1 is the lowest and 3 is the highest and each alternative was given a unique score for each criteria.

7.0 SUMMARY

The Holy Cross alternative stands out as the best alternative because it has the lowest total project cost and lowest amortized cost, it does not require a distribution system pump station, the tank can be located above ground, the tank site has adequate space, and the tank site is not located near BART.

However, the Atwood site is also feasible and there are no fatal flaws. The Town of Colma requested the tank be located below grade. Also, a booster pump station is required and the tank site is located adjacent to BART. For these reasons the Atwood alternative is more expensive and less favorable than the Holy Cross alternative.

The Salem Memorial Park alternative has a fatal flaw and is not recommended. The proposed tank site is small and would require a cost prohibitive tank depth of 70 feet. However, if it is possible to utilize the adjacent parking lot during construction, a feasible below grade tank could be constructed. This would require renegotiations with Lucky Chance Casino who currently leases the parking lot from the Salem Memorial Cemetery.

8.0 RECOMMENDATIONS

Table 11 shows the Holy Cross Cemetery alternative ranks the highest considering the evaluation criteria developed in this memorandum. The Atwood Property is also a feasible alternative and does not have any fatal flaws. We recommend beginning negotiations with the Holy Cross cemetery management staff and/or the Atwood property owner to purchase property for the recycled water storage tank site.

Table 11 Alternative Evaluation Summary
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Criteria	Atwood Property	Salem Memorial Park	Holy Cross Cemetery
Site	**Score: 2** • Located near an underground BART tunnel. • Due to City's request, tank would need to be underground. • Need to convert to "P" zoning.	**Score: 1** • Site size is severely constrained. • Need to use Lucky Chance parking lot during construction.	**Score: 3** • Above ground tank is feasible.
Conveyance System	**Score: 2** • Distribution pump station required. • Booster pump station required for demands along pipeline.	**Score: 1** • Distribution pump station required. • Booster pump station required for demands along pipeline.	**Score: 3** • Longer transmission piping needed to storage tank. • No distribution pump station needed.
Land Owner Feedback	**Score: 2** • Willing to negotiate property sale.	**Score: 1** • Negotiations with current lessee required to use parking lot.	**Score: 3** • Willing to negotiate property sale.
Geotechnical Considerations	**Score: 3** • No groundwater anticipated.	**Score: 1** • No groundwater anticipated. • Unnamed, inactive fault less than 400 ft. away. • Internally braced shoring required due to site size constraints.	**Score: 2** • No groundwater anticipated. • Hillside fault approximately 900 ft. away.
Amortized Cost	**Score: 2** $3,775,000	**Score: 1** $3,796,000	**Score: 3** $2,992,000
Overall Score	**11**	**5**	**14**

Notes:

(1) For each alternative and criteria a ranking from 1 to 3 is given, with 1 being the worst and 3 being the best.

APPENDIX A – COST ESTIMATE

Engineers...Working Wonders With Water®

PROJECT SUMMARY

Project:	**Daly City RW Pre-Design: Atwood Configuration**	**Estimate Class:**	**4**
Client:	**North Dan Mateo County Sanitation District**	**PIC:**	**MJB**
Location:	**Daly City, CA**	**PM:**	**DGB**
Zip Code:	**94014**	**Date:**	**January 30, 2017**
Carollo Job #	**10076A.10**	**By:**	**EC**
		Reviewed:	**DGB**

NO.	DESCRIPTION			TOTAL
01	Transmission Pipeline			$3,606,000
02	Pump Station at WWTP			$490,000
03	Storage Tank			$4,069,000
04	Distribution System			$7,616,000
05	Distribution System Pump Station			$725,000
		TOTAL DIRECT COST		**$16,506,000**
	Contingency		30.0%	$4,952,000
		Subtotal		**$21,458,000**
	General Contractor Overhead, Profit & Risk		12.0%	$2,575,000
		Subtotal		**$24,033,000**
	Escalation to Mid-Point		12.6%	$3,033,000
		Subtotal		**$27,066,000**
	Sales Tax (Applied to 50% Total Direct Cost)		9.0%	$743,000
		Subtotal		**$27,809,000**
	General Conditions		12.0%	$3,337,000
	TOTAL ESTIMATED CONSTRUCTION COST			**$31,146,000**
	Engineering, Legal & Administration Fees		20.0%	$6,229,000
	Owner's Reserve for Change Orders		5.0%	$1,557,000
	TOTAL ESTIMATED PROJECT COST			**$38,932,000**

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 01 Transmission Pipeline

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 15 - Mechanical					
15000	14" DI Pipe Finished	16332	LF	$215.85	$3,525,305	
15000	16" DI Pipe Finished	319	LF	$244.24	$77,937	
15000	12" DI Pile Finished	13	LF	$194.36	$2,543	
	Total					**$3,605,784**
	Grand Total					**$3,605,784**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 02 Pump Station at WWTP

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02260	Sheet Piling, 27#/Sf To 20' Deep, Driven, Pulled & Salvaged (Pits Only)	1,881.00	SF	$47.13	$88,646	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	492.56	CY	$2.08	$1,024	
02300	20 Cy Dump Truck, 30 Miles/Round Trip	492.56	CY	$14.02	$6,905	
02300	Imported Pipe Bed & Zone/Confined Structure Backfill, Class B Material	129.56	CY	$88.36	$11,448	
	Total					**$108,023**
	Division 03 - Concrete					
03300	18" Structural Flat Mat On Grade	33.00	CY	$549.30	$18,127	
03300	18" Edge Forms, Slab On Grade, Add	98.00	LF	$26.19	$2,567	
03300	12" Straight Wall >8' High	52.22	CY	$1,172.98	$61,253	
03300	8" Straight Wall, To 8' High	2.47	CY	$1,649.14	$4,073	
03300	12" Elevated Slab To 20'	33.00	CY	$553.50	$18,265	
	Total					**$104,285**
	Division 15 - Mechanical					
15000	Pump at Tratment Plant	3	EA	$43,867.00	$131,601	
15112	12" 150# Fxf Awwa Butterfly Valve, No Op	3.00	EA	$3,669.84	$11,010	
15114	12"- 200 Psi Ci Fxf Swing Check Valve	3.00	EA	$8,565.04	$25,695	
15119	Air/Vac Valve, 150# Flange, 12"	3.00	EA	$8,457.66	$25,373	
15121	12" Flex Cplg, Above Ground	3.00	EA	$1,635.24	$4,906	
15121	14" Flex Cplg, Above Ground	1.00	EA	$1,880.05	$1,880	
15251	14"X12" Cldi Flg Rdcg Tee In Place	3.00	EA	$5,884.41	$17,653	
15251	14" 90° 125# Cldi Fxf Ell	2.00	EA	$4,689.68	$9,379	
15251	14" Flg Cldi Pipe In Bldg	20.00	LF	$208.75	$4,175	
15251	12" Flg Cldi Pipe In Bldg	9.00	LF	$171.61	$1,544	
	Total					**$233,217**
	Division 17 - Instrumentation and Controls					
17000	I&C Adder	1.00	LS	$44,552.48	$44,552	
	Total					**$44,552**
	Grand Total					**$490,077**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 03 Storage Tank

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02000	Shoring System with tiebacks	1	LS	$690,000.00	$690,000	
02300	Topsoil Strip & Stockpile On Site, To 1000 Cy	1,557.41	CY	$8.99	$14,003	
02300	Replace Topsoil To 1000 Cy (From Stockpile)	1,557.41	CY	$18.89	$29,424	
02300	Stripping & Stockpiling Equip. Move-On Cost	1.00	LS	$3,060.68	$3,061	
02300	Remove Grass & Shrubs Medium Density, 2" Depth To 1 Acre	42,050.00	SF	$.04	$1,493	
02300	Clearing & Grubbing Equipment Move-On Cost	1.00	LS	$1,761.82	$1,762	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	26,066.67	CY	$2.08	$54,205	
02300	Native Trench Backfill/Unconfined Struct. Bf, Class B Material	10,242.81	CY	$20.83	$213,365	
02300	10 Cy Dump Truck, 20 Miles/Round Trip	15,823.85	CY	$17.87	$282,825	
	Total					**$1,290,137**
	Division 03 - Concrete					
03300	18" X 18" Square Column/Pier	81	CY	$1,873.73	$151,772	
03300	20" W X 36" D Conc Beam	122.22	CY	$1,422.40	$173,846	
03300	12" Elevated Slab, 27'-32' High	465.41	CY	$661.48	$307,860	
03300	36" Structural Flat Mat On Grade	1516.67	CY	$619.64	$939,786	
03300	30" Straight Wall >8' High	1333.33	CY	$686.44	$915,246	
03300	30" Straight Wall >8' High	406.67	CY	$686.44	$279,153	
	Total					**$2,767,663**
	Division 05 - Metals					
05500	Fixed Aluminum Ladder - No Safety Cage	60.00	VLF	$119.85	$7,191	
	Total					**$7,191**
	Division 07 - Thermal and Moisture					
07700	2'-6" X 4'-6" Roof Hatch & Curb, All Aluminum	1.00	EA	$2,129.26	$2,129	
07700	3'-0" X 2'-6" Roof Hatch & Curb, All Aluminum	1.00	EA	$1,449.08	$1,449	
	Total					**$3,578**
	Grand Total					**$4,068,569**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 04 Distribution System

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02260	Sheet Piling, 22#/Sf To 15' Deep, Driven, Pulled & Salvaged (Pits Only)	336	SF	$40.74	$13,688	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	19	CY	$2.08	$39	
02300	20 Cy Dump Truck, 30 Miles/Round Trip	19	CY	$14.02	$262	
	Total					**$13,988**
	Division 03 - Concrete					
03300	12" Edge Forms, Slab On Grade, Add	48	LF	$13.50	$648	
03300	12" Flat Non-Formed S.O.G.	3	CY	$489.40	$1,307	
03300	12" Straight Wall, To 8' High	6	CY	$1,325.17	$8,243	
03300	12" Straight Wall, To 8' High	4	CY	$1,325.17	$5,499	
	Total					**$15,697**
	Division 05 - Metals					
05500	Fixed Galv. Steel Ladder - No Safety Cage	28	VLF	$101.85	$2,852	
05500	Galvanized Steel Pit Frame & Cover	64	SF	$35.09	$2,246	
	Total					**$5,097**
	Division 11 - Equipment					
11000	Booster Pump	2	EA	$30,600.00	$61,200	
11000	Hydro-pneumatic tank	2	EA	$6,600.00	$13,200	
	Total					**$74,400**
	Division 15 - Mechanical					
15000	12" DI Pile Finished	3061	LF	$194.36	$594,843	
15000	2" PVC Pipe Finished	1743	LF	$163.38	$284,706	
15000	3" PVC Pipe Finished	219	LF	$165.41	$36,215	
15000	4" DI Pipe Finished	9599	LF	$169.01	$1,622,353	
15000	6" DI Pipe Finished	4520	LF	$174.85	$790,388	
15000	8" DI Pipe Finished	8769	LF	$181.50	$1,591,570	
15000	10" DI Pipe Finished	203	LF	$188.15	$38,283	
15000	14" DI Pipe Finished	6063	LF	$215.85	$1,308,675	
15000	16" DI Pipe Finished	2519	LF	$244.24	$615,157	
15000	18" DI Pipe Finished	380	LF	$265.59	$100,867	
15000	1.5" PVC Pipe Finished	3125	LF	$162.38	$507,478	
15000	1" PVC Pipe Finished	102	LF	$161.39	$16,451	
	Total					**$7,506,985**
	Grand Total					**$7,616,167**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 05 Distribution System Pump Station

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02742	4" Ac Paving On 8" Abc	111.11	SY	$72.66	$8,073	
	Total					**$8,073**
	Division 04 - Masonry					
04220	Standard Concrete Block, 8"	680	SF	$21.88	$14,876	
04220	Standard Concrete Block, 8"	1320	SF	$21.88	$28,877	
04220	Integral Cmu Color Adder	2000	SF	$1.85	$3,704	
04220	Full Grout (All Cells)	2000	SF	$1.62	$3,241	
04220	Seismic Reinforcement Adder	2000	SF	$1.82	$3,642	
	Total					**$54,339**
	Division 07 - Thermal and Moisture					
07200	2" Composite Roof Insulation	2000	SF	$3.69	$7,382	
07400	Standing Seam 0.032" Aluminum Enameled On Mansard Or Vertical Surface	2000	SF	$24.05	$48,096	
	Total					**$55,478**
	Division 08 - Doors and Windows					
08110	6/0 X 6/8 X 1.75" "B" Label Double Hollow Metal Door W/Frame & Hdwre	1	PR	$2,459.68	$2,460	
	Total					**$2,460**
	Division 15 - Mechanical					
15000	In field pumps El Camino	2.00	EA	$62,200.00	$124,400	
15000	In field pumps Hillside	2.00	EA	$156,650.00	$313,300	
	Total					**$437,700**
	Division 16 - Electrical					
16000	Electrical Adder for In Field Pump Station	1	LS	$167,415.00	$167,415	
	Total					**$167,415**
	Grand Total					**$725,465**

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PROJECT SUMMARY

Project:	**Daly City RW Pre-Design: Salem Configuration**	**Estimate Class:**	**4**
Client:	**North Dan Mateo County Sanitation District**	**PIC:**	**MJB**
Location:	**Daly City, CA**	**PM:**	**DGB**
Zip Code:	**94014**	**Date:**	**January 30, 2017**
Carollo Job #	**10076A.10**	**By:**	**EC**
		Reviewed:	**DGB**

NO.	DESCRIPTION			TOTAL
01	Transmission Pipeline			$3,546,000
02	Pump Station at WWTP			$503,000
03	Storage Tank			$4,107,000
04	Distribution System			$8,004,000
05	Distribution System Pump Station			$598,000
		TOTAL DIRECT COST		**$16,758,000**
	Contingency		30.0%	$5,027,000
		Subtotal		**$21,785,000**
	General Contractor Overhead, Profit & Risk		12.0%	$2,614,000
		Subtotal		**$24,399,000**
	Escalation to Mid-Point		12.6%	$3,079,000
		Subtotal		**$27,478,000**
	Sales Tax (Applied to 50% Total Direct Cost)		9.0%	$754,000
		Subtotal		**$28,232,000**
	General Conditions		12.0%	$3,388,000
	TOTAL ESTIMATED CONSTRUCTION COST			**$31,620,000**
	Engineering, Legal & Administration Fees		20.0%	$6,324,000
	Owner's Reserve for Change Orders		5.0%	$1,581,000
	TOTAL ESTIMATED PROJECT COST			**$39,525,000**

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Salem Configuration
Client: North Dan Mateo County Sanitation District
Date : January 30, 2017
Location: Daly City, CA
By : EC
Element: 01 Transmission Pipeline
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 15 - Mechanical					
15000	14" DI Pipe Finished	16052	LF	$215.85	$3,464,965	
15000	16" DI Pipe Finished	319	LF	$244.24	$77,937	
15000	12" DI Pipe Finished	15	LF	$194.36	$2,972	
	Total					**$3,545,874**
	Grand Total					**$3,545,874**

Engineers...Working Wonders With Water®

DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Salem Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 02 Pump Station at WWTP

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02260	Sheet Piling, 27#/Sf To 20' Deep, Driven, Pulled & Salvaged (Pits Only)	1,881.00	SF	$47.13	$88,646	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	492.56	CY	$2.08	$1,024	
02300	20 Cy Dump Truck, 30 Miles/Round Trip	492.56	CY	$14.02	$6,905	
02300	Imported Pipe Bed & Zone/Confined Structure Backfill, Class B Material	129.56	CY	$88.36	$11,448	
	Total					**$108,023**
	Division 03 - Concrete					
03300	18" Edge Forms, Slab On Grade, Add	98.00	LF	$26.19	$2,567	
03300	18" Structural Flat Mat On Grade	33.00	CY	$549.30	$18,127	
03300	12" Straight Wall >8' High	52.22	CY	$1,172.98	$61,253	
03300	8" Straight Wall, To 8' High	2.47	CY	$1,649.14	$4,073	
03300	12" Elevated Slab To 20'	33.00	CY	$553.50	$18,265	
	Total					**$104,285**
	Division 15 - Mechanical					
15000	Pump at treatment plant	3	EA	$47,834.00	$143,502	
15112	12" 150# Fxf Awwa Butterfly Valve, No Op	3.00	EA	$3,669.84	$11,010	
15114	12"- 200 Psi Ci Fxf Swing Check Valve	3.00	EA	$8,565.04	$25,695	
15119	Air/Vac Valve, 150# Flange, 12"	3.00	EA	$8,457.66	$25,373	
15121	14" Flex Cplg, Above Ground	1.00	EA	$1,880.05	$1,880	
15121	12" Flex Cplg, Above Ground	3.00	EA	$1,635.24	$4,906	
15251	14"X12" Cldi Flg Rdcg Tee In Place	3.00	EA	$5,884.41	$17,653	
15251	14" 90° 125# Cldi Fxf Ell	2.00	EA	$4,689.68	$9,379	
15251	14" Flg Cldi Pipe In Bldg	20.00	LF	$208.75	$4,175	
15251	12" Flg Cldi Pipe In Bldg	9.00	LF	$171.61	$1,544	
	Total					**$245,118**
	Division 17 - Instrumentation and Controls					
17000	I&C Adder	1	LS	$45,742.58	$45,743	
	Total					**$45,743**
	Grand Total					**$503,168**

Carollo Engineers...Working Wonders With Water®

DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Salem Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 03 Storage Tank

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02000	Shoring System with internal bracing	1	LS	$600,000.00	$600,000	
02300	Topsoil Strip & Stockpile On Site, To 1000 Cy	753.70	CY	$8.99	$6,776	
02300	Replace Topsoil To 1000 Cy (From Stockpile)	753.70	CY	$18.89	$14,240	
02300	Stripping & Stockpiling Equip. Move-On Cost	1.00	LS	$3,060.68	$3,061	
02300	Remove Grass & Shrubs Medium Density, 2" Depth To 1 Acre	20,350.00	SF	$.04	$722	
02300	Clearing & Grubbing Equipment Move-On Cost	1.00	LS	$1,761.82	$1,762	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	25,601.85	CY	$2.08	$53,238	
02300	10 Cy Dump Truck, 20 Miles/Round Trip	15,938.89	CY	$17.87	$284,881	
02300	Native Trench Backfill/Unconfined Struct. Bf, Class B Material	9,662.96	CY	$20.83	$201,287	
	Total					**$1,165,967**
	Division 03 - Concrete					
03300	30" Straight Wall >8' High	557.33	CY	$686.44	$382,572	
03300	30" Straight Wall >8' High	1063.33	CY	$686.44	$729,908	
03300	24" X 24" Square Column/Pier	260.94	CY	$1,501.21	$391,725	
03300	42" Structural Flat Mat On Grade	1607.41	CY	$578.15	$929,325	
03300	22" W X 42" D Conc Beam	145.83	CY	$1,381.24	$201,426	
03300	12" Elevated Slab, 33'-38' High	425.04	CY	$694.09	$295,016	
	Total					**$2,929,972**
	Division 05 - Metals					
05500	Fixed Aluminum Ladder - No Safety Cage	66.00	VLF	$119.85	$7,910	
	Total					**$7,910**
	Division 07 - Thermal and Moisture					
07700	2'-6" X 4'-6" Roof Hatch & Curb, All Aluminum	1.00	EA	$2,129.26	$2,129	
07700	3'-0" X 2'-6" Roof Hatch & Curb, All Aluminum	1.00	EA	$1,449.08	$1,449	
	Total					**$3,578**
	Grand Total					**$4,107,427**

DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Salem Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 04 Distribution System

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02260	Sheet Piling, 38#/Sf To 25' Deep, Driven, Pulled & Salvaged (Pits Only)	336	SF	$46.02	$15,464	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	18.67	CY	$2.08	$39	
02300	20 Cy Dump Truck, 30 Miles/Round Trip	18.67	CY	$14.02	$262	
	Total					**$15,765**
	Division 03 - Concrete					
03300	12" Edge Forms, Flat Mat On Grade, Add	48	LF	$14.88	$714	
03300	12" Structural Flat Mat On Grade	2.67	CY	$816.40	$2,180	
03300	12" Straight Wall, To 8' High	6.22	CY	$1,325.17	$8,243	
03300	12" Straight Wall, To 8' High	4.15	CY	$1,325.17	$5,499	
	Total					**$16,636**
	Division 05 - Metals					
05500	Fixed Galv. Steel Ladder - No Safety Cage	28	VLF	$101.85	$2,852	
05500	Galvanized Steel Pit Frame & Cover	64	SF	$35.09	$2,246	
	Total					**$5,097**
	Division 11 - Equipment					
11000	Booster Pump	2	EA	$30,600.00	$61,200	
11000	Hydro-pneumatic tank	2	EA	$6,600.00	$13,200	
	Total					**$74,400**
	Division 15 - Mechanical					
15000	12" DI Pipe Finished	2534	LF	$194.36	$492,424	
15000	2" PVC Pipe Finished	1743	LF	$163.38	$284,706	
15000	3" PVC Pipe Finished	219	LF	$165.41	$36,215	
15000	14" DI Pipe Finished	11248	LF	$215.85	$2,427,887	
15000	16" DI Pipe Finished	448	LF	$244.24	$109,303	
15000	4" DI Pipe Finished	9599	LF	$169.01	$1,622,353	
15000	6" DI Pipe Finished	4520	LF	$174.85	$790,388	
15000	8" DI Pipe Finished	8314	LF	$181.50	$1,508,970	
15000	10" DI Pipe Finished	512	LF	$188.15	$96,271	
15000	1.5" PVC Pipe Finished	3125	LF	$162.38	$507,478	
15000	1" PVC Pipe Finished	102	LF	$161.39	$16,451	
	Total					**$7,892,446**
	Grand Total					**$8,004,345**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Salem Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 05 Distribution System Pump Station

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02742	4" Ac Paving On 8" Abc	111.11	SY	$72.66	$8,073	
	Total					**$8,073**
	Division 04 - Masonry					
04220	Standard Concrete Block, 8"	1320	SF	$21.54	$28,437	
04220	Standard Concrete Block, 8"	680	SF	$21.54	$14,649	
04220	Integral Cmu Color Adder	2000	SF	$1.76	$3,528	
04220	Full Grout (All Cells)	2000	SF	$1.54	$3,087	
04220	Seismic Reinforcement Adder	2000	SF	$1.73	$3,469	
	Total					**$53,170**
	Division 07 - Thermal and Moisture					
07200	2" Composite Roof Insulation	2000	SF	$3.52	$7,032	
07400	Standing Seam 0.032" Aluminum Enameled On Mansard Or Vertical Surface	2000	SF	$22.91	$45,815	
	Total					**$52,847**
	Division 08 - Doors and Windows					
08110	6/0 X 6/8 X 1.75" "B" Label Double Hollow Metal Door W/Frame & Hdwre	1	PR	$2,398.88	$2,399	
	Total					**$2,399**
	Division 15 - Mechanical					
15000	In field pumps El Camino	2	EA	$63,400.00	$126,800	
15000	In field pumps Hillside	2	EA	$108,400.00	$216,800	
	Total					**$343,600**
	Division 16 - Electrical					
16000	Electrical Adder In Field Pump Station	1	LS	$138,026.67	$138,027	
	Total					**$138,027**
	Grand Total					**$598,116**

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PROJECT SUMMARY

Project:	**Daly City RW Pre-Design: Holy Cross Configuration**	**Estimate Class:**	**4**
Client:	**North Dan Mateo County Sanitation District**	**PIC:**	**MJB**
Location:	**Daly City, CA**	**PM:**	**DGB**
Zip Code:	**94014**	**Date:**	**January 30, 2017**
Carollo Job #	**10076A.10**	**By:**	**EC**
		Reviewed:	**DGB**

NO.	DESCRIPTION			TOTAL
01	Transmission Pipeline			$3,599,000
02	Pump Station at WWTP			$562,000
03	Storage Tank			$2,431,000
04	Distribution System			$6,748,000
05	Distribution System Pump Station			$0
		TOTAL DIRECT COST		**$13,340,000**
	Contingency		30.0%	$4,002,000
		Subtotal		**$17,342,000**
	General Contractor Overhead, Profit & Risk		12.0%	$2,081,000
		Subtotal		**$19,423,000**
	Escalation to Mid-Point		12.6%	$2,451,000
		Subtotal		**$21,874,000**
	Sales Tax (Applied to 50% Total Direct Cost)		9.0%	$600,000
		Subtotal		**$22,474,000**
	General Conditions		12.0%	$2,697,000
	TOTAL ESTIMATED CONSTRUCTION COST			**$25,171,000**
	Engineering, Legal & Administration Fees		20.0%	$5,034,000
	Owner's Reserve for Change Orders		5.0%	$1,259,000
	TOTAL ESTIMATED PROJECT COST			**$31,464,000**

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Holy Cross Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 01 Transmission Pipeline

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 15 - Mechanical					
15000	14" DI Pipe Finished	16313	LF	$215.85	$3,521,307	
15000	16" DI Pipe Finished	319	LF	$244.24	$77,937	
	Total					**$3,599,244**
	Grand Total					**$3,599,244**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Holy Cross Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 02 Pump Station at WWTP

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02260	Sheet Piling, 27#/Sf To 20' Deep, Driven, Pulled & Salvaged (Pits Only)	1,881.00	SF	$47.13	$88,646	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	492.56	CY	$2.08	$1,024	
02300	20 Cy Dump Truck, 30 Miles/Round Trip	492.56	CY	$14.02	$6,905	
02300	Imported Pipe Bed & Zone/Confined Structure Backfill, Class B Material	129.56	CY	$88.36	$11,448	
	Total					**$108,023**
	Division 03 - Concrete					
03300	18" Edge Forms, Slab On Grade, Add	98.00	LF	$26.19	$2,567	
03300	18" Structural Flat Mat On Grade	33.00	CY	$549.30	$18,127	
03300	12" Straight Wall >8' High	52.22	CY	$1,172.98	$61,253	
03300	8" Straight Wall, To 8' High	2.47	CY	$1,649.14	$4,073	
03300	12" Elevated Slab To 20'	33.00	CY	$553.50	$18,265	
	Total					**$104,285**
	Division 15 - Mechanical					
15000	Pumps at Treatment Plant	3	EA	$65,734.00	$197,202	
15112	12" 150# Fxf Awwa Butterfly Valve, No Op	3.00	EA	$3,669.84	$11,010	
15114	12"- 200 Psi Ci Fxf Swing Check Valve	3.00	EA	$8,565.04	$25,695	
15119	Air/Vac Valve, 150# Flange, 12"	3.00	EA	$8,457.66	$25,373	
15121	14" Flex Cplg, Above Ground	1.00	EA	$1,880.05	$1,880	
15121	12" Flex Cplg, Above Ground	3.00	EA	$1,635.24	$4,906	
15251	12" Flg Cldi Pipe In Bldg	9.00	LF	$171.61	$1,544	
15251	14" Flg Cldi Pipe In Bldg	20.00	LF	$208.75	$4,175	
15251	14"X12" Cldi Flg Rdcg Tee In Place	3.00	EA	$5,884.41	$17,653	
15251	14" 90° 125# Cldi Fxf Ell	2.00	EA	$4,689.68	$9,379	
	Total					**$298,818**
	Division 17 - Instrumentation and Controls					
17000	I&C Adder	1	LS	$51,112.58	$51,113	
	Total					**$51,113**
	Grand Total					**$562,238**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Holy Cross Configuration
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 03 Storage Tank

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02300	Topsoil Strip & Stockpile On Site, To 1000 Cy	279.89	CY	$8.99	$2,516	
02300	Replace Topsoil To 1000 Cy (From Stockpile)	279.89	CY	$18.89	$5,288	
02300	Stripping & Stockpiling Equip. Move-On Cost	1.00	LS	$3,060.68	$3,061	
02300	Remove Grass & Shrubs Medium Density, 2" Depth To 1 Acre	19,731.02	SF	$.04	$700	
02300	Clearing & Grubbing Equipment Move-On Cost	1.00	LS	$1,761.82	$1,762	
02300	10 Cy Dump Truck, 20 Miles/Round Trip	450.89	CY	$17.87	$8,059	
02300	Native Trench Backfill/Unconfined Struct. Bf, Class B Material	450.89	CY	$20.83	$9,392	
	Total					**$30,779**
	Division 03 - Concrete					
03000	Prestressed Concrete Tank	1.00	LS	$2,400,000.00	$2,400,000	
	Total					**$2,400,000**
	Grand Total					**$2,430,779**

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DETAILED COST ESTIMATE

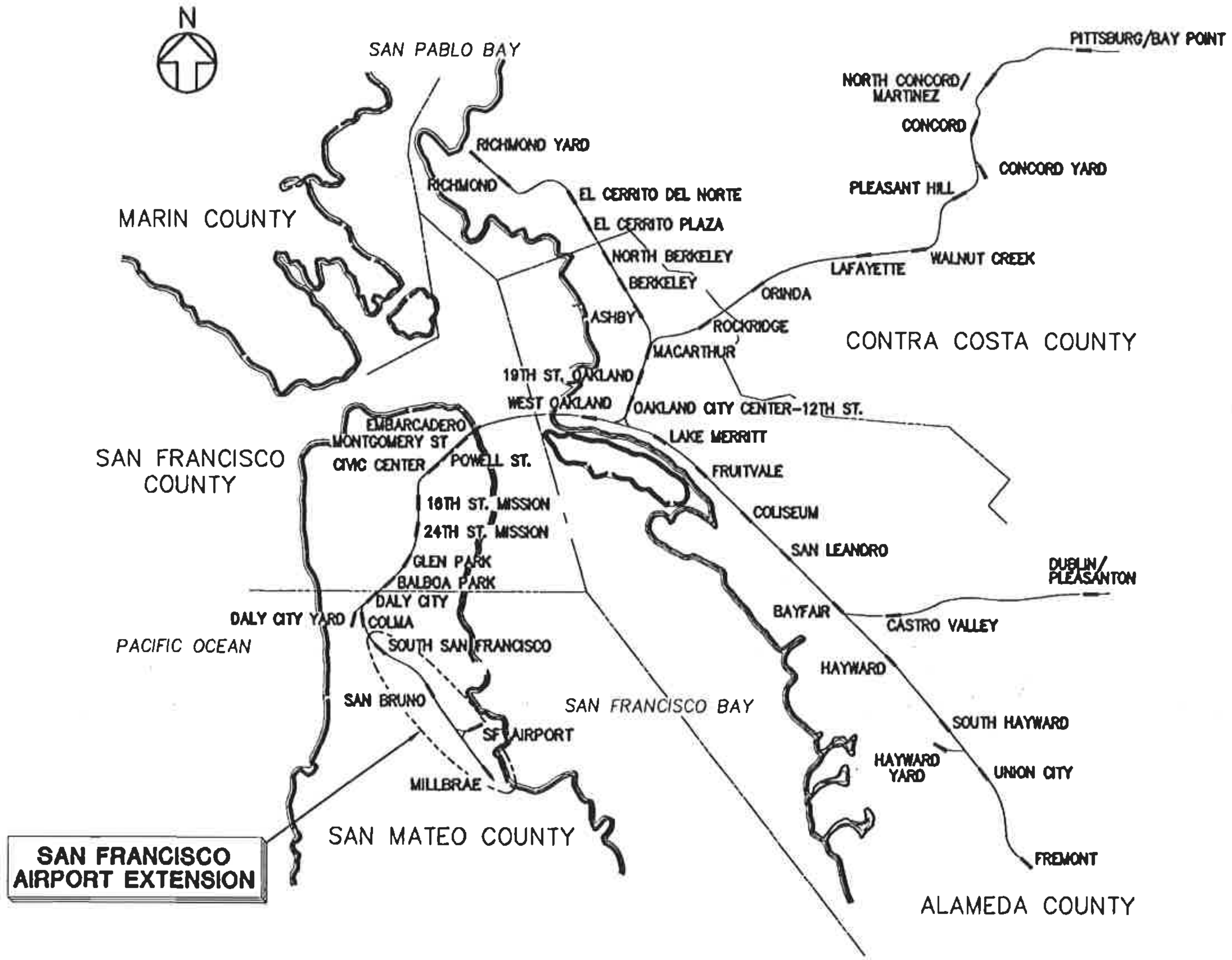
Project: Daly City RW Pre-Design: Holy Cross
Client: North Dan Mateo County Sanitation District
Location: Daly City, CA
Element: 04 Distribution System

Date : January 30, 2017
By : EC
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 15 - Mechanical					
15000	14" DI Pipe Finished	8515	LF	$215.85	$1,837,936	
15000	10" DI Pipe Finished	203	LF	$188.15	$38,283	
15000	4" DI Pipe Finished	9617	LF	$169.01	$1,625,434	
15000	12" DI Pipe Finished	2534	LF	$194.36	$492,424	
15000	18" DI Pipe Finished	194	LF	$265.59	$51,656	
15000	1.5" PVC Pipe Finished	3125	LF	$162.38	$507,478	
15000	1" PVC Pipe Finished	102	LF	$161.39	$16,451	
15000	8" DI Pipe Finished	5741	LF	$181.50	$1,041,909	
15000	6" DI Pipe Finished	4565	LF	$174.85	$798,251	
15000	3" PVC Pipe Finished	219	LF	$165.41	$36,215	
15000	2" PVC Pipe Finished	1743	LF	$163.38	$284,706	
15118	3" Rdc Pressure Bf Preventer Assy W/Relief Valve	3	EA	$5,620.21	$16,861	
	Total					**$6,747,604**
	Grand Total					**$6,747,604**

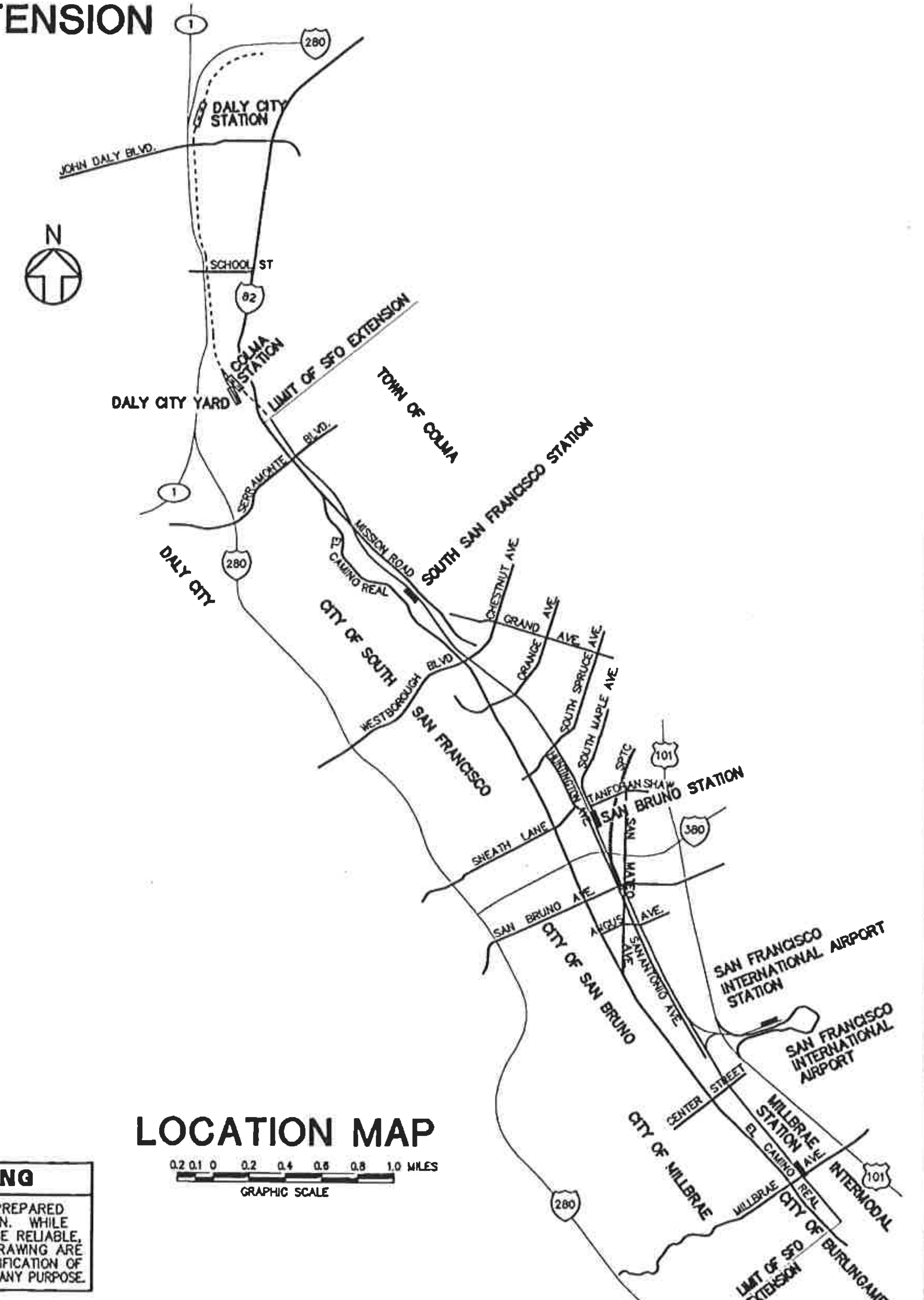
APPENDIX B – BART RECORD DRAWINGS REVIEW

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT
SAN FRANCISCO AIRPORT EXTENSION



KEY PLAN

2 1 0 2 4 6 8 10 MILES
GRAPHIC SCALE



LOCATION MAP

0.2 0.1 0 0.2 0.4 0.6 0.8 1.0 MILES
GRAPHIC SCALE

RECORD DRAWING

THIS RECORD DRAWING HAS BEEN PREPARED BASED UPON AS-BUILT INFORMATION. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, THOSE RELYING ON THIS RECORD DRAWING ARE ADVISED TO OBTAIN INDEPENDENT VERIFICATION OF ITS ACCURACY BEFORE APPLYING IT FOR ANY PURPOSE.

REV	DATE	BY	SUB	APP	DESCRIPTION
1	31MY03	[signature]	[signature]	[signature]	RECORD DRAWING
0	29SE98				ISSUED FOR CONSTRUCTION

REV	DATE	BY	SUB	APP	DESCRIPTION

DESIGNED BY R. MCFARLAND
DRAWN BY G. OW-YANG
CHECKED BY S. WHITAKER
IN CHARGE S. WHITAKER
DATE 31MY2003

ORIGINAL DRAWING BEARS THE REGISTERED PROFESSIONAL ENGINEER SEAL No. C21792 AND SIGNATURE OF: R. L. MCFARLAND

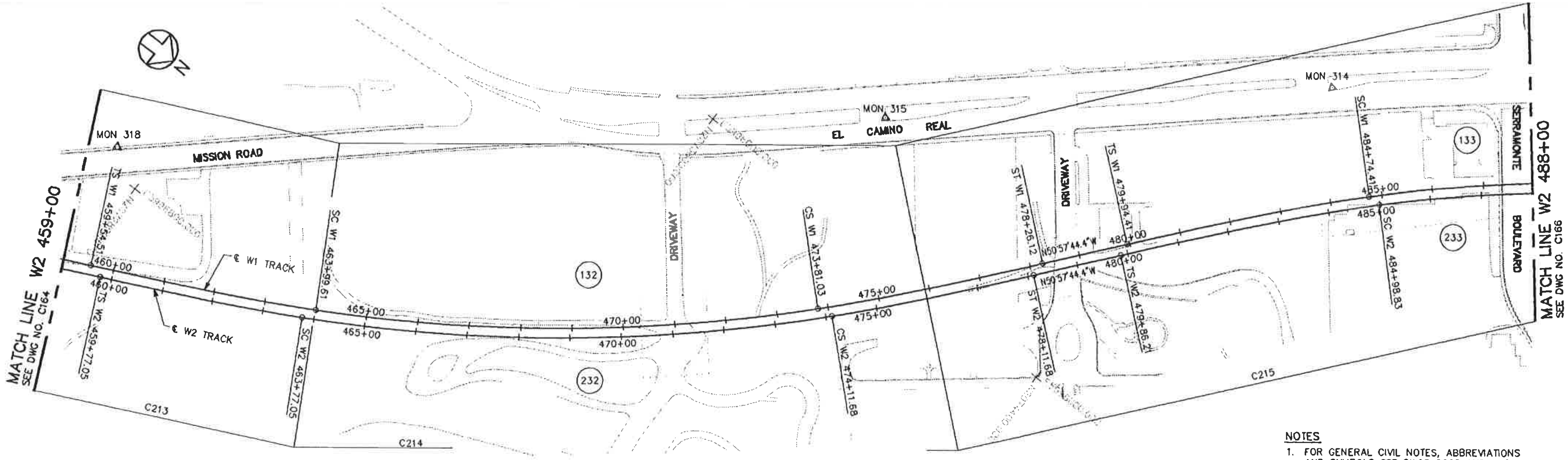
SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

HNTB CORPORATION — SUBMITTED ORIGINAL SIGNED BY: S. A. WHITAKER

TUTOR-SALIBA/SLATTERY — APPROVED ORIGINAL SIGNED BY: E. D. RITCHIE

SAN FRANCISCO AIRPORT EXTENSION LINE, TRACKWORK, AND SYSTEMS
TITLE SHEET
VOLUME 1 OF 13

CADD FILE NO W1AX0011 | CADD DATE 14MY2003
SCALE AS NOTED
CONTRACT NUMBER 12YC-120 | ACTIVITY CODE
DWG NO 1AX001 | REV 1 | PAGE NO /



NOTES
1. FOR GENERAL CIVIL NOTES, ABBREVIATIONS AND SYMBOLS SEE DWGS C002 AND C003.

LINE/ CURVE NO	POINTS	STATION	COORDINATE NORTH	COORDINATE EAST	CURVE DATA			SPEED (MPH)		SUPER ELEVATION (IN)	UNBALANCE (IN)	REMARKS
W2 TRACK (232)	TS SC PI CS ST	W2 459+77.05 W2 463+77.05 W2 474+11.68 W2 478+11.68	2072850.916 2073207.316 2073687.656 2074014.904 2074273.077	5996974.217 5996792.762 5996569.475 5996152.951 5995847.512	Δ = 25°08'55.2" Ls1 = 400.000 P1 = 2.039 Δc = 18°08'12.4" Ls2 = 400.000 P2 = 2.039	Ts1 = 929.489 θs1 = 03°30'21.4" K1 = 199.975 Rc = 3268.500 θs2 = 03°30'21.4" K2 = 199.975	Ts2 = 929.489 Xs1 = 399.850 Ys1 = 8.157 Lc = 1034.633 Xs2 = 399.850 Ys2 = 8.157	DESIGN SPEED OPERATING SPEEDS MAXIMUM MINIMUM	80 67.3 52.7	5.00 5.00 5.00	4.11 1.44 −1.05	
W1 TRACK (132)	TS SC PI CS ST	W1 459+54.51 W1 463+99.61 W1 473+81.03 W1 478+26.12	2072822.791 2073218.859 2073676.204 2073985.200 2074273.290	5996967.827 5996764.962 5996555.020 5996157.829 5995818.670	Δ = 25°08'55.2" Ls1 = 445.091 P1 = 2.539 Δc = 17°18'06.9" Ls2 = 445.092 P2 = 2.539	Ts1 = 948.010 θs1 = 03°55'24.1" K1 = 222.511 Rc = 3250.000 θs2 = 03°55'24.1" K2 = 222.511	Ts2 = 948.010 Xs1 = 444.883 Ys1 = 10.156 Lc = 981.421 Xs2 = 444.883 Ys2 = 10.156	DESIGN SPEED OPERATING SPEEDS MAXIMUM MINIMUM	80 77.3 67.3	5.25 5.25 5.25	3.91 3.30 1.23	
W2 TRACK (233)	TS SC PI CS ST	W2 479+86.21 W2 484+98.83 W2 488+53.57 W2 493+66.19	2074383.000 2074717.648 2074820.083 2074980.442 2075399.760	5995711.951 5995323.878 5995172.924 5995085.947 5994791.392	Δ = 17°36'36.8" Ls1 = 512.623 P1 = 3.879 Δc = 07°12'08.3" Ls2 = 512.623 P2 = 3.879	Ts1 = 693.968 θs1 = 05°12'14.2" K1 = 256.241 Rc = 2822.000 θs2 = 05°12'14.2" K2 = 256.241	Ts2 = 693.968 Xs1 = 512.200 Ys1 = 15.511 Lc = 354.736 Xs2 = 512.200 Ys2 = 15.511	DESIGN SPEED OPERATING SPEEDS MAXIMUM MINIMUM	80 69.6 47.3	6.25 6.25 6.25	4.30 1.73 −2.56	
W1 TRACK (133)	TS SC PI CS ST	W1 479+94.41 W1 484+74.41 W1 488+67.45 W1 493+47.45	2074379.284 2074691.882 2074807.858 2074983.017 2075376.250	5995687.955 5995323.900 5995159.421 5995060.311 5994785.317	Δ = 17°36'36.8" Ls1 = 480.000 P1 = 3.379 Δc = 07°55'41.2" Ls2 = 480.000 P2 = 3.379	Ts1 = 680.458 θs1 = 04°50'27.8" K1 = 239.943 Rc = 2840.500 θs2 = 04°50'27.8" K2 = 239.943	Ts2 = 680.458 Xs1 = 479.657 Ys1 = 13.512 Lc = 393.045 Xs2 = 479.657 Ys2 = 13.512	DESIGN SPEED OPERATING SPEEDS MAXIMUM MINIMUM	80 77.3 47.3	6.00 6.00 6.00	4.48 3.78 −2.34	

RECORD DRAWING

THIS RECORD DRAWING HAS BEEN PREPARED BASED UPON AS-BUILT INFORMATION. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, THOSE RELYING ON THIS RECORD DRAWING ARE ADVISED TO OBTAIN INDEPENDENT VERIFICATION OF ITS ACCURACY BEFORE APPLYING IT FOR ANY PURPOSE.

REV	DATE	BY	SUB	APP	DESCRIPTION
0	15MR04				RECORD DRAWING
E	20FE98				CONFORMED

THE AS-BUILT INFORMATION USED TO PREPARE THIS DRAWING WAS FURNISHED BY THE 12YC-120 DESIGN-BUILD CONTRACTOR

DESIGNED BY C. KONG
DRAWN BY C. KONG
CHECKED BY G. LUSHEROVICH
IN CHARGE G. HOLIT
DATE 12JN1997

ORIGINAL DRAWING BEARS THE REGISTERED PROFESSIONAL ENGINEER SEAL No. C15652 AND SIGNATURE OF: GERT EUGENE HOLT

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

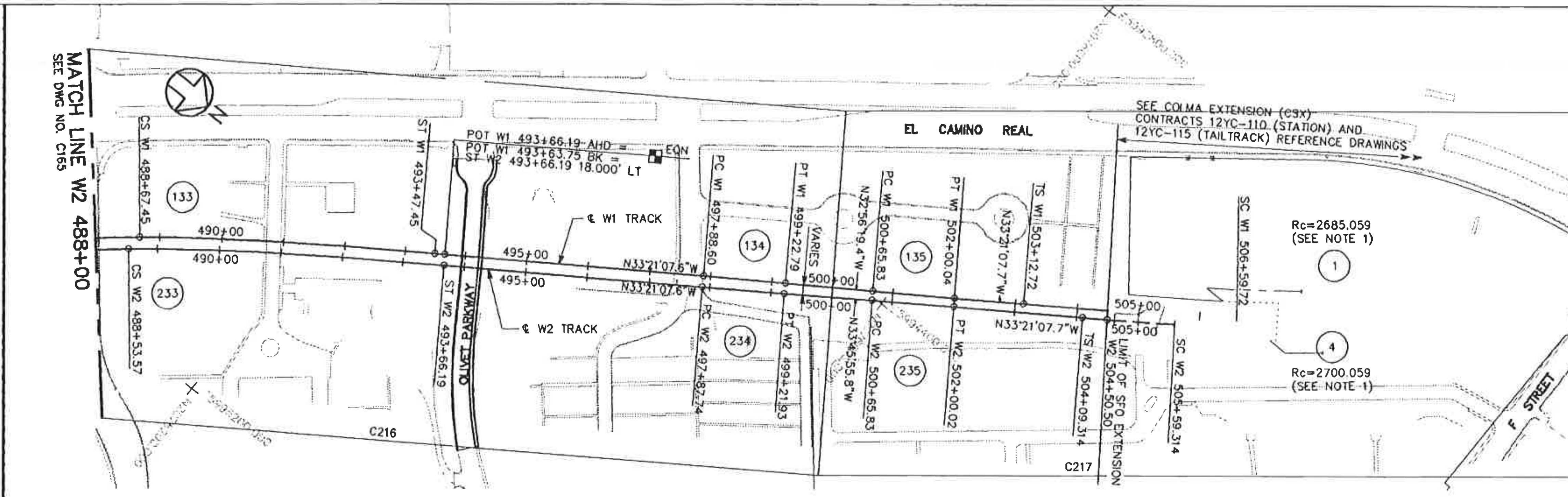
BAY AREA TRANSIT CONSULTANTS
BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
SUBMITTED ORIGINAL SIGNED BY: BALRAM M. BHANDARI

BAY AREA TRANSIT CONSULTANTS
BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
APPROVED ORIGINAL SIGNED BY: ASHOK KOTHARI

SAN FRANCISCO AIRPORT EXTENSION LINE, TRACKWORK, AND SYSTEMS

ALIGNMENT PLAN AND DATA
W2 459+00 TO W2 488+00

CADD FILE NO WFA0C165
CADD DATE 05MR2004
SCALE 1"=100'
CONTRACT NUMBER 12YC-120
ACTIVITY CODE
DWG NO C165
REV 0
PAGE NO 26



RECORD DRAWING

THIS RECORD DRAWING HAS BEEN PREPARED BASED UPON AS-BUILT INFORMATION. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, THOSE RELYING ON THIS RECORD DRAWING ARE ADVISED TO OBTAIN INDEPENDENT VERIFICATION OF ITS ACCURACY BEFORE APPLYING IT FOR ANY PURPOSE.

LINE/ CURVE NO	POINTS	STATION	COORDINATE NORTH	COORDINATE EAST	CURVE DATA	SPEED (MPH)		SUPER ELEVATION (IN)	UNBALANCE (IN)	REMARKS
W1 TRACK W2 TRACK	POT POT ST	W1 493+66.19 AH= W1 493+63.75 BK= W2 493+66.19 18.000' LT	2075389.864 2075399.760	5994776.357 5994791.392						EQUATION
W2 TRACK (234)	PC PI PT	W2 497+87.74 W2 499+21.93	2075751.878 2075807.926 2075863.707	5994559.635 5994522.745 5994485.452	△ = 00°24'48.2" T = 67.099 Rc = 18600.000 Lc = 134.197	DESIGN SPEED	80	0	1.60	
						OPERATING SPEEDS				
						MAXIMUM	52.8	0	0.70	
						MINIMUM	47.3	0	0.56	
W1 TRACK (134)	PC PI PT	W1 497+88.60 W1 499+22.79	2075742.702 2075798.750 2075855.063	5994544.125 5994507.236 5994470.751	△ = 00°24'48.2" T = 67.099 Rc = 18600.000 Lc = 134.197	DESIGN SPEED	80	0	1.60	
						OPERATING SPEEDS				
						MAXIMUM	67.3	0	1.13	
						MINIMUM	47.3	0	0.56	
W2 TRACK (235)	PC PI PT	W2 500+65.83 W2 502+00.02	2075983.331 2076039.107 2076095.150	5994405.475 5994368.185 5994331.298	△ = 00°24'48.1" T = 67.093 Rc = 18600.000 Lc = 134.186	DESIGN SPEED	80	0	1.60	
						OPERATING SPEEDS				
						MAXIMUM	47.3	0	0.56	
						MINIMUM	47.3	0	0.56	
W2 TRACK	POS	W2 504+50.50								END W2 TRACK
W1 TRACK (135)	PC PI PT	W1 500+65.83 W1 502+00.04	2075975.110 2076031.427 2076087.478	5994392.974 5994356.487 5994319.595	△ = 00°24'48.3" T = 67.103 Rc = 18600.000 Lc = 134.206	DESIGN SPEED	80	0	1.60	
						OPERATING SPEEDS				
						MAXIMUM	67.3	0	1.13	
						MINIMUM	47.3	0	0.56	
W1 TRACK (1)	TS SC PI1-W1 CS ST	W1 503+12.773 W1 506+59.773 W1 509+85.784 W1 512+85.784	2076181.598 2076467.221 2076597.650 2076714.848 2076922.671	5994257.647 5994060.711 5993983.810 5993848.972 5993632.674	△ = 13°51'35" Ts1 = 498.082' Ts2 = 478.472' Ls1 = 347.000' θs1 = 03°42'00" Xs1 = 346.855' P1 = 1.868' K1 = 173.476' Ys1 = 7.472' △c = 06°57'24" Rc = 2685.059' Lc = 326.011' Ls2 = 300.000' θs2 = 03°12'03" Xs2 = 299.906' P2 = 1.396' K2 = 149.984' Ys2 = 5.585'	DESIGN SPEED	70	4.00	4.49	SEE NOTE 1
						OPERATING SPEEDS				
						MAXIMUM	67.3	4.00	3.84	
						MINIMUM	33.3	4.00	-2.08	
W1 TRACK	POS	W1 504+72.05								END W1 TRACK
W2 TRACK (4)	TS SC PI1-W2 CS ST	W4 504+09.314 W1 505+59.314 W2 510+62.450 W2 512+12.450	2076269.982 2076394.505 2076606.787 2076777.778 2076880.685	5994216.227 5994132.606 5993994.549 5993807.774 5993698.643	△ = 13°51'35" Ts1 = 403.212' Ts2 = 403.212' Ls1 = 150.000' θs1 = 01°35'29" Xs1 = 149.988' P1 = 0.347' K1 = 74.998' Ys1 = 1.389" △c = 10°40'36" Rc = 2700.059' Lc = 503.136' Ls2 = 150.000' θs2 = 01°35'29" Xs2 = 149.988' P2 = 0.347' K2 = 74.998' Ys2 = 1.389'	DESIGN SPEED	50	2.50	1.81	SEE NOTE 1
						OPERATING SPEEDS				
						MAXIMUM	47.3	2.50	1.35	
						MINIMUM	33.3	2.50	-0.59	

REV	DATE	BY	SUB	APP	DESCRIPTION
0	15MR04				RECORD DRAWING
E	20FE98				CONFORMED

THE AS-BUILT INFORMATION USED TO PREPARE THIS DRAWING WAS FURNISHED BY THE 12YC-120 DESIGN-BUILD CONTRACTOR

DESIGNED BY C. KONG
DRAWN BY C. KONG
CHECKED BY G. LUSHEROVICH
IN CHARGE G. HOLT
DATE 12JN1997

ORIGINAL DRAWING BEARS THE REGISTERED PROFESSIONAL ENGINEER SEAL No. C15652 AND SIGNATURE OF: GERT EUGENE HOLT

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

BAY AREA TRANSIT CONSULTANTS
BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
SUBMITTED ORIGINAL SIGNED BY: BALRAM N. BHANDARI

BAY AREA TRANSIT CONSULTANTS
BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
APPROVED ORIGINAL SIGNED BY: ASHOK KOTHARI

SAN FRANCISCO AIRPORT EXTENSION LINE, TRACKWORK, AND SYSTEMS

ALIGNMENT PLAN AND DATA
W2 488+00 TO W2 504+50.500

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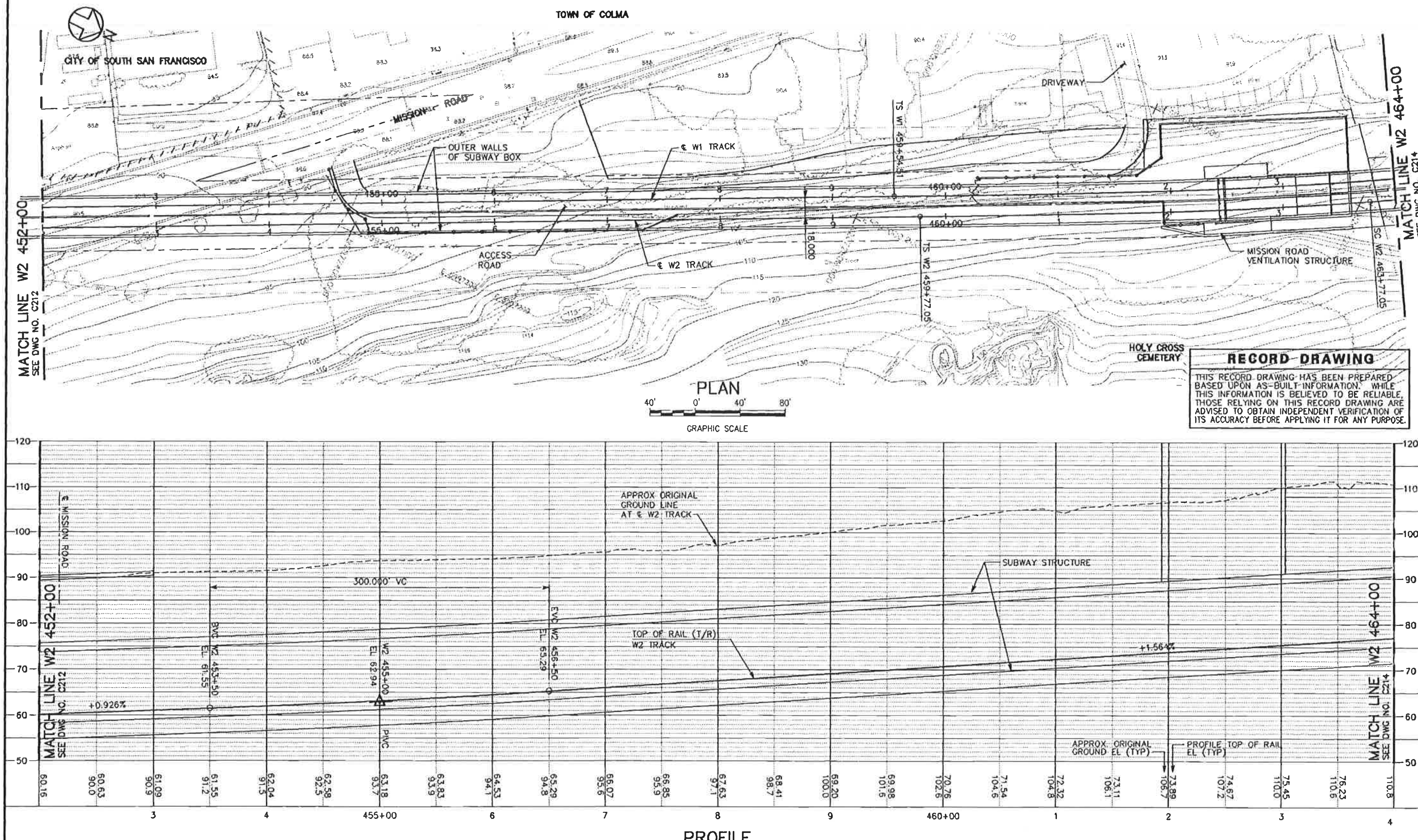

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CHECKED BY G. LUSHEROVICH
IN CHARGE G. HOLIT
DATE 12JUN1997

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SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

BAY AREA TRANSIT CONSULTANTS
BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
SUBMITTED ORIGINAL SIGNED BY: BALRAM M. BHANDARI

BAY AREA TRANSIT CONSULTANTS
BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
APPROVED ORIGINAL SIGNED BY: ASHOK KOTHARI

SAN FRANCISCO AIRPORT EXTENSION LINE, TRACKWORK, AND SYSTEMS

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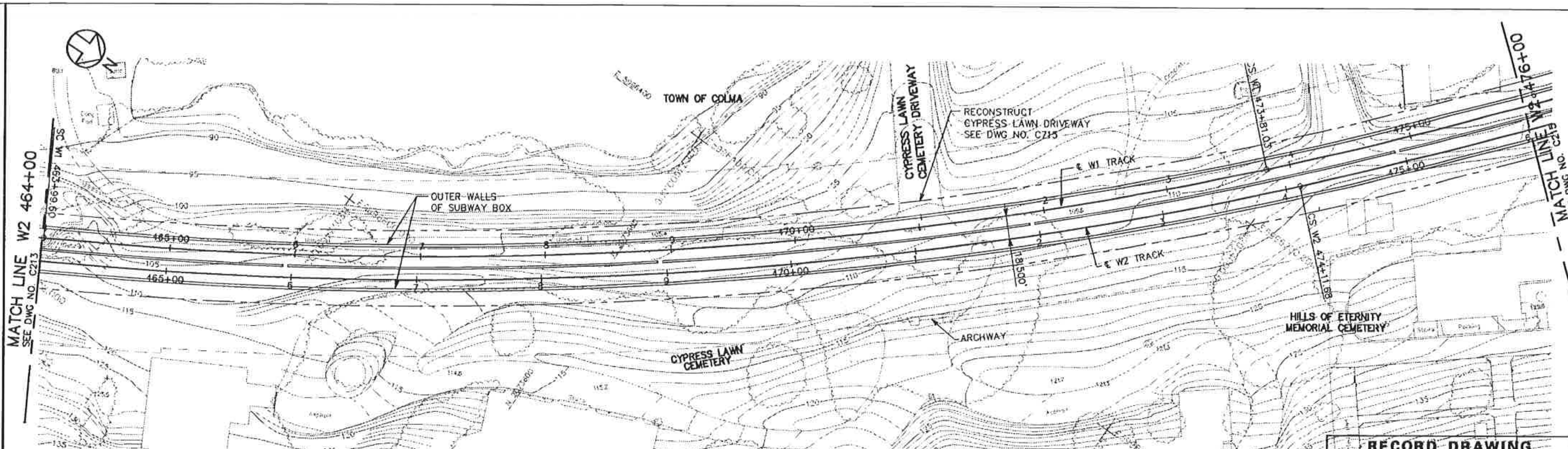

PLAN

40' 0' 40' 80'

GRAPHIC SCALE

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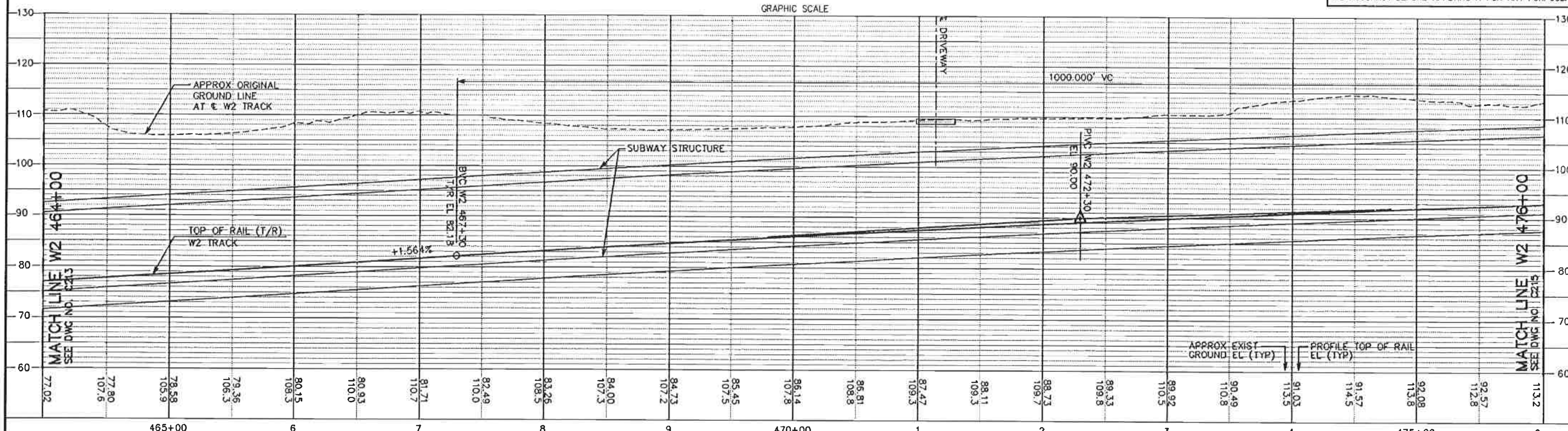

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IN CHARGE G. HOLIT
DATE 12JN1997

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SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

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BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
APPROVED ORIGINAL SIGNED BY: ASHOK KOTHARI

SAN FRANCISCO AIRPORT EXTENSION LINE, TRACKWORK, AND SYSTEMS

PLAN AND PROFILE
W2 464+00 TO W2 476+00

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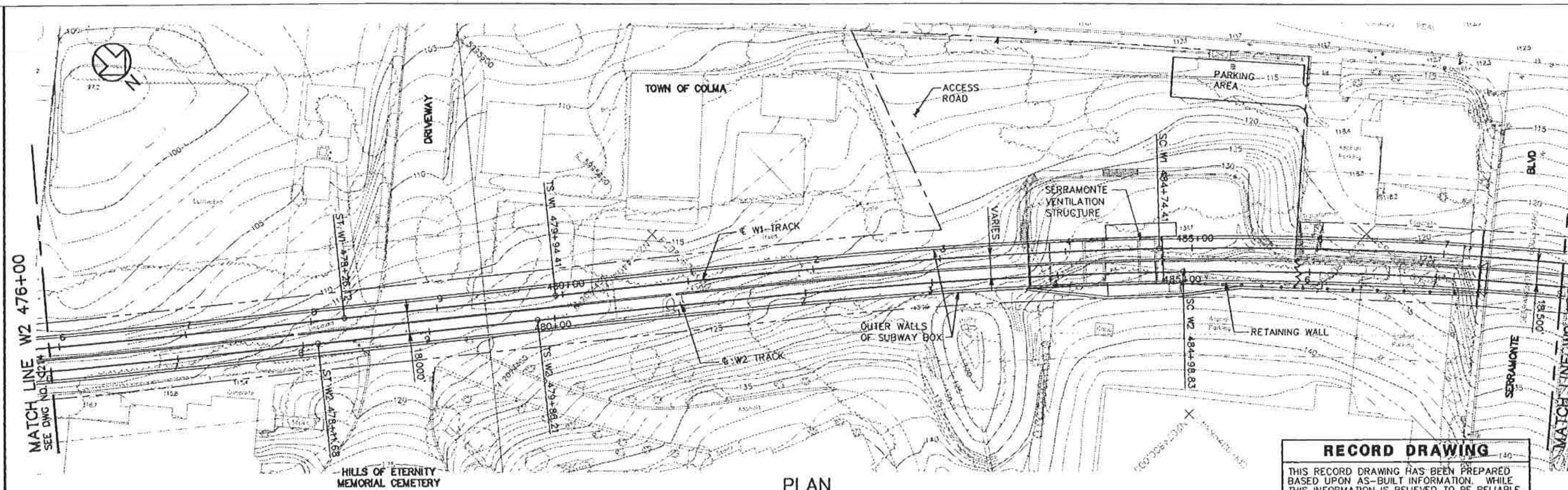

PLAN

40' 0' 40' 80'

GRAPHIC SCALE

RECORD DRAWING

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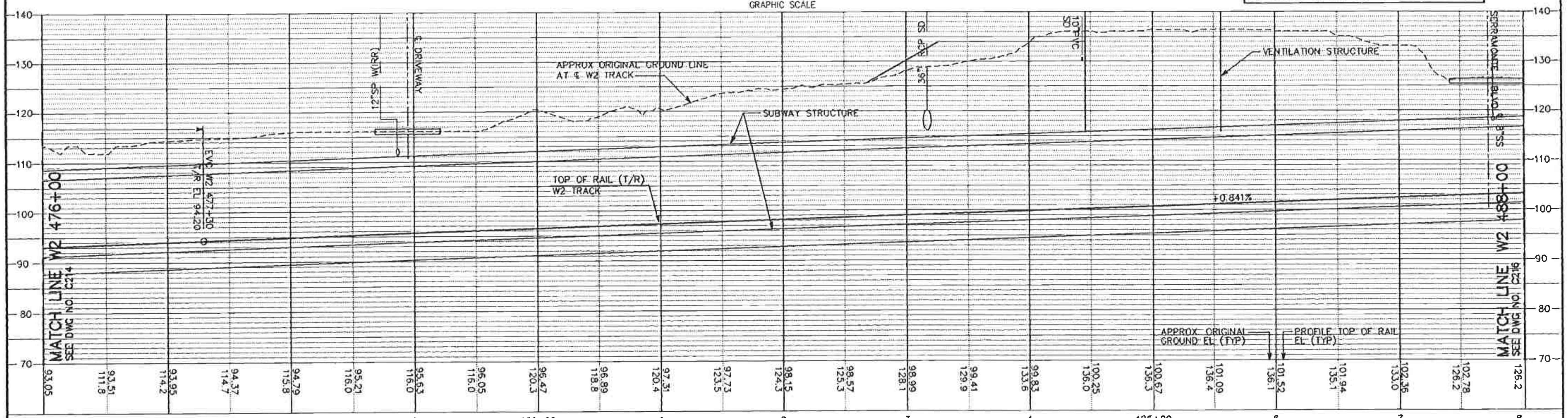

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E	20FE98				CONFORMED

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DESIGNED BY C. KONG
DRAWN BY F. CLINTON
CHECKED BY G. LUSHEROVICH
IN CHARGE G. HOUT
DATE 12JN1997

ORIGINAL DRAWING BEARS THE REGISTERED PROFESSIONAL ENGINEER SEAL No. C15652 AND SIGNATURE OF: GERT EUGENE HOUT

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

BAY AREA TRANSIT CONSULTANTS
BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
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BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
APPROVED ORIGINAL SIGNED BY: ASHOK KOTHARI

SAN FRANCISCO AIRPORT EXTENSION LINE, TRACKWORK, AND SYSTEMS

PLAN AND PROFILE
W2 476+00 TO W2 488+00

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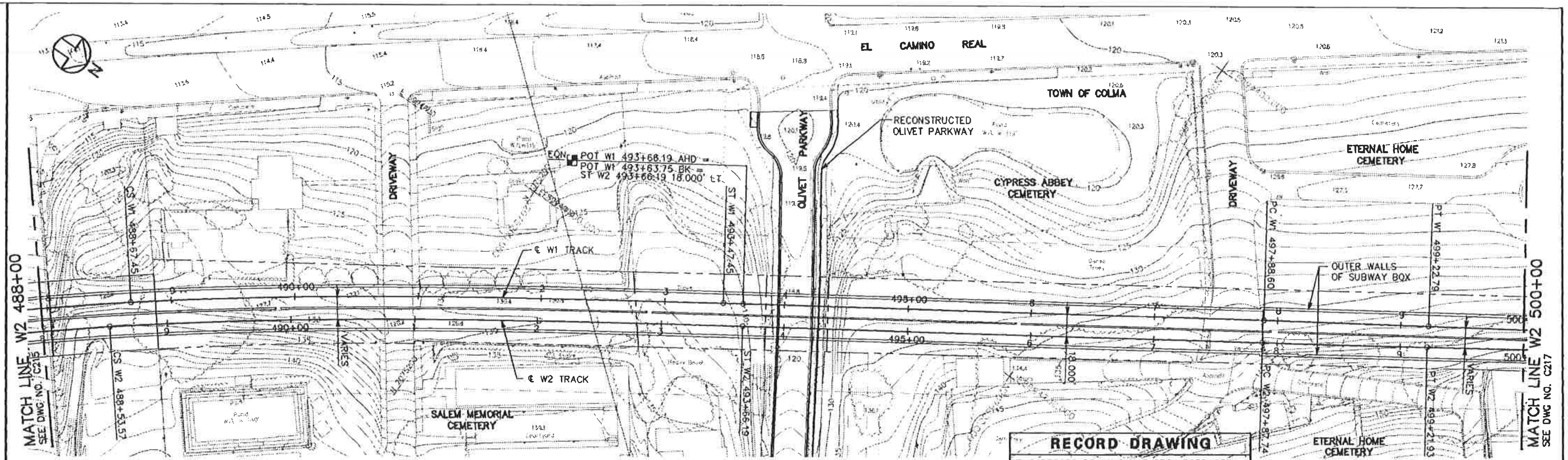

RECORD DRAWING

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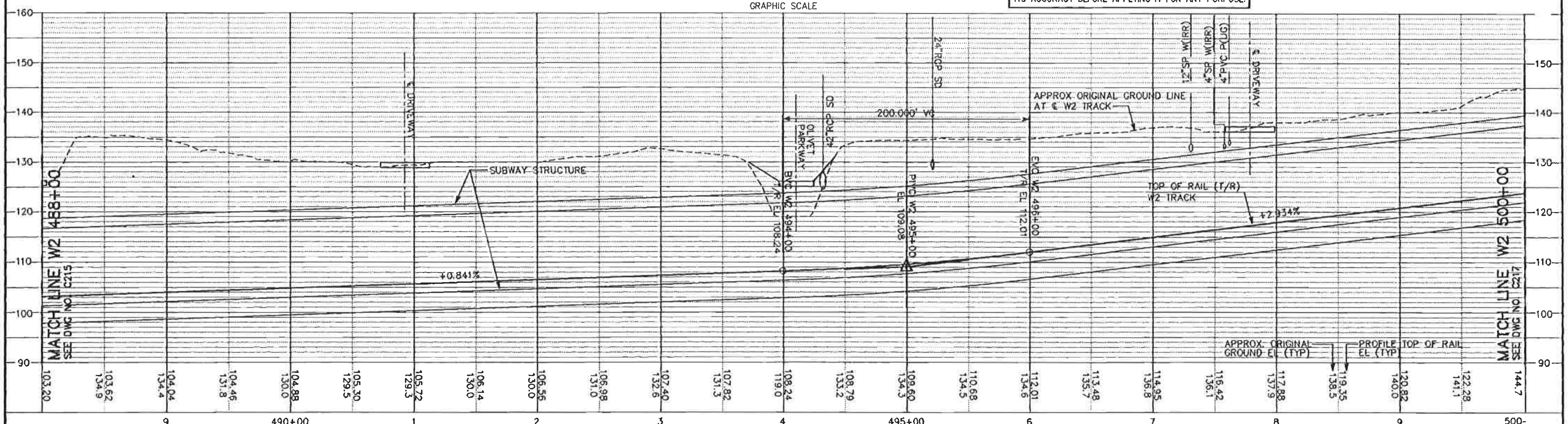
PLAN

40' 0' 40' 80'
GRAPHIC SCALE



PROFILE

REV	DATE	BY	SUB	APP	DESCRIPTION
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E	20FE98				CONFORMED

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IN CHARGE G. HOLIT
DATE 12JN1997

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SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

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BECHTEL-PARSONS BRINCKERHOFF-TODD-WARREN
APPROVED ORIGINAL SIGNED BY: ASHOK KOTHARI

SAN FRANCISCO AIRPORT EXTENSION LINE, TRACKWORK, AND SYSTEMS

PLAN AND PROFILE
W2 488+00 TO W2 500+00

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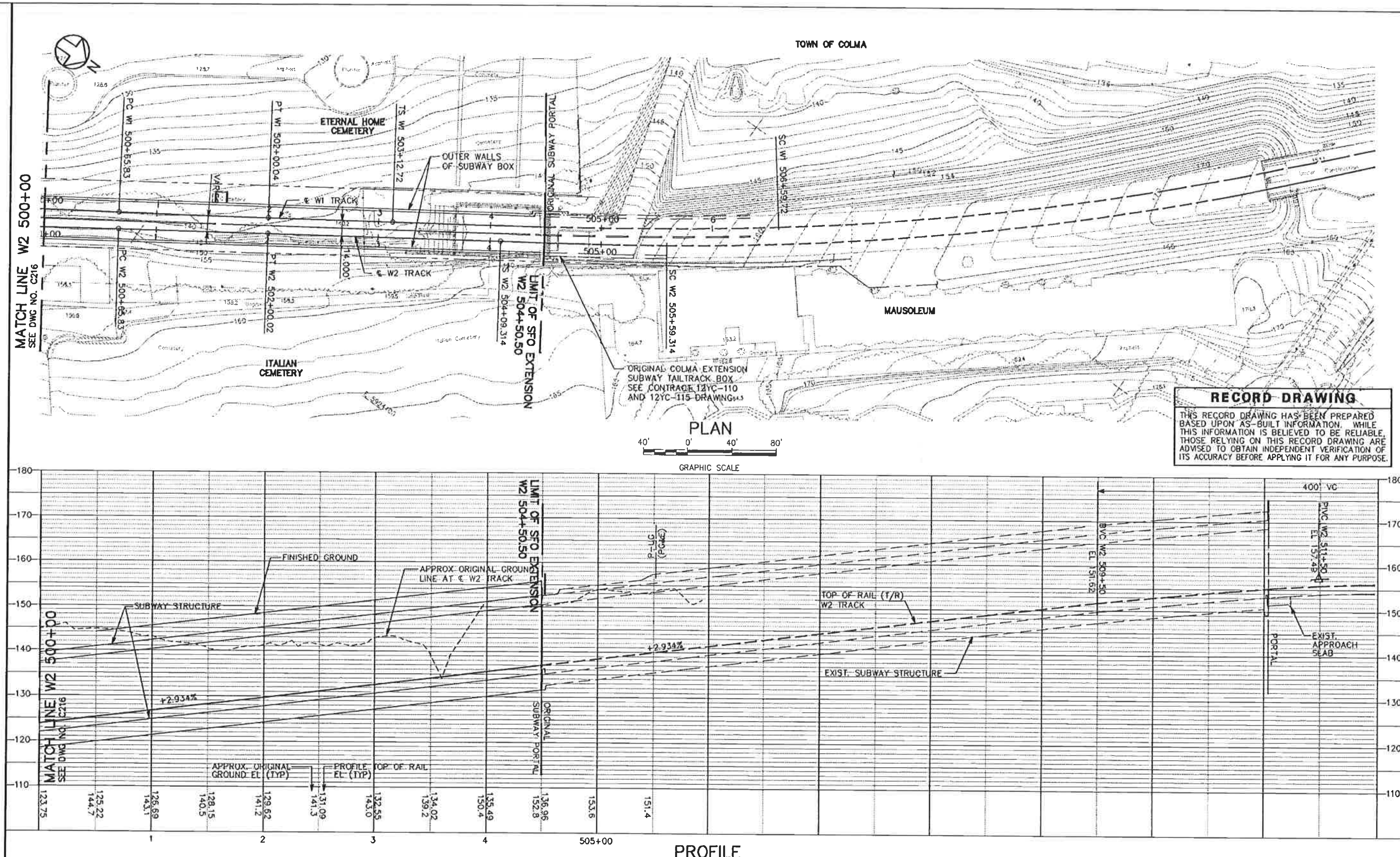

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IN CHARGE G. HOLT
DATE 12JN1997

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APPROVED ORIGINAL SIGNED BY: ASHOK KOTHARI

SAN FRANCISCO AIRPORT EXTENSION LINE, TRACKWORK, AND SYSTEMS

PLAN AND PROFILE
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REV 0
PAGE NO 46

APPENDIX C – BART CONSTRUCTION GUIDELINES

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

GENERAL GUIDELINES FOR DESIGN AND CONSTRUCTION OVER OR ADJACENT TO BART'S SUBWAY STRUCTURES

1. Structures over or adjacent to BART's subway structures shall be designed and constructed so as not to impose any temporary or permanent adverse effects on subway. The minimum clearance between any part of the adjacent structures to exterior face of substructures shall be 7'-6". Minimum cover of 8 feet shall be maintained wherever possible.

2. In general, cut-and-cover subway structures were designed with an area surcharge applied at the ground surface both over and adjacent to the structures. The area surcharge was considered static uniform load with the following value:

D (ft)	**Additional Average Vertical Loading (psf)**
D>20	0
5<D<20	800-40D
D<5	600

Where **D** is the vertical distance from the top of the subway roof to the ground surface.

3. In general, steel-lined tunnels were designed to support the weight of 35 feet of earth above the roof of the tunnel. Whenever the actual depth of cover is less than this amount, construction may be added imposing an additional average vertical loading of 120 lbs. per square foot for each foot of depth of reduced cover. Where basements are excavated, the allowable additional average vertical loading can be increased to the extent that it is balanced by the weight of the removed material. The effects of soil rebound in such cases shall be fully analyzed.

4. Shoring is required for excavations in the Zone of Influence. Zone of Influence is defined as the area above a Line of Influence which is a line from the critical point of substructure at a slope of 1 ½ horizontal to 1 vertical (line sloping towards ground level).

5. Shoring shall be required to maintain at-rest soil condition and monitored for movement.

6. Soil redistribution caused by temporary shoring or permanent foundation system shall be analyzed.

7. Dewatering shall be monitored for changes in groundwater level. Recharging will be required if existing groundwater level is expected to drop more than 2 feet.

8. Piles shall be predrilled to a minimum of 10 feet below the Line of Influence. Piles shall be driven in a sequence away from BART structures. No pile will be allowed between steel-lined tunnels.

9. Subway structures shall be monitored for vibration during pile driving operations for all piles within 100 feet of the structures. Steel –lined tunnels shall also be monitored for movement and deformation. Requirements for monitoring will be provided upon request.

10. Excavation shall be done with extreme care to prevent damage to the waterproofing membrane and the structure itself. Hand excavation shall be performed for the final one foot above the subway roof.

The above shall be considered as general information only and is not intended to cover all situations. Notwithstanding these guidelines, pertinent design and construction documents shall be submitted to BART for review and approval. In addition, the following shall be submitted as applicable:

- Geologic Hazards Evaluation and Geotechnical Investigation reports. The reports shall include engineering geology map, site plan showing the location of subway structures, BART easement, soil reworking plan and the geological conclusion and recommendations.
- Dewatering monitoring and recharging plans.
- Vibration monitoring plan and/or movement and deformation monitoring plans for steel-lined tunnels. Plans shall include locations and details of instruments in subways.
- Foundation plan showing the anticipated total foundation loads.
- Excavation plan for area within the Zone of Influence showing excavation slope or shoring system.
- Procedures and control of soil compaction operation.

APPENDIX D – BART APPLICATION FOR PERMIT OR PLAN REVIEW

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

BART

APPLICATION
FOR PERMIT OR PLAN REVIEW (CONSTRUCTION)

Date:____________________

Attention: Manager,
Real Estate and Property Development Department

For BART use only

PERMIT No.

Application is made for permission to perform the following in the BART Right of Way:

Check all that applies:
- ☐ Excavate
- ☐ Construct Temporary Improvement
- ☐ Construction Permanent improvement
- ☐ Permit to ____________________

Submitted Document
- ☐ Drawings – 6 sets (11x17 preferred)
- ☐ Plans and Specs. – 6 sets
- ☐ others ____________________(6 sets)

Start Date____________________
End Date____________________
Estimated Duration____________

Detailed scope of work (describe in details all work requested for permit):____________________

List/Describe type of Equipment to be used:__ ____________________

Approximate cost of work in the permit area $____________________

Type of construction (check all that applies)

Type of Pipe
- ☐ Underground
- ☐ Surface

Excavation
- ☐ Length____________
- ☐ Width____________
- ☐ Depth____________

Conduit
- ☐ Type of Conduit____________
- ☐ No. of Ducts ____________
- ☐ Buried Cable ____________
- ☐ Others ____________

☐ Surface type to be disturbed (if any)____________________

Method of work:____________________

Is the proposed work in the BART operating envelope? ☐ Yes ☐ No

Is the proposed Permit Area within 50 feet (Vertical or Horizontal) of Trackway? ☐ Yes ☐ No

If yes to any of the above, evidence of Railroad Protective Liability coverage may be required.

Applicant agrees to submit the As-built drawings (if required) after final inspection and sign-off. Failure to submit As-built may result in forfeiture of refundable deposit. Please allow 4 to 6 weeks for processing this application. Expect refundable deposit about 30 days after sign-off

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

Environmental Review
Specify any review for CEQA______________________________
Identify any document certification________________________
Project Approval Date______________________________

Specify any change to existing landscape or irrigation______________________________

Will any excavated material be transported off of Permit Area ☐ Yes ☐ No

Does the proposed work involve fuel or known hazardous material on BART premises? ☐ Yes ☐ No

If yes, please specify and/or explain (Including any fuel storage capacity).

Name of Applicant (print company or agency)

Address (Print)

By (authorized signature) Phone

Name & Title (Print)

Joint construction applicant

Address (Print)

By (authorized signature) Phone

Name & Title (Print)

For official use only

Permit No.______________ Date Issued: ______________ Work Order No.______________

Reviewed by
ROW Management__________
Mechanical Engineering__________
Civil/ Engineering.__________
Electrical Engineering__________
Electrical Engineering__________

Traction Power__________
Safety__________
Engineering Liaison__________
Field. Management__________
Insurance Department.__________

Application receipt date:__________
Refundable deposit__________
Completion date__________
As-built submittal date__________
Deposit Return Date __________

As-Built Drawings required ☐ Yes ☐ No

Location:
Line__________
Mile Post__________

Inspector/ Safety Monitor's name________________
Inspector/Safety Monitor Sign-off________________ Date: __________

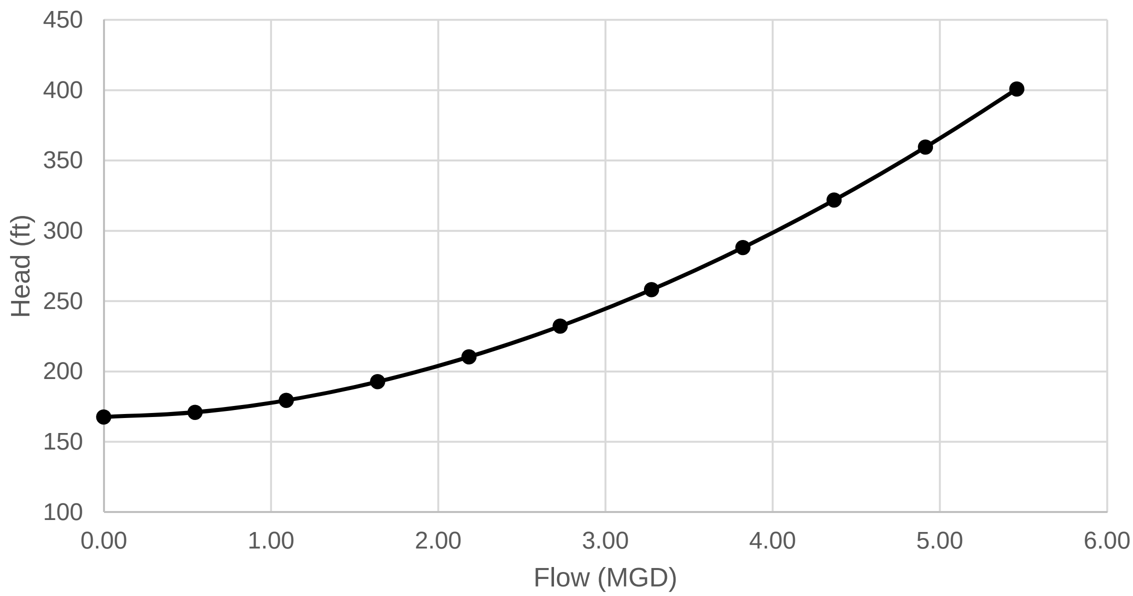
Notes:____

Applicant agrees to submit the As-built drawings (if required) after final inspection and sign-off. Failure to submit As-built may result in forfeiture of refundable deposit. Please allow 4 to 6 weeks for processing this application. Expect refundable deposit about 30 days after sign-off

APPENDIX E – PUMP SYSTEM CURVES

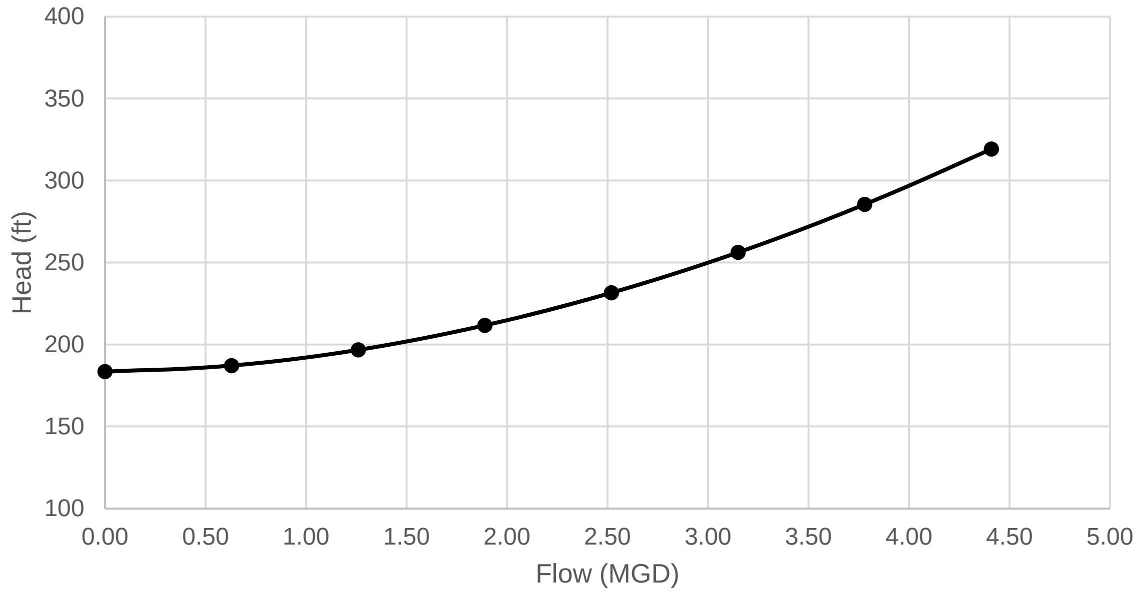
ATWOOD PROPERTY SYSTEM PUMP CURVES

Pump Station to Atwood Property System Curve



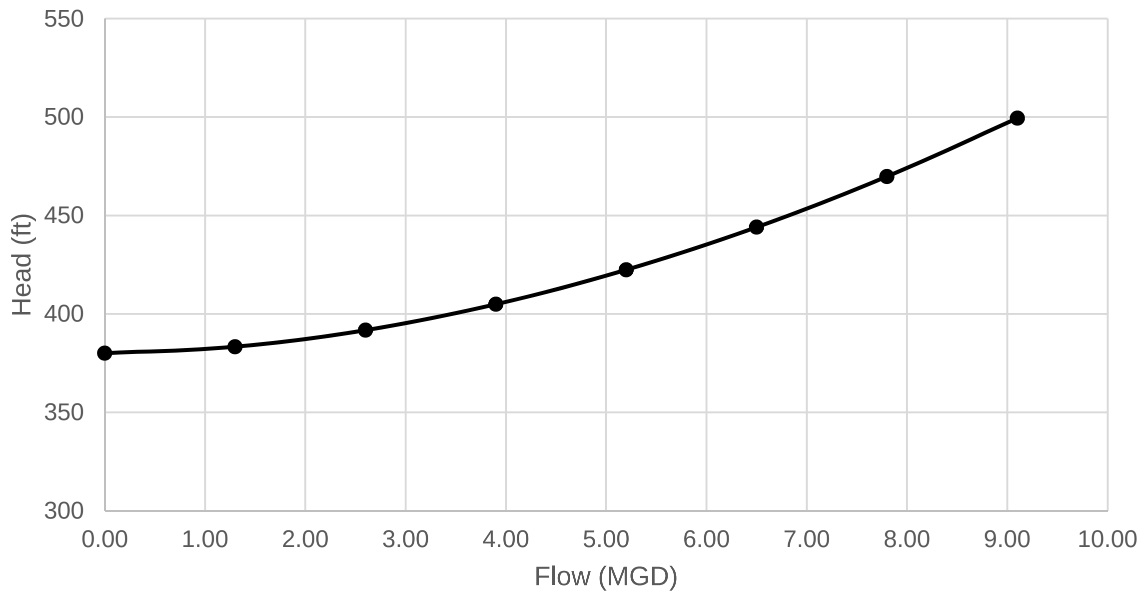
**static head based on having a minimum pressure of 5 pounds per square inch (psi) the highest elevation along the transmission main (193 ft)*

Atwood Property El Camino Real Distribution System Pump Curve



**static head assumes a minimum of 50 psi being delivered to Winston Manor Park, a direct connection customer with the highest elevation for the El Camino Real System*

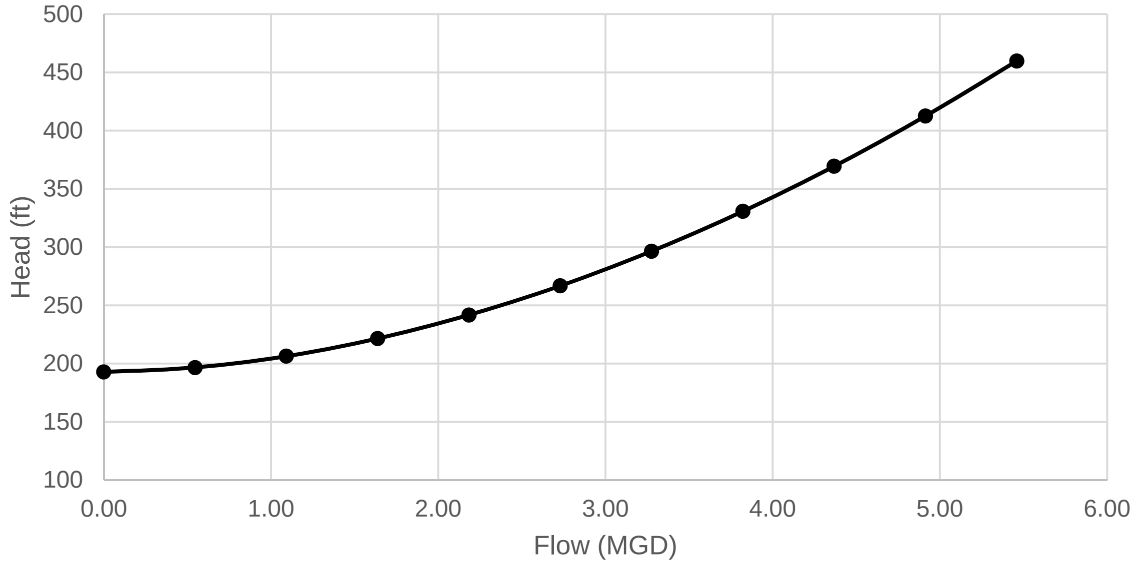
Atwood Property Hillside Boulevard Distribution System Pump Curve



**static head assumes a minimum of 10 psi being delivered to the Holy Cross Cemetery, a storage filling customer with the highest elevation for the Hillside Blvd System*

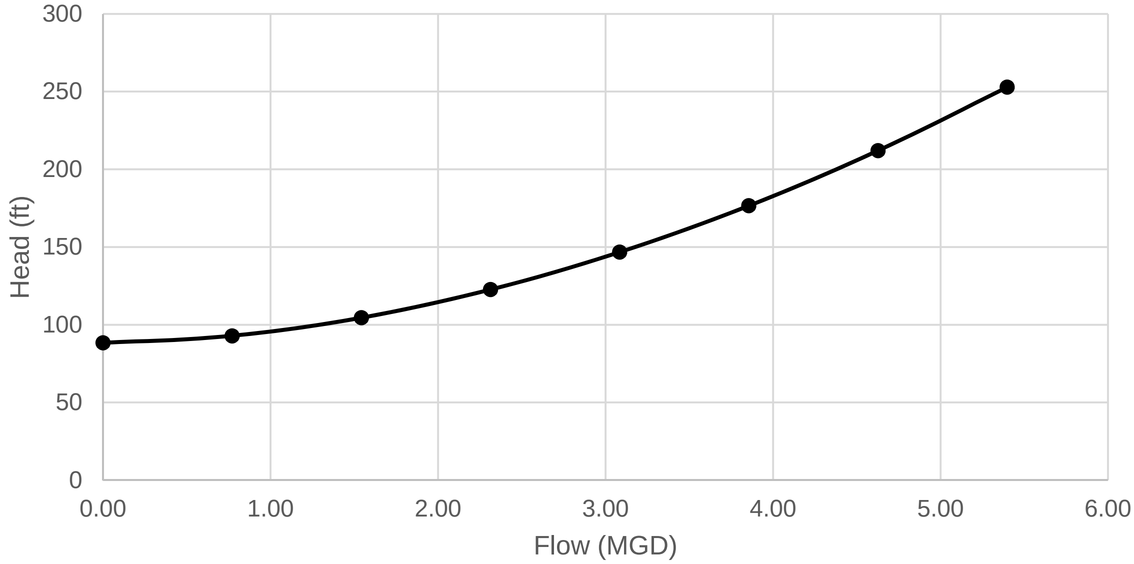
1.0 SALEM MEMORIAL PARK SYSTEM PUMP CURVES

Pump Station to Salem Memorial Park System Curve



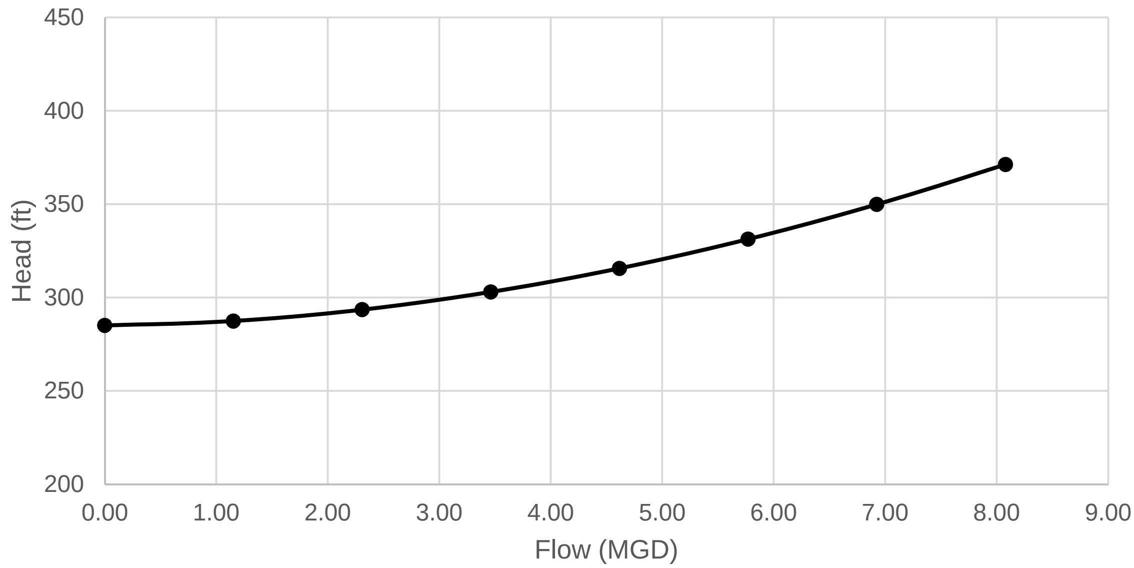
**static head based on having a minimum pressure of 5 psi at the highest elevation along the transmission main (220 ft)*

Salem Memorial Park El Camino Real Distribution System Pump Curve



**static head assumes a minimum of 50 psi being delivered to Winston Manor Park, the customer with the highest elevation for the El Camino Real System*

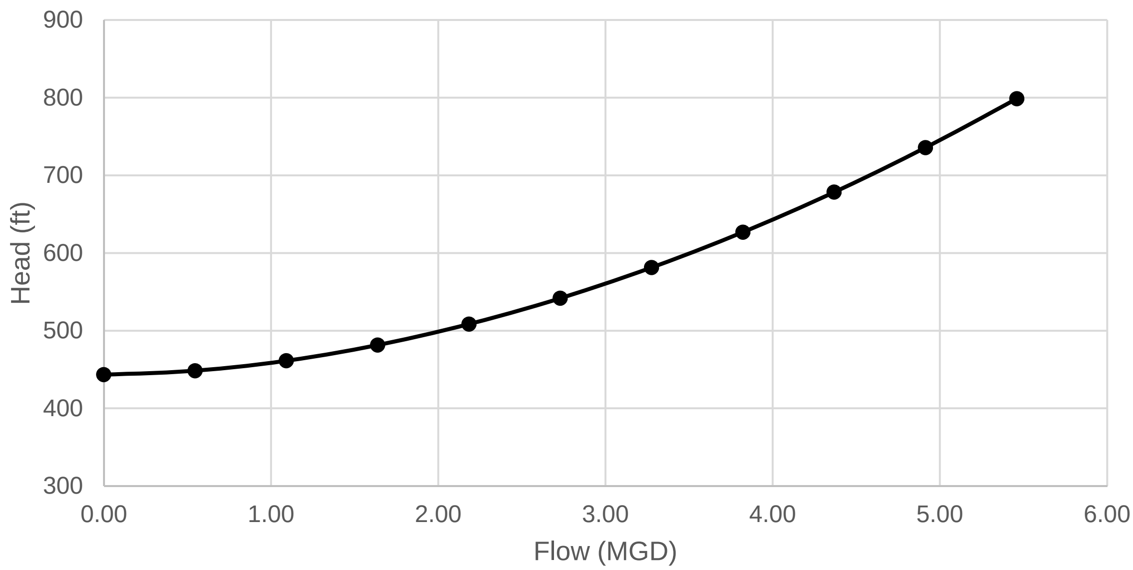
Salem Memorial Park Hillside Boulevard Distribution System Pump Curve



**static head assumes a minimum of 10 psi being delivered to the Holy Cross Cemetery, a storage filling customer with the highest elevation for the Hillside Blvd System*

2.0 HOLY CROSS CEMETERY SYSTEM PUMP CURVES

Pump Station to Holy Cross Cemetery System Curve



**static head based on the highest water level in the Holy Cross Storage Tank (30 ft at elevation 450)*

APPENDIX F – GEOTECHNICAL DESKTOP SITING STUDY

June 15, 2016
Project No. 04.72160021

Carollo Engineers, Inc.
2700 Ygnacio Valley Road, Suite 300
Walnut Creek, California 94598

Attention: Mr. Darren Buane

Subject: Geotechnical Desktop Siting Study for Recycled Water Storage Tank, Feasibility of Expanded Tertiary Recycled Water Facilities Project, Colma, California

Dear Mr. Buane,

Fugro Consultants, Inc. is pleased to submit this preliminary geotechnical desktop siting study for the storage tank component of the North San Mateo County Sanitation District's Feasibility of Expanded Tertiary Recycled Water Facilities Project.

We appreciate this opportunity to be of continuing service to Carollo Engineers, Inc. If you have any questions regarding the information presented in this memorandum, please contact us.

Sincerely,
FUGRO CONSULTANTS, INC.

Ronald L. Bajuniemi, P.E., G.E.
Senior Consultant

REGISTERED PROFESSIONAL ENGINEER
RONALD L. BAJUNIEMI
No. GE 112
Exp. 12/31/17
GEOTECHNICAL
STATE OF CALIFORNIA

RLB/klh/jt

Copies Submitted: (PDF) Addressee

CONTENTS

TABLES

CONTENTS – CONTINUED

FIGURES

INTRODUCTION

This letter presents the results of the geotechnical desktop study and site reconnaissance conducted by Fugro Consultants, Inc., (Fugro) for the recycled water storage tank component of the North San Mateo County Sanitation District's Feasibility of Expanded Tertiary Recycled Water Facilities Project (Project). Three potential storage tank sites were identified for further investigation in the Daly City Storage Tank Site Initial Screening memorandum by Carollo Engineers, Inc. (Carollo) dated April 1, 2016. All three sites of interest are located in Colma, California as shown on the Vicinity Map, Plate 1. The three general tank sites are shown in the Colma area on the Feasible Tank Sites, Plate 2, with specific locations as follows:

- Salem Memorial Park Site, southwest of Hillside Boulevard between Serramonte Boulevard and Olivet Parkway.
- Atwood Property, north and south of Olivet Parkway between State Highway 82 and the Bay Area Rapid Transit (BART) easement.
- Holy Cross Cemetery Property, approximately 0.25 miles northeast of Hillside Boulevard behind the Pacific Nurseries Property.

Site specific maps of the proposed locations are shown on Plates 3, 4 and 5.

Carollo has determined that these sites have sufficient space to house the storage tank and pump station and the property owners are willing to host the proposed facilities or sell the property to the Project agencies.

PROJECT DESCRIPTION

The Project would increase the tertiary treatment capacity at the City of Daly City's wastewater treatment plant (WWTP) and deliver recycled water for irrigation to sites in Daly City, and cemeteries in Colma, California. The Project includes treatment process upgrades at the WWTP, a transmission pipeline to Colma, a distribution system and storage tank. The storage tank location is a critical element to define the proposed transmission and distribution pipeline alignments.

The Daly City Storage Tank Site Initial Screening (Carollo, 2016) (Initial Screening) recommended further investigation of three (3) sites in Colma, California. The purpose of this preliminary study is to summarize the geologic and geotechnical characteristics of each site, as well as constructability considerations such as general shoring requirements.

Each site must have sufficient space to accommodate the recycled water storage tank (approximate capacity of 2.41-million gallons) and pump station. The storage tank could be located above or below grade and designed as a circular or rectangular tank. If the tank is installed below grade, it is possible to install relatively light weight facilities above the tank, such as a parking lot or sports field. The pump station would be located above grade and could be situated on top of the tank or as a separate structure adjacent to the tank. Locating the pump station on top of the tank reduces the overall site size but requires additional structural reinforcement of the tank. The minimum site footprint for the tank and pump station as determined by Carollo (2016) is approximately 0.5 to 1.5 acres. Reducing the site further causes the tank to be excessively deep.

The storage tank should be located at the highest possible elevation to reduce long-term pumping cost. In most cases, a pump station will be required to deliver recycled water to the cemeteries. However, if the tank site elevation was adequate, and depending on elevations in the service area, it may be possible to gravity-feed the cemeteries along El Camino Real/State Highway 82.

SCOPE OF SERVICES

The purpose of our preliminary geotechnical desktop study and site reconnaissance was to obtain information on typical surface and subsurface conditions at each site in order to evaluate the geotechnical, geologic and construction considerations of the potential storage tank sites. The scope of services performed included the following tasks:

- Compiling and reviewing available pertinent geotechnical and geologic data, including published geologic and geohazard maps as well as geologic and geotechnical records contained in our files;
- Conducting a reconnaissance site visit to supplement the available information on surface and subsurface conditions; and
- Preparing this memorandum presenting the results of our geotechnical desktop study, site reconnaissance, and a discussion of fatal flaws and geotechnical considerations for each site.

REVIEW OF EXISTING DATA

Prior to conducting our site reconnaissance, Fugro reviewed relevant, available information relating to geotechnical and geologic data, as well as results of previous explorations performed within the vicinity of the sites, including the following reports:

- ALAN KROPP & ASSOCIATES, 1981. *Geotechnical Investigation Communications Network*.
- COOPER CLARK & ASSOCIATES, 1968. *Soil Investigation Proposed Industrial Development*.
- EARTH INVESTIGATIONS CONSULTANTS, 2001. *Geotechnical Investigation Proposed Water Storage Tank*

- EMCON ASSOCIATES, 1982. *Closure Plan Junipero Serra Solid Waste Disposal Site*.
- HARDING LAWSON ASSOCIATES, 1988. *Soil Investigation Our Lady of peace Garden Crypt Additions Holy Cross Cemetery*.
- KLEINFELDER, 1990. *Geotechnical Investigation Report Metro Bay Centre*.
- LOWNEY/KALDVEER ASSOCIATES, 1971. *Foundation Investigation – Standard Brands Paint Store*.
- LOWNEY/KALDVEER ASSOCIATES, 1974. *Foundation Investigation – Serra Vista Square*.

GEOLOGIC SETTING

The potential storage tank sites are located within the Coast Ranges Geomorphic Province of Northern California, as shown on the Regional Geologic Map – Plate 6. This province is characterized by northwest-trending faults and folds, erosion and deposition within the broad transform boundary between the North American and Pacific tectonic plates (see Plate 7 – Regional Fault Map). Translational motion along the plate boundary occurs across a distributed zone of right-lateral shear, expressed as a nearly 50-mile-wide zone of northwest-trending, near-vertical active strike-slip faults. This translational motion occurs primarily along the active San Andreas, Hayward, Calaveras and San Gregorio faults. Historically, the San Francisco Bay region is seismically active and has been subjected to strong ground shaking from several large earthquakes.

REGIONAL SEISMICITY

The project sites are located in the San Francisco Bay Area, which is considered one of the most seismically active regions in the United States. Significant earthquakes have occurred in the San Francisco Bay Area and are believed to be associated with crustal movements along a system of sub-parallel fault zones that generally trend in a northwesterly direction.

As shown on Plate 8, several major fault zones extend through the Bay Area in a northwesterly direction. The faults causing such earthquakes are part of a system of right lateral faults along the Pacific and North American Plate boundary that extends for at least 450 miles along the coast of California, and locally includes the San Andreas, San Gregorio, Calaveras and Hayward faults. The approximate distance from the project site to the nearby known active faults is summarized in Table 1.

Table 1. Distances to Major Active Faults

Fault Name	Distance to Site (miles)		
	Salem Memorial Park Site	Atwood Property	Holy Cross Cemetery Property
San Andreas (peninsula segment)	2.1	1.8	2.6
San Gregorio	7.0	6.7	7.8
Hayward-Rodgers Creek	17	16	16
Calaveras	26	25	25

In 2007, the Working Group on California Earthquake Probabilities (WGCEP 2007), in conjunction with the United States Geological Survey (USGS), published an updated report evaluating the probabilities of significant earthquakes occurring in the Bay Area over the next three decades. WGCEP 2007 finds that there is a 93 percent probability that at least one magnitude 6.7 or greater earthquake will occur in the San Francisco Bay region in the next 30 years. This probability is an aggregate value that considers seven principal Bay Area fault systems and unknown faults (background values). The San Francisco Bay region continues to be seismically active. The principal active faults in the Bay Area include the San Andreas, Hayward, Calaveras, and the San Gregorio faults. Earthquakes occurring along these faults are capable of generating strong ground shaking at the project site. Earthquake intensities will vary throughout the Bay Area depending upon the magnitude of earthquake, the distance of the site from the causative fault, and the type of materials underlying the site.

SITE CONDITIONS AND CONSIDERATIONS

In addition to the geotechnical desktop study, a site reconnaissance of the potential sites was conducted by a Fugro engineer on May 11, 2016. The site-specific findings from the desktop study and reconnaissance are summarized in the following sections. It is anticipated that the subsurface conditions at all three sites could support the proposed tanks on shallow foundation systems.

SALEM MEMORIAL PARK SITE

The Salem Memorial Park Site is situated southwest of Hillside Boulevard between Serramonte Boulevard and Olivet Parkway, as shown in Plate 2. The Low Water Elevation (LW EL) in the storage tank at this location, as proposed by Carollo (2016), is 177 feet (Datum unknown). The site is covered by grass and is currently unused. There is an approximate 5 percent slope in the southwest direction. The Salem Memorial Park Site is “space limited” and may require a deep tank to reduce the structure footprint.

The surficial soils at the Salem Memorial Park Site has been mapped as Colma Formation (Qc) by the USGS (1998). The Colma Formation consists primarily of well sorted fine to medium sand containing few beds of sandy silt, clay and gravel. The CGS and USGS (2008) has mapped this area to have a high shaking potential. During the site reconnaissance, surficial pavement cracks were observed and this may be indicative of expansive subgrade soils.

In general, historical borings indicate groundwater elevations dating back several decades indicate that groundwater was not encountered down a maximum drilling elevation of 66 feet. The California Department of Water Resources indicate that nearby groundwater levels ranged from Elevations -83 to -93 feet (NAVD88) between 2012 and 2014. Historical borings further away from the cemeteries (approximately 0.7 miles northwest) indicate groundwater levels ranging from 150 to 170 feet in elevation (Datum unknown) and one anomalous boring indicated that groundwater was encountered at approximately Elevation 150 feet (Datum unknown) approximately 0.8 miles southwest. The low water table elevation may be attributed to the pumping implemented by nearby cemeteries, and if such activities remain consistent, groundwater is not anticipated to be encountered during construction.

The USGS Quaternary Fault and Fold Database indicates an inferred unnamed fault less than 400 feet northeast of the Salem Memorial Park site, as shown on Plate 8. There is very limited information regarding this unnamed fault. Notably, this fault does not appear on the USGS State of California Special Studies Zone (1982), which maps potentially active faults. As defined by the map, a fault is deemed potentially active if they have been active during the Holocene time (within the last 11,000 years) and have a relatively high potential for surface rupture. Additionally, this site does not fall into the zones included in the Alquist-Priolo Act, which establishes regulatory zones around the surface traces of active faults. The CGS and USGS (2008) has mapped this area to have a high shaking potential. This unnamed fault will require further evaluation. The Salem Memorial Park site is located in an area that has been mapped by the USGS (1997) as flat land with a very low susceptibility to liquefaction. Flat land is defined as "areas of gentle slope at low elevation that have little or no potential for formation of slumps, translational slides, or earth flows except along stream banks and terrace margins."

The proposed Salem Memorial Park site space is limited and will require a deeper tank to accommodate the smaller footprint. From a geotechnical standpoint, there are no restrictions for the maximum excavation depth. However, other considerations, such as shoring, may limit the excavation depth. Due to the greater height of the proposed storage tank at this site, temporary construction slopes are likely not feasible at this site and shoring will likely be necessary. Additionally, minimum embedment for shoring will be greatest at this site due to the height of the proposed storage tank. Excavatability is not anticipated to be an issue for standard equipment.

ATWOOD PROPERTY

The Atwood Property consists of two parcels, one on each side of Olivet Parkway east of El Camino Real/State Highway 82, as shown in Plate 3. The LW EL in the storage tank at this location, as proposed by Carollo (2016), is 91 feet (Datum unknown). The site is covered by grass and is currently unused. There is an approximate 5 percent slope in the southwest direction.

The Atwood Property site is located near an inferred contact between Alluvium (Qal) and the Colma Formation (Qc) by the USGS (1998). The Alluvium deposits consist primarily of sand and silt, but locally may contain clay, gravel or boulders. The Colma Formation consists primarily of well sorted fine to medium sand containing few beds of sandy silt, clay and gravel. During the site reconnaissance, surficial pavement cracks were observed and this may be indicative of expansive subgrade soils.

In general, historical borings indicate groundwater elevations dating back several decades indicate that groundwater was not encountered down a maximum drilling elevation of 66 feet. The California Department of Water Resources indicate that nearby groundwater levels ranged from Elevations -83 to -93 feet (NAVD88) between 2012 and 2014. Historical borings further away from the cemeteries (approximately 0.6 miles northwest) indicate groundwater levels ranging from 150 to 170 feet in elevation (Datum unknown) and one anomalous boring indicated that groundwater was encountered at approximately Elevation 150 feet (Datum unknown) approximately 0.5 miles southwest. The low water table elevation may be attributed to the pumping implemented by nearby cemeteries, and if such activities remain consistent, groundwater is not anticipated to be encountered during construction.

The Atwood Property site is located near a contact between an area that has been mapped to have a very low susceptibility to liquefaction and an area that has been mapped to have a high susceptibility to liquefaction. Although evidence of liquefaction damage from prior events, such as the 1989 Loma Prieta earthquake, was not observed during the site reconnaissance, a larger and closer event from the nearby San Andreas Fault may produce enough energy to induce liquefaction at this site. The Atwood Property site is located in an area that has been mapped by the USGS (1997) as flat land with a high shaking potential (CGS and USGS, 2008). Flat land is defined as "areas of gentle slope at low elevation that have little or no potential for formation of slumps, translational slides, or earth flows except along stream banks and terrace margins."

The proposed storage tank at the Atwood Property will be adjacent to an underground BART tunnel, as shown in Plate 9 – Cross Section of the Atwood Property. General guidelines for construction adjacent to BART's subway structures indicate that the minimum clearance between any part of the adjacent structures to exterior face of substructures must be 7.5 feet. Shoring will be required for excavations within the Zone of Influence, which is defined as the area above a Line of Influence, which is a line from the critical point of substructure at a slope of 1.5 horizontal to 1 vertical (line sloping towards ground level). Shoring is required to maintain at-rest soil conditions and must be monitored for movement.

As-built drawings by BART indicate that top of rails (essentially the bottom of the tunnel) range from Elevation 109 to 121 feet at distances of approximately 60 and 70 feet from the proposed tank. Therefore, no lateral loads induced by the subway structure and trains will be imposed on the proposed tank. Additionally, the tank walls need to be restrained and designed for no deflection. This restriction also applies for shoring and the restraint on the wall will need to be internal (no tie-backs). Excavatability is not anticipated to be an issue for standard equipment.

HOLY CROSS CEMETERY PROPERTY

The Holy Cross Cemetery Property is located approximately 0.25 miles northeast of Hillside Boulevard behind the Pacific Nurseries Property, as shown on Plate 4. The LW EL in the storage tank at this location, as proposed by Carollo (2016), is 440 feet. There is an approximate 10 percent slope in the southeast direction. The site is currently used for agriculture; however, Holy Cross Cemetery indicates that the space can be made available for the proposed storage tank, if desired. There is currently a storage tank owned by the Holy Cross Cemetery approximately 200 feet southeast of the proposed storage tank. During the site reconnaissance, an alternate location within the Holy Cross Cemetery property was also considered. This alternate location is located approximately 2,200 feet southeast of the original proposed location with an approximate 5 percent slope in the northwest direction. The alternate location is at about Elevation 295 feet and currently not in use, except for two storage tanks owed by California Water Services Company.

The Holy Cross Cemetery site is located near a mapped contact between sandstone and shale (Kjs), slope debris (Qsr), and the Colma Formation (Qc) by the USGS (1998). Where it overlies the Colma Formation, slope debris commonly consists of silty to clayey sand or gravel. The Colma Formation consists primarily of well sorted fine to medium sand containing few beds of sandy silt, clay and gravel.

A previous geotechnical investigation was performed for an additional proposed storage tank for Holy Cross Cemetery southeast of the existing storage tank by Earth Investigations Consultants. The three boring logs in the report indicate that the subsurface conditions at the site generally consists of 0 to 12 feet of medium dense fill over medium dense to dense silty sand. The borings were drilled at approximately Elevation 415 feet (Datum unknown) down to a maximum depth of 51.5 feet (Elevation 363.5 feet). Bedrock was not encountered in these borings. Based on these borings, bedrock is not anticipated to be encountered at the proposed tank location at Holy Cross Cemetery. In addition, the alternate location is about 100 to 150 feet lower, therefore, bedrock is not anticipate at that location.

The Holy Cross Cemetery site is located in an area that has been mapped by the CGS and USGS (2008) to have a high shaking potential and by the USGS (1997) to have a very low susceptibility to liquefaction.

The San Francisco South Quadrangle map (Bonilla, 1998) and the San Mateo County Planning Map (Leighton & Associates and San Mateo County Planning Department, 1973) indicates the Hillsdale Fault approximately 900 feet from the proposed site, as shown on Plate 8. This fault is considered inactive by the San Mateo County Planning Map, which defines an inactive fault to be a fault in which movement appears to be older than 2 to 3 million years.

In general, historical borings indicate groundwater elevations dating back several decades indicate that groundwater was not encountered down a maximum drilling elevation of 125 feet. The California Department of Water Resources indicate that nearby groundwater levels ranged from Elevations -83 to -93 feet (NAVD88) between 2012 and 2014. Historical borings further away from the cemeteries (approximately 1.5 miles northwest) indicate groundwater levels ranging from 150 to 170 feet in elevation (Datum unknown) and one anomalous boring indicated that groundwater was encountered at approximately Elevation 150 feet (Datum unknown) approximately 1.5 miles southwest. The low water table elevation may be attributed to the pumping implemented by nearby cemeteries, and if such activities remain consistent, groundwater is not anticipated to be encountered during construction. In the previous borings done for the proposed additional storage tank, groundwater was not encountered to the maximum depth explored of 51½ feet.

Slides and earth flows are landslides that tend to move slowly and rarely threaten life directly. Movement may be induced by changes such as increased water content, earthquake shaking, addition of load, or removal of downslope support. Movement may cause deformation and tilting which may cause destruction to foundations, offset of roads, and breaking of underground pipes. The Holy Cross Cemetery site is located near a contact between an area that has been mapped as flat land and an area that has been mapped to have few landslides by the USGS (Wentworth et al., 1997). Flat land is defined as "areas of gentle slope at low elevation that have little or no potential for the formation of slumps, translational slides, or earth flows except along stream banks and terrace margins." Areas that have been mapped to have few landslides are considered to contain "few, if any, large mapped landslides, but locally contain scattered small landslides and questionably identified larger landslides." During the site reconnaissance, no evidence of landslides was observed near the proposed location.

GENERAL CONSTRUCTION CONSIDERATIONS

Excavations and Shoring

Excavations will be required to construct tank and pump station foundations and to remove locally weak or unsuitable soils. All excavations that will be deeper than 5 feet and will be entered by workers should be shored or sloped for safety in accordance with Occupational Safety and Health Administration (OSHA) standards.

We recommend that the contractor or its specialty subcontractor design temporary construction slope to conform to OSHA's "Guidelines for Excavations and Temporary Sloping". The contractor or responsible subcontractor, based on the subsurface conditions exposed at the time of construction, should determine temporary slope inclinations. Table 2 presents the allowable slopes for excavations less than 20 feet by the OSHA Technical Manual and anticipated soil types to be encountered at each proposed location.

Table 2. Allowable Slopes for Excavations less than 20 Feet by OSHA

Site	Anticipated Soil Type	Soil type Description	H:V Ratio	Slope Angle (°)
Salem Memorial Park Site	Type C	Cohesive soils with UC strength of 1 ksf or less; granular soils such as gravel, sand, and loamy sand, submerged soil, and submerged unstable rock	1 ½:1	34
Atwood Property	Type C	Cohesive soils with UC strength of 1 ksf or less; granular soils such as gravel, sand, and loamy sand, submerged soil, and submerged unstable rock	1 ½:1	34
Holy Cross Cemetery Property	Type C	Cohesive soils with UC strength of 1 ksf or less; granular soils such as gravel, sand, and loamy sand, submerged soil, and submerged unstable rock	1 ½:1	34

If temporary slopes are left open for extended periods of time, exposure to weathering and rain could have detrimental effects such as sloughing and erosion. We recommend that all vehicles and other surcharge loads be kept at least 10 feet away from the top of temporary slopes and that the temporary slopes be protected from excessive drying and/or saturation during construction.

For excavations greater than 20 feet, vertical cuts and shoring will be necessary. We suggest that the owner and the contractor be familiar with applicable local, state and federal regulations for temporary shoring, including the current OSHA Excavation and Trench Safety Standards. It should be noted that the contractor will be solely responsible for the design and construction of temporary shoring. The shoring should satisfy two main objectives. (1) Shoring should be rigid to prevent movements of the retained soils that could adversely affect adjacent existing developments or structures. (2) Shoring should be impermeable to prevent lowering of surrounding groundwater. Lowering of site groundwater could induce settlements in the surrounding soils. Typically, shoring embedment should be twice the height of the excavation. The contractor should be aware that in no case should excavation depths exceed those specified in local, state or federal safety regulations. Specifically, one needs to be aware of the current OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926. We understand that these regulations are strictly enforced, and if they are not closely followed, the owner, contractor, and/or his earthwork and utility subcontractors could be liable for substantial penalties.

The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures.

Cut slopes and/or shoring design should be reviewed by a Geotechnical Engineer. Construction of cut slopes and/or installation of shoring should be observed by a Geotechnical engineer.

CONCLUSIONS AND RECOMMENDATIONS

We believe that the project is feasible at all three proposed sites from a geotechnical standpoint. Table 3 presents a comparison of site conditions and considerations for each site.

Table 3: Summary of Site Conditions and Considerations at Each Proposed Location

Hazard / Consideration	Site		
	Salem Memorial Park Site	**Atwood Property**	**Holy Cross Cemetery Property**
Liquefaction Potential	Very low to high	Very low	Very low
Landslide Distribution	Flat land	Flat land	Flat land to few landslides
Shaking Potential	High	High	High
Groundwater	Not anticipated during construction	Not anticipated during construction	Not anticipated during construction
Others	Unnamed fault <400 feet away	Located near BART	Hillsdale Fault approximately 900 feet away
	Deepest shoring required		

LIMITATIONS

Our services consist of professional opinions, conclusions, and recommendations that are made in accordance with generally accepted, local geotechnical engineering principles and practices at the time our services were performed. This warranty is in lieu of all other warranties, either expressed or implied.

The preliminary assessments and recommendations contained in this letter are based on the data obtained from the geotechnical desktop study and site reconnaissance. Variations may exist and conditions not observed or described in this memorandum could be encountered during construction. Our conclusions and recommendations are based on our analysis of the observed conditions. The chosen site will require detailed geotechnical investigation. This letter has been prepared for the exclusive use of Carollo Engineers, Inc., North San Mateo County Sanitation District and their consultants for specific application to the Expanded Tertiary Recycled Water Facilities Project as described herein. In the event that there are any changes in the ownership, nature, design, or location of the proposed project, or if any future additions are planned, the conclusions and recommendations contained in this report should not be considered valid unless 1) the project changes are reviewed by Fugro, and 2) conclusions and recommendations presented in this report are modified or verified in writing. Reliance on this report by others must be at their risk unless we are consulted on the use or limitations. We cannot be responsible for the impacts of any changes in geotechnical standards, practices, or regulations subsequent to performance of services without our further consultation. We can neither vouch for the accuracy of information supplied by others, nor accept consequences for unconsulted use of segregated portions of this report.

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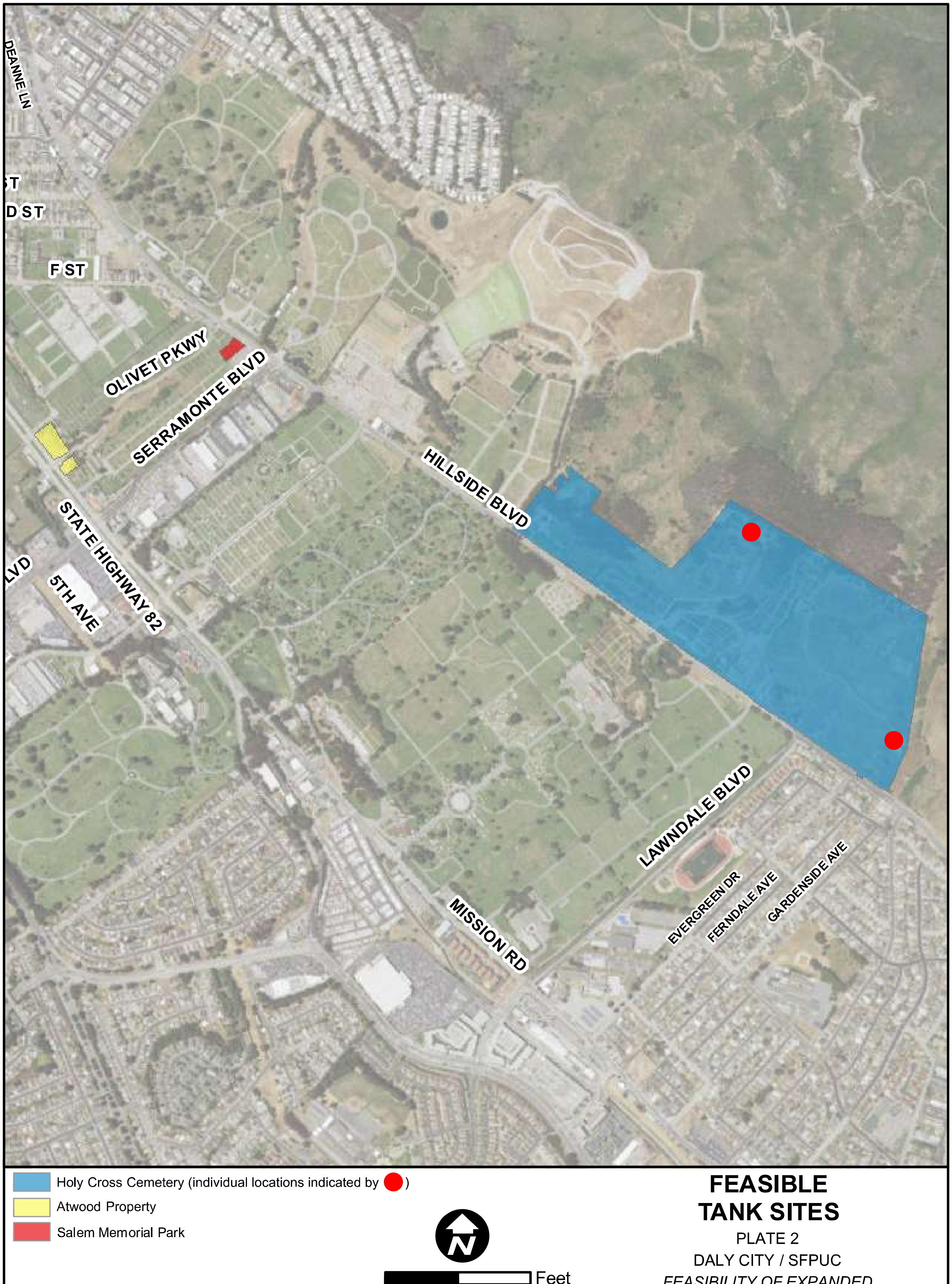
FIGURES

Fugro Consultants, Inc.
Project No. 04.72160021

LOCATION MAP
DALY CITY - COLMA PIPELINE PROJECT
DALY CITY, CALIFORNIA

PLATE 1

G:\04.72160021 Daly City Colma Pipeline Project\GIS\Outputs\Working\mxd\Figures\DalyCity_LocationMap.mxd; ticci; 5/17/2016



FEASIBLE TANK SITES

PLATE 2

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

Below Grade Storage Tank
Pump Station
Construction Clearance
Vacant Land
Piping

N

Feet
0 50 100

SALEM MEMORIAL PARK SITE

PLATE 3

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

carollo

ATWOOD PROPERTY

PLATE 4

DALY CITY / SFPUC

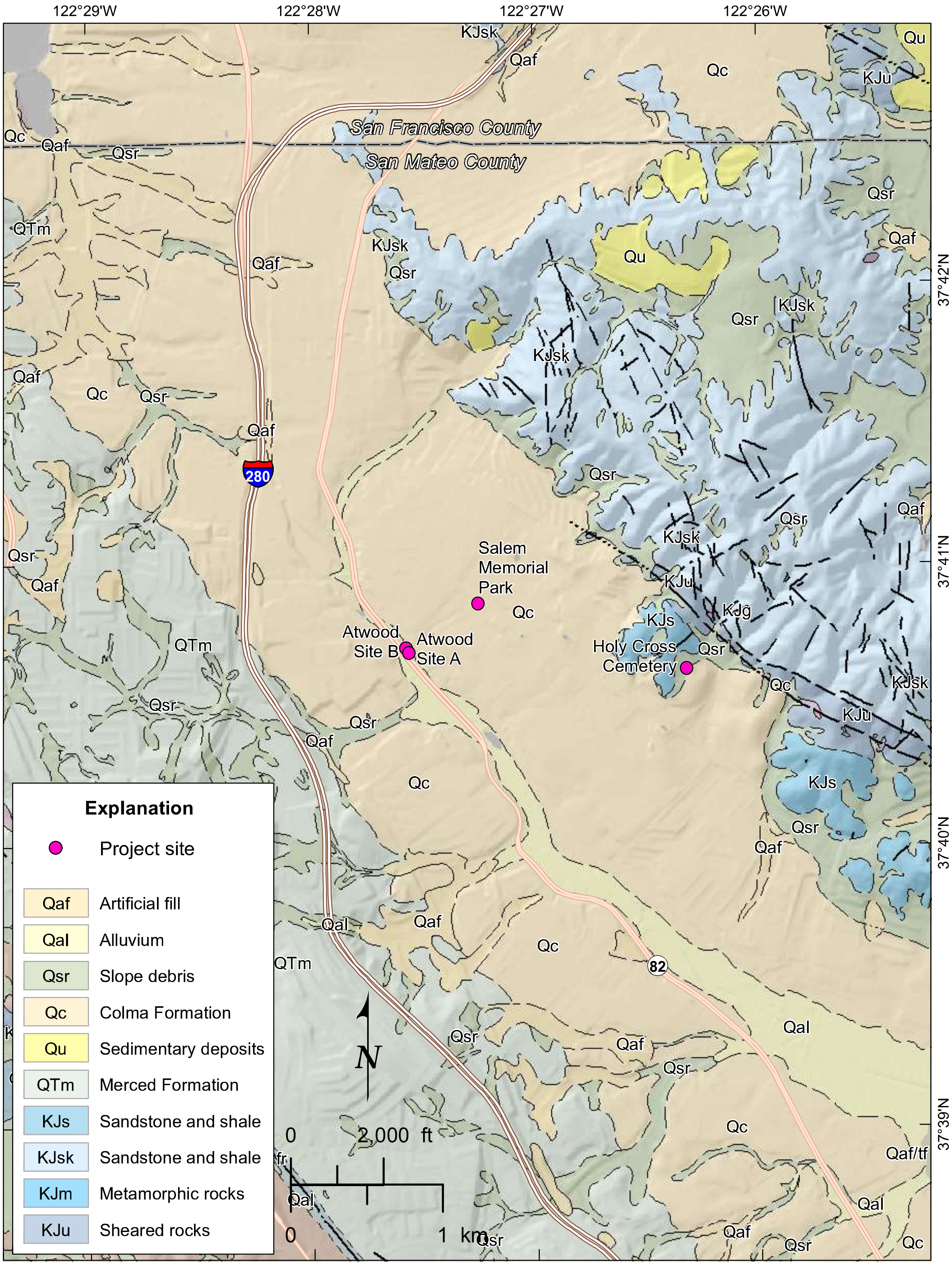
FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

HOLY CROSS CEMETERY

PLATE 5

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

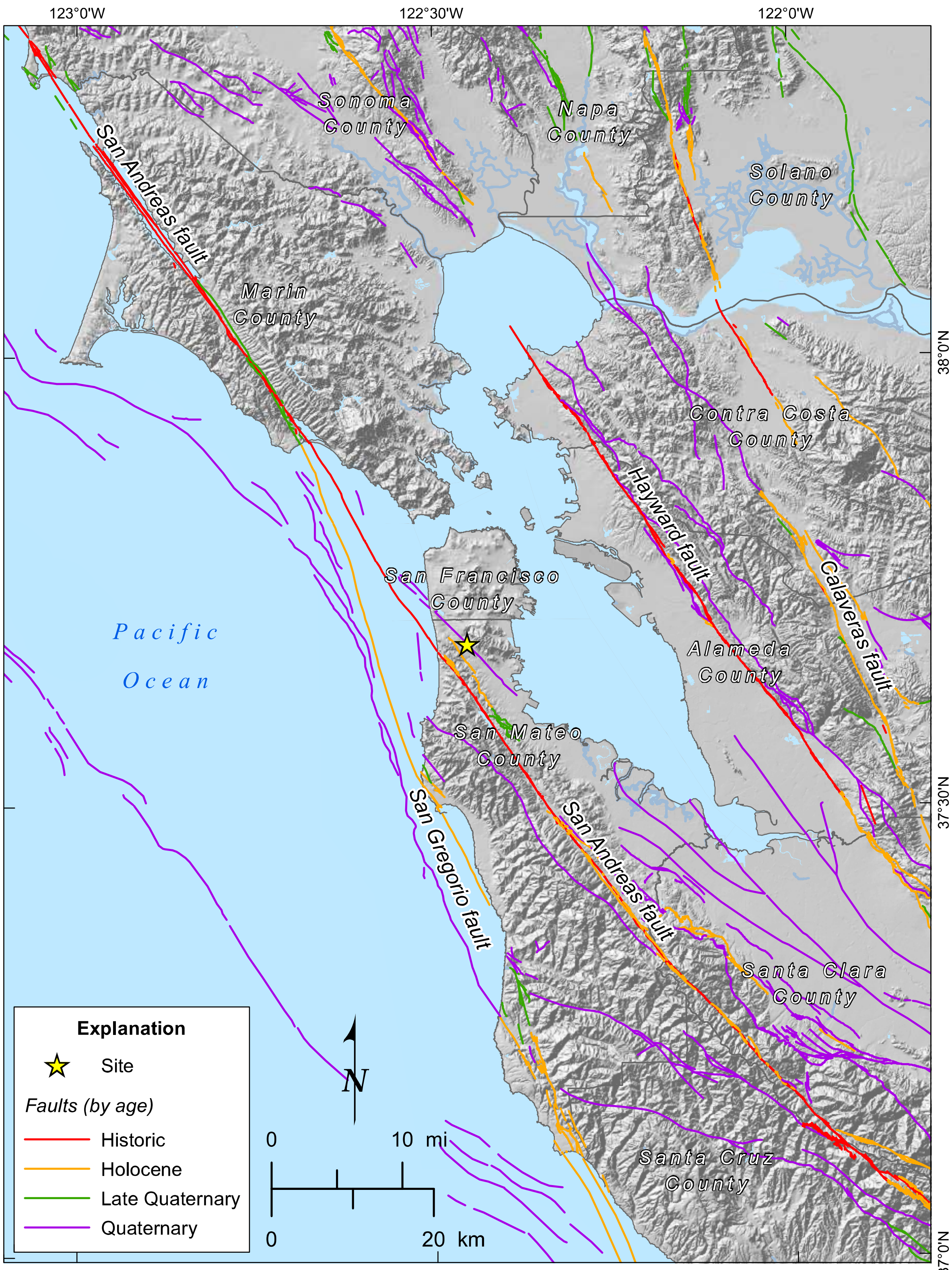


Geologic data from USGS OFR 98-354.

GEOLOGIC MAP
DALY CITY - COLMA PIPELINE PROJECT
DALY CITY, CALIFORNIA

PLATE 6

Fugro Consultants, Inc.
Project No. 04.72160021

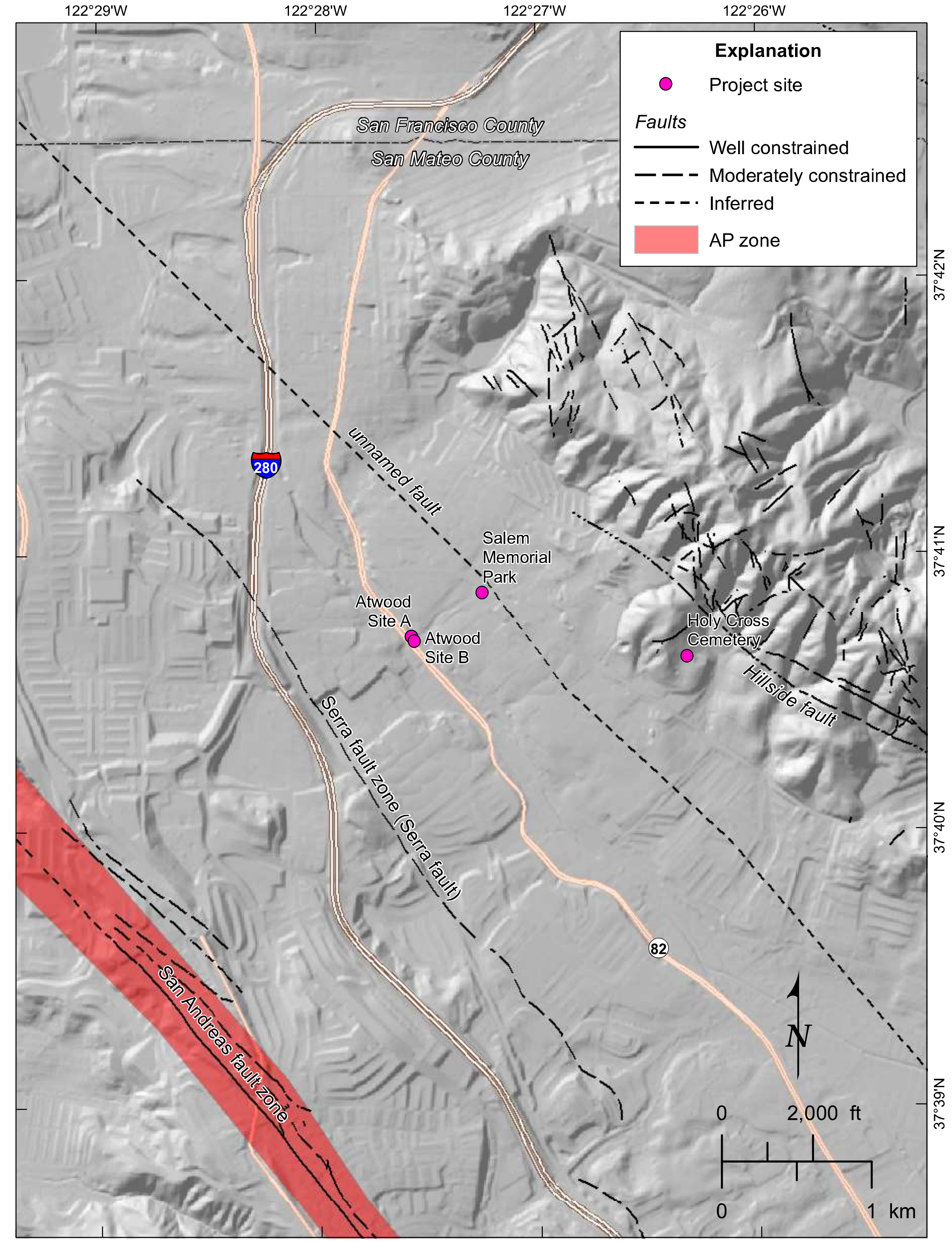


Fault data from USGS Quaternary Fault and Fold Database.

REGIONAL FAULT MAP
DALY CITY - COLMA PIPELINE PROJECT
DALY CITY, CALIFORNIA

PLATE 7

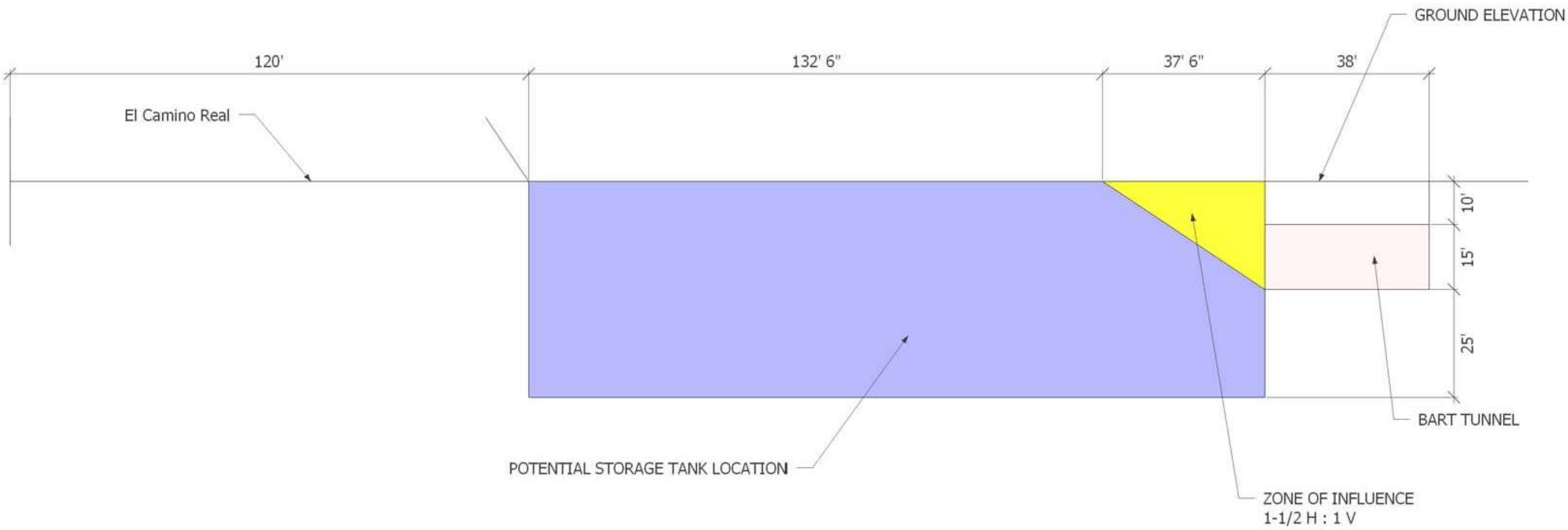
Fugro Consultants, Inc.
Project No. 04.72160021



Fault data from USGS Quaternary Fault and Fold Database and from Bonilla, 1998.
AP Zone from California Geological Survey.

VICINITY FAULT MAP
DALY CITY - COLMA PIPELINE PROJECT
DALY CITY, CALIFORNIA

PLATE 8



CROSS SECTION OF THE ATWOOD PROPERTY
DALY CITY - COLMA PIPELINE PROJECT
DALY CITY, CALIFORNIA

PLATE 9

APPENDIX D – PROJECT MEMORANDUM 02 - RECYCLED WATER CUSTOMER OUTREACH

Engineers...Working Wonders With Water®

DRAFT PROJECT MEMORANDUM - 02

Project Name:	Feasibility of Expanded Tertiary Recycled Water Facilities (Project)	**Updated Date:**	April 1, 2016
Client:	City of Daly City	**Project Number:**	10076A.10
Prepared By:	Darren Baune and Ron Papa		
Reviewed By:	Tracy Clinton		
Subject:	Recycled Water Customer Outreach		

1.0 PURPOSE

The purpose of this project memorandum (PM) is to summarize the outreach the project team has conducted with potential recycled water customers.

2.0 BACKGROUND

The Recycled Water Treatment and Delivery System Expansion Feasibility Study (Feasibility Study) (Carollo, 2009), identified eighteen potential recycled water customers in the Town of Colma and the City of South San Francisco. The potential customers included city parks, schools, a golf course, and cemeteries.

The Feasibility Study also identified potential recycled water customers located in the San Francisco Lake Merced area. During the October 19, 2015 Project Kick-Off Meeting, the San Francisco Public Utilities Commission (SFPUC) requested that the project team no longer consider providing delivery and distribution facilities to the Lake Merced Area. The potential recycled water customers in the Town of Colma and South San Francisco identified in the Feasibility Study are presented in Table 1.

**Table 1 Potential Recycled Water Customers, Town of Colma and South San Francisco, 2009 Feasibility Study
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City**

No.	Name	Existing Irrigated Acreage	Average Annual Demand (afy)	Average Day Demand (mgd)[1]	Peak Day Demand (mgd)[2]	Peak Day Demand over 8 hrs (mgd)[3]
1	Alta Loma Park	5.4	9	0.02	0.03	0.09
2	El Camino High School	8.2	36	0.08	0.10	0.30
3	Alta Loma Middle School	5.0	14	0.03	0.04	0.12
4	Sunshine Gardens Elementary	3.4	6	0.01	0.02	0.06
5	Holy Cross Cemetery	150.0	255	0.55	0.72	2.16
6	Cypress Lawn Memorial Park	146.0	248	0.54	0.70	2.10
7	Cypress Hills Golf Course	30.0	62	0.13	0.17	0.51
8	Woodlawn Cemetery	49.5	84	0.18	0.24	0.72

Table 1 Potential Recycled Water Customers, Town of Colma and South San Francisco, 2009 Feasibility Study
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Name	Existing Irrigated Acreage	Average Annual Demand (afy)	Average Day Demand (mgd)[1]	Peak Day Demand (mgd)[2]	Peak Day Demand over 8 hrs (mgd)[3]
9	Olivet Memorial Park	56.7	96	0.21	0.27	0.81
10	Salem Cemetery	11.7	20	0.04	0.06	0.18
11	Hills of Eternity and Home of Peace	31.5	54	0.12	0.15	0.45
12	Greenlawn Memorial Park	27.0	46	0.10	0.13	0.39
13	Golden Hill Memorial Park	2.0	16	0.04	0.05	0.15
14	Eternal Home	12.6	21	0.05	0.06	0.18
15	Winston Manor Park	1.44	2	0.01	0.01	0.03
16	Hoy Sun Cemetery	7.2	16	0.03	0.04	0.12
17	Serbian Cemetery	13.5	23	0.05	0.06	0.18
18	Italian Cemetery	28.0	48	0.10	0.13	0.39
	Total	**589.1**	**1,056**	**2.29**	**2.98**	**8.94**

Notes:
(1) Based on the maximum month demand (0.33 acre feet per acre, which is 20% of the average annual demand) averaged over 30 days.
(2) Based on a peaking factor of 1.33.
(3) Based on 8 hours of irrigation per day.

3.0 ADDITIONAL RECYCLED WATER CUSTOMERS

The Project team added the following five potential recycled water customers to the Project based on Daly City's request. The Benjamin Franklin Intermediate School, the Garden Village Elementary School, the Margaret Pauline Brown Elementary School, and the City Hall of Daly City are all located in Daly City and the Japanese Benevolent Society is located in the Town of Colma.

4.0 WATER RECYCLING ACT OF 2013

In 2013, Assembly Bill (AB) 803, which is also known as the Water Recycling Act of 2013, was passed. This bill paved the way for using recycled water for irrigation at cemeteries, key legislation of the bill includes:

- Allows for hose bibs to be used at cemeteries supplied with disinfected tertiary treated recycled water.
- If a hose bib is installed in a public area of the cemetery, the cemetery supplied with disinfected tertiary treated recycled water shall post visible signage and labeling indicating that the water is non-potable.

5.0 PUBLIC OUTREACH

Carollo conducted several outreach efforts with the potential recycled water customers. The purpose of the outreach efforts are as follows:

- Provide potential customers with information regarding the Project.
- Obtain information about each customer's distribution system that would be incorporated into the preliminary design.

During the outreach, Carollo focused on understanding how each cemetery operates their system and the physical attributes of each site. Carollo did not negotiate with the potential customers regarding any aspects, such as the price of water, since it was assumed that Daly City and/or SFPUC would lead those discussions as or when needed. The outreach efforts are described in further detail in the following subsections.

5.1 Initial Customer Meeting

Carollo conducted a meeting with prospective recycled water customers on December 22, 2015. The meeting was attended by SFPUC, Daly City, Carollo, the town of Colma, and six cemeteries. The purpose of the meeting was to provide basic information regarding the Project to the potential customers and to address any questions/concerns the potential customers may have.

5.2 Customer Questionnaire

Carollo developed a questionnaire for the potential recycled water customers. The purpose of the questionnaire was to gain more information (i.e.: irrigation schedule, irrigable acreage, storage volume, peak water use, etc.) regarding each customer's irrigation system. The information obtained from these questionnaires will be incorporated into the preliminary design of the Project. The customer questionnaire is shown in Appendix A.

The customer questionnaire was provided to the cemeteries that attended the initial customer meeting on December 22, 2015. On January 15, 2016, the customer questionnaires were sent to all the cemeteries, by the Town of Colma. Carollo received two completed customer questionnaires. The customer questionnaire responses are shown in Appendix B.

5.3 Project Fact Sheet

Carollo generated a fact sheet to provide information about the Project for potential customers. The fact sheet summarizes project highlights, project schedule, and contact information for the stakeholders involved. The project fact sheet is shown in Appendix C.

5.4 Site Visits

Carollo conducted site visits with potential recycled water customers in January 2016. Carollo visited fourteen cemeteries and spoke with cemetery personnel to gather information about each facility. The information included property boundaries, irrigated areas, existing storage volume and location, potential connection point for recycled water irrigation line, and existing irrigation system layout. Summaries of the site visits at the different cemeteries are provided in Appendix D.

The key findings obtained and conclusions from the site visits are as follows:

- Two cemeteries, the Japanese Benevolent Society and Serbian Cemetery, have minimal irrigation potential and have been removed from the Project.
- Several cemeteries have existing storage tanks/ponds. Using existing storage tanks/ponds can potentially decrease the amount of storage needed for the Project.
- The majority of the cemeteries have hose bibs. The Water Recycling Act of 2013 minimizes the retrofit requirements associated with the hose bibs (i.e. the hose bibs can remain in place and use tertiary recycled water with proper signage).
- For customers with existing storage, the Project would deliver recycled water to the existing storage tank/pond to allow recycled water to be distributed through the existing distribution pipelines. For customers without existing storage, the Project would connect the recycled water to the irrigation system. The appropriate retrofit requirements will need to be performed for both types of customers to maintain completely separate potable and recycled water systems
- The retrofit required for each cemetery will be different considering the unique aspects of each site.

6.0 RECYCLED WATER CUSTOMERS

The current list of potential recycled water customers is presented in Table 2. The table shows there are 22 customers with an average daily demand of 2.49 million gallons per day (mgd) and a peak day demand of 3.32 mgd. An overview of the recycled water customers is shown in Figure 1.

Table 2 Potential Recycled Water Customers
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Name	Type	Location	Existing Irrigated Acreage	Average Annual Demand (afy)[1]	Average Day Demand (mgd)[2]	Peak Day Demand (mgd)[3]	Peak Day Demand over 8 hrs (mgd)[4]	Irrigation Water Supply	Potable Water Supply	Storage Available	Assumed Retrofit Requirement
1	Benjamin Franklin Intermediate School	School	Broadmoor	9.5	16	0.03	0.05	0.14	Cal Water	Cal Water	No	Cut and cap line from Cal Water service
2	Garden Village Elementary School	School	Broadmoor	2.3	4	0.01	0.01	0.03	Daly City Water	Daly City Water	No	Cut and cap line from Daly City Water service
3	Daly City Hall	Other	Daly City	1.7	3	0.01	0.01	0.02	Daly City Water	Daly City Water	No	Cut and cap line from Daly City Water service
4	M Pauline Brown Elementary School	School	Daly City	9.0	15	0.03	0.04	0.13	Daly City Water	Daly City Water	No	Cut and cap line from Daly City Water service
5	Cypress Lawn Memorial Park - East and West Campus	Cemetery	Colma	124.0	211	0.44	0.59	1.77	Private Well	Cal Water	Yes	Irrigation system is already separated
6	Eternal Home	Cemetery	Colma	12.6	21	0.04	0.06	0.18	Private Well	Cal Water	Yes	Irrigation system is already separated
7	Greenlawn Memorial Park	Cemetery	Colma	31.5	54	0.11	0.15	0.45	Cal Water	Cal Water	No	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.
8	Italian Cemetery	Cemetery	Colma	21.3	36	0.08	0.10	0.30	Private Well	Private Well	Yes	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.
9	Alta Loma Middle School	School	South San Francisco	8.5	14	0.03	0.04	0.12	Cal Water	Cal Water	No	Cut and cap line from Cal Water service
10	Alta Loma Park	School	South San Francisco	5.4	9	0.02	0.03	0.08	Cal Water	Cal Water	No	Cut and cap line from Cal Water service
11	El Camino High School	School	South San Francisco	13.0	22	0.05	0.06	0.19	Cal Water	Cal Water	No	Cut and cap line from Cal Water service
12	Sunshine Gardens Elementary	School	South San Francisco	3.4	6	0.01	0.02	0.05	Cal Water	Cal Water	No	Cut and cap line from Cal Water service
13	Winston Manor Park	School	South San Francisco	1.4	2	0.01	0.01	0.02	Cal Water	Cal Water	No	Cut and cap line from Cal Water service
14	Cypress Hills Golf Course	Golf Course	Colma	8.0	14	0.03	0.04	0.11	Cal Water	Cal Water	No	Cut and cap line from Cal Water service
15	Cypress Lawn Memorial Park - Hillside Campus	Cemetery	Colma	28.0	48	0.10	0.13	0.40	Cal Water	Cal Water	No	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.
16	Golden Hill Memorial Park	Cemetery	Colma	9.8	17	0.03	0.05	0.14	Cal Water	Cal Water	No	Cut and cap line from Cal Water service and well
17	Hills of Eternity and Home of Peace and Salem Cemetery	Cemetery	Colma	43.2	73	0.15	0.21	0.62	Private Well	Private Well	Yes	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.
18	Holy Cross Cemetery	Cemetery	Colma	250.0	425	0.89	1.19	3.56	Private Well	Cal Water	Yes	Irrigation system is already separated
19	Hoy Sun Cemetery	Cemetery	Colma	8.8	15	0.03	0.04	0.13	Cal Water	Cal Water	No	Cut and cap line from Cal Water service
20	Olivet Memorial Park	Cemetery	Colma	56.7	96	0.20	0.27	0.81	Private Well	Cal Water	Yes	Irrigation system is already separated
21	Pet's Rest Cemetery	Cemetery	Colma	0.6	1	0.00	0.00	0.01	Cal Water	Cal Water	No	Cut and cap line from Cal Water service
22	Woodlawn Cemetery	Cemetery	Colma	49.5	84	0.18	0.24	0.71	Private Well	Cal Water	Yes	Irrigation system is already separated
	TOTAL			**698.5**	**1,186**	**2.49**	**3.32**	**9.95**				

Notes:
(1) Based on a demand rate of 1.7 acre-feet per acre per year
(2) Based on the maximum month demand (0.33 acre feet per acre, which is 20% of the average annual demand) averaged over 30 days.
(3) Based on a peaking factor of 1.33.
(4) Based on 8 hours of irrigation per day.

RECYCLED WATER CUSTOMERS

FIGURE 1

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

APPENDIX A

CUSTOMER QUESTIONNAIRE

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

Potential Customer Questionnaire

The purpose of this questionnaire is to gather additional information that will be used for the preliminary design of the recycled water system.

Please return your completed questionnaire (electronic or hard copy) as soon as possible (preferably today) to:

Tracy Clinton
Carollo Engineers
2700 Ygnacio Valley Road, Suite 300
Walnut Creek, CA 94598
TClinton@Carollo.com

1. SITE CONTACT INFORMATION

Contact Name ______________________________

Contact Phone ______________________________

Contact Email ______________________________

2. SITE INFORMATION

Site Name ______________________________

Site Address ______________________________

APN / Parcel Number ______________________________

Total Acreage ______________________________

3. IRRIGATION INFORMATION

Current Water Source for Irrigation ______________________________

Existing Irrigable Acreage ______________________________

Future Irrigable Acreage ______________________________

Existing Storage Volume (acre feet) ______________________________

Future Storage Volume (acre feet) ______________________________

Minimum Irrigation Pressure (psi) ______________________________

Yearly Water Use (gal) ______________________________

Average Water Use per Day (gal) ______________________________

Peak Water Use per Day (gal) ______________________________

Yearly Irrigation Schedule (please circle the months when irrigation occurs)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Weekly Irrigation Schedule (please circle the days when irrigation occurs)	Mon Tue Wed Thu Fri Sat Sun
Hourly Irrigation Schedule (please circle the hours when irrigation occurs)	12AM 1AM 2AM 3AM 4AM 5AM 6AM 7AM 8AM 9AM 10AM 11AM 12PM 1PM 2PM 3PM 4PM 5PM 6PM 7PM 8PM 9PM 10PM 11PM
Is the Irrigation System Separated from the Potable Water System?	______________________________
If not, what is the irrigation system connected to? (please circle all that apply)	Drinking/Water Fountains Restrooms Hose Bibbs Others (please specify:____________________)

4. OTHER INFORMATION

Are you interested in receiving recycled water for irrigation?	______________________________
Please list down any concerns/issues/notes?	______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________

Signature: ______________________________

Date: ______________________________

APPENDIX B

CUSTOMER QUESTIONNAIRE RESPONSES

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

Potential Customer Questionnaire

The purpose of this questionnaire is to gather additional information that will be used for the preliminary design of the recycled water system.

Please return your completed questionnaire (electronic or hard copy) as soon as possible (preferably today) to:

Tracy Clinton
Carollo Engineers
2700 Ygnacio Valley Road, Suite 300
Walnut Creek, CA 94598
TClinton@Carollo.com

See notes on Lg map

1. SITE CONTACT INFORMATION

Contact Name	JOHN BERMUDEZ
Contact Phone	650-756-2060
Contact Email	jabermudez@holycrosscemeteries.com

2. SITE INFORMATION

Site Name	HOLY CROSS CATHOLIC CEMETERY
Site Address	1500 MISSION ROAD, COLMA CA. 94014
APN / Parcel Number	011370080
Total Acreage	425 AC

3. IRRIGATION INFORMATION

Current Water Source for Irrigation	WELL
Existing Irrigable Acreage	250 AC
Future Irrigable Acreage	175 AC
Existing Storage Volume (acre feet)	3.07 AC FT / 1MG
Future Storage Volume (acre feet)	3.0 AC FT / 1MG
Minimum Irrigation Pressure (psi)	141 PSI
Yearly Water Use (gal)	252,000,000 GAL
Average Water Use per Day (gal)	700,000 GAL
Peak Water Use per Day (gal)	800,00 GAL

Yearly Irrigation Schedule (please circle the months when irrigation occurs)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Weekly Irrigation Schedule (please circle the days when irrigation occurs)	Mon Tue Wed Thu Fri Sat Sun
Hourly Irrigation Schedule (please circle the hours when irrigation occurs)	12AM 1AM 2AM 3AM 4AM 5AM 6AM 7AM 8AM 9AM 10AM 11AM 12PM 1PM 2PM 3PM 4PM 5PM 6PM 7PM 8PM 9PM 10PM 11PM
Is the Irrigation System Separated from the Potable Water System?	YES
If not, what is the irrigation system connected to? (please circle all that apply)	Drinking/Water Fountains Restrooms Hose Bibbs Others (please specify:__________)

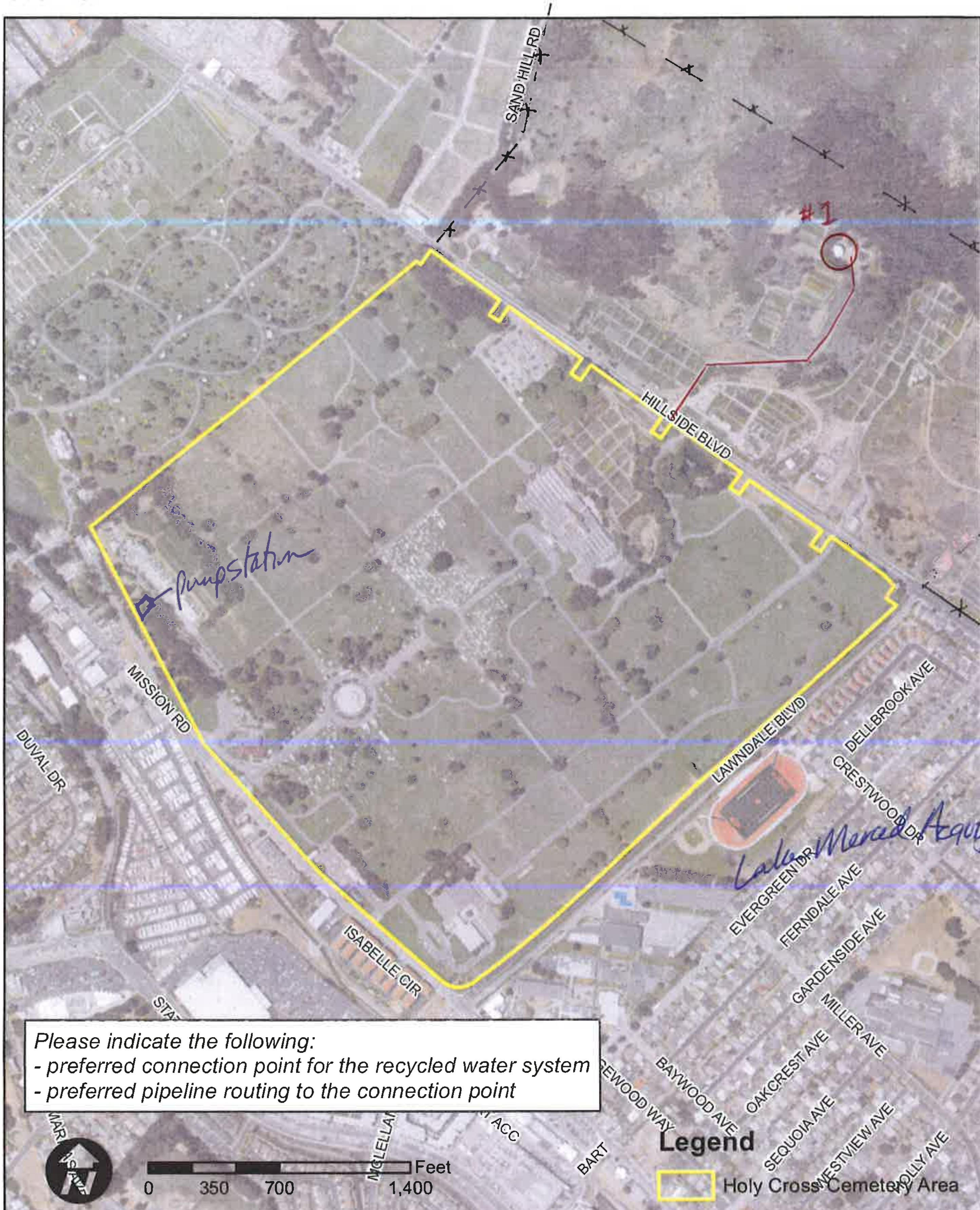
4. OTHER INFORMATION

Are you interested in receiving recycled water for irrigation?	YES WE ARE INTERESTED IN RECEIVING RECYCLED WATER
Please list down any concerns/issues/notes?	CONCERNS: SERVICE INTERUPTION CONSTANT WATER SUPPLY, COST

Signature: John Bermudez

Date: 1/26/2016

Overview



PLAN VIEW

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

Potential Customer Questionnaire

The purpose of this questionnaire is to gather additional information that will be used for the preliminary design of the recycled water system.

Please return your completed questionnaire (electronic or hard copy) as soon as possible (preferably today) to:

Tracy Clinton
Carollo Engineers
2700 Ygnacio Valley Road, Suite 300
Walnut Creek, CA 94598
TClinton@Carollo.com

Home of Peace
Hills of Eternity
SALEM Cemeteries

1. SITE CONTACT INFORMATION

Contact Name: Chris J. Miller Grounds Supt
Contact Phone: 650 826 4045
Contact Email: CMiller@JCEMSF.ORG

2. SITE INFORMATION

Site Name: Home of Peace / Hills of Eternity / Salem
Site Address: 1171 / 1299 / 1301
APN / Parcel Number:
Total Acreage: 60-70 ? Acres

3. IRRIGATION INFORMATION

Current Water Source for Irrigation: Well Water
Existing Irrigable Acreage: 60-70 Acres
Future Irrigable Acreage: ~~5-10 Acres~~ Ø
Existing Storage Volume (~~acre feet~~ gallons): 500,000 Gallons
Future Storage Volume (acre feet): Ø
Minimum Irrigation Pressure (psi): ? 80 PSI
Yearly Water Use (gal): ? 45,840,000 per Year
Average Water Use per Day (gal): 230,000 per DAY
Peak Water Use per Day (gal): 250,000

Yearly Irrigation Schedule (please circle the months when irrigation occurs)	Jan (Feb) (Mar) (Apr) (May) (Jun) (Jul) (Aug) (Sep) (Oct) Nov Dec
Weekly Irrigation Schedule (please circle the days when irrigation occurs) Auto → Manual 5 Days a week	Mon (Tue) Wed (Thu) Fri (Sat) Sun
Hourly Irrigation Schedule (please circle the hours when irrigation occurs)	(12AM 1AM 2AM 3AM 4AM 5AM 6AM 7AM 8AM 9AM 10AM 11AM 12PM 1PM 2PM 3PM 4PM 5PM 6PM 7PM 8PM 9PM 10PM 11PM)
Is the Irrigation System Separated from the Potable Water System?	NO
If not, what is the irrigation system connected to? (please circle all that apply)	~~Drinking~~ (Water Fountains) (Restrooms) (Hose Bibbs) Others (please specify:__________)

4. OTHER INFORMATION

Are you interested in receiving recycled water for irrigation?	1) Costs
Please list down any concerns/issues/notes?	2) maintenance 3) Safety — 4) Valves — sprinklers — Clean or Not

Signature: [signature]

Date: 12-22-15

Overview

PLAN VIEW

Overview

PLAN VIEW

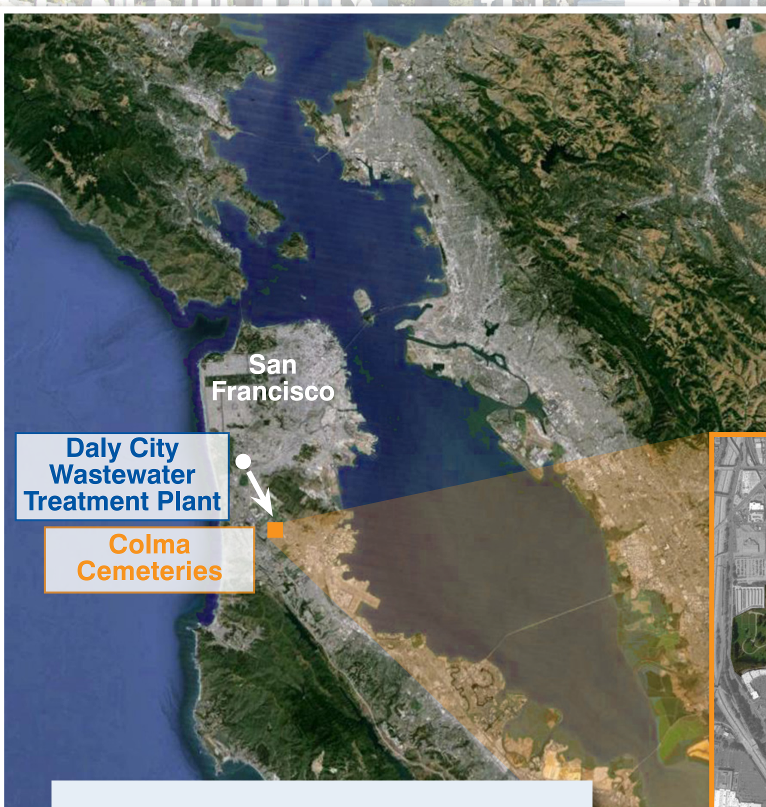
APPENDIX C

PROJECT FACT SHEET

City of Daly City and San Francisco Public Utilities Commission

Recycled Water Project

PRELIMINARY DESIGN



Providing Recycled Water to Colma Cemeteries

- Reduces irrigation reliance on the groundwater basin
- Provides local, sustainable, drought-proof water supply
- Preserves available groundwater supplies for drinking water

Expanding the Daly City Treatment Facility

- Increases recycled water opportunities
- Enhances treatment process capacity
- Provides a valuable resource for beneficial use

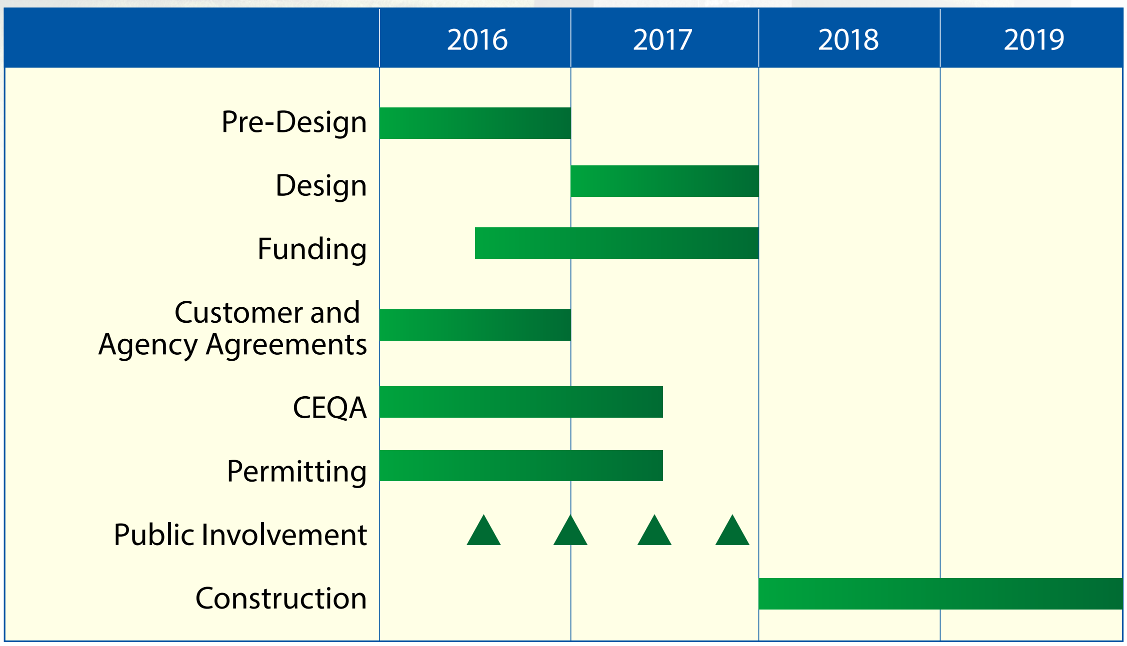
Colma cemeteries

The City of Daly City (Daly City) currently produces 2.77 million gallons per day of recycled water. This recycled water is used for irrigation at the San Francisco Golf Club, Olympic Club, Lake Merced Golf Club, Harding Park Golf Club, and several city parks and medians. **Daly City** and the **San Francisco Public Utilities Commission** (SFPUC) are jointly pursuing the Feasibility of Expanded Tertiary Recycled Water Facilities Project, which will provide an additional 3+/- million gallons per day of recycled water irrigation supply to the cemeteries in the **Town of Colma** and other parks and schoolyards. The goal of the project is to reduce irrigation reliance on the groundwater basin and to create a local, sustainable, drought-proof water supply that preserves the local groundwater basin for drinking water supply.

Project Highlights

- ***Increases recycled water supply:*** This project would produce an additional 3+/- million gallons per day of recycled water for the region.
- ***Provides local, drought-proof water supply:*** Recycled water produced from the Daly City Wastewater Treatment Plant provides a continuous and sustainable water supply during times of drought. The supply satisfies California Title 22 regulations for tertiary unrestricted water reuse.
- ***Reduces reliance on groundwater basin:*** The recent prolonged California drought has detrimentally affected many groundwater basins across the State. This project would provide a reliable water supply, reduce irrigation reliance on the groundwater basin, and help meet the California Sustainable Groundwater Management Act to enhance local drinking water supply.

Project Schedule



Contacts

Patrick Sweetland
Director of Water and Wastewater Resouces
City of Daly City
(650) 991-8201
psweetland@dalycity.org

Brad Donohue
Public Works Director
Town of Colma
(650) 757-8888
brad.donohue@colma.ca.gov

Paula Kehoe
Director of Water Resources
San Francisco Public Utilities Commission
(415) 554-0792
pkehoe@sfwater.org

Tony Carrasco
District Manager
California Water Service Company
(650) 558-7820
acarrasco@calwater.com

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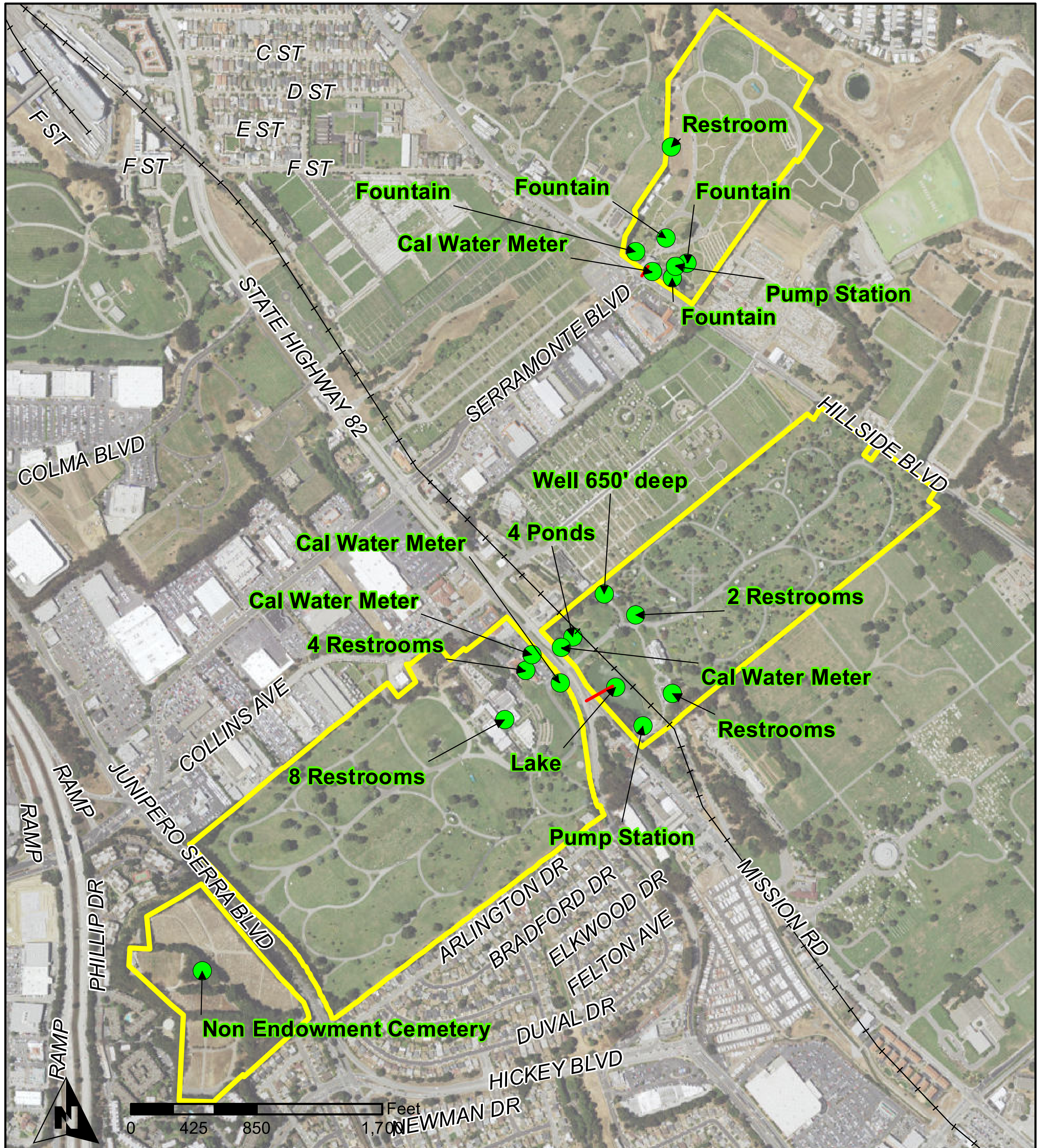
Engineers...*Working Wonders With Water*®

APPENDIX D

CEMETERY SITE VISIT SUMMARIES

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 152.0 acres; Design demand: 2.17 MGD
- Cal Water serves restrooms, office, kitchen - all potable uses.
- Irrigation and hose bibbs / vase fills are on the well.
- Propery to the south of Hillside Boulevard, hose bibbs are 60' apart. Property to the north of Hillside Boulevard, hose bibbs are 20' apart.
- Well is 650' deep.
- The 4 ponds are interconnected to the lake.
- There are two pump stations. Pump station by the lake has two 100 hp pumps (700 gpm). Booster pump station to the north of Hillside Boulevard is 40 hp (500 gpm).
- Total irrigation storage of 1 MG in all four lakes.
- Irrigation occurs a maximum of four times a week (Mon, Wed, Fri, Sun; 6PM - 6AM).
- East and West campuses are on well water. Hillside campus is on Cal Water.

ASSUMED RETROFIT

- For East and West campuses, connect 200' service line to existing storage pond
- For Hillside campus, connect 80' service line to irrigation line. Cap and cut line for all restrooms. Connect potable system to Cal Water.
- Signage on hose bibbs
- Meter

Key

- Service Line
- Points of Interest
- Cypress Lawn
- BART Line

Overview

PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 12.6 acres; Design demand: 0.18 MGD.
- Future expansion: 4.6 irrigable acres.
- Well is 600 feet deep.
- 65,000 gallon storage tank.
- Site has hose bibbs every 50' for hoses / vase fills.
- Cal Water service in restrooms / offices along El Camino
- Well water for irrigation, hose bibbs, and toilet along Hillside Blvd.
- Automatic sprinkler system.
- Restroom on Hillside Blvd is on well water w/ septic holding tank. Currently uses bottled water for drinking.

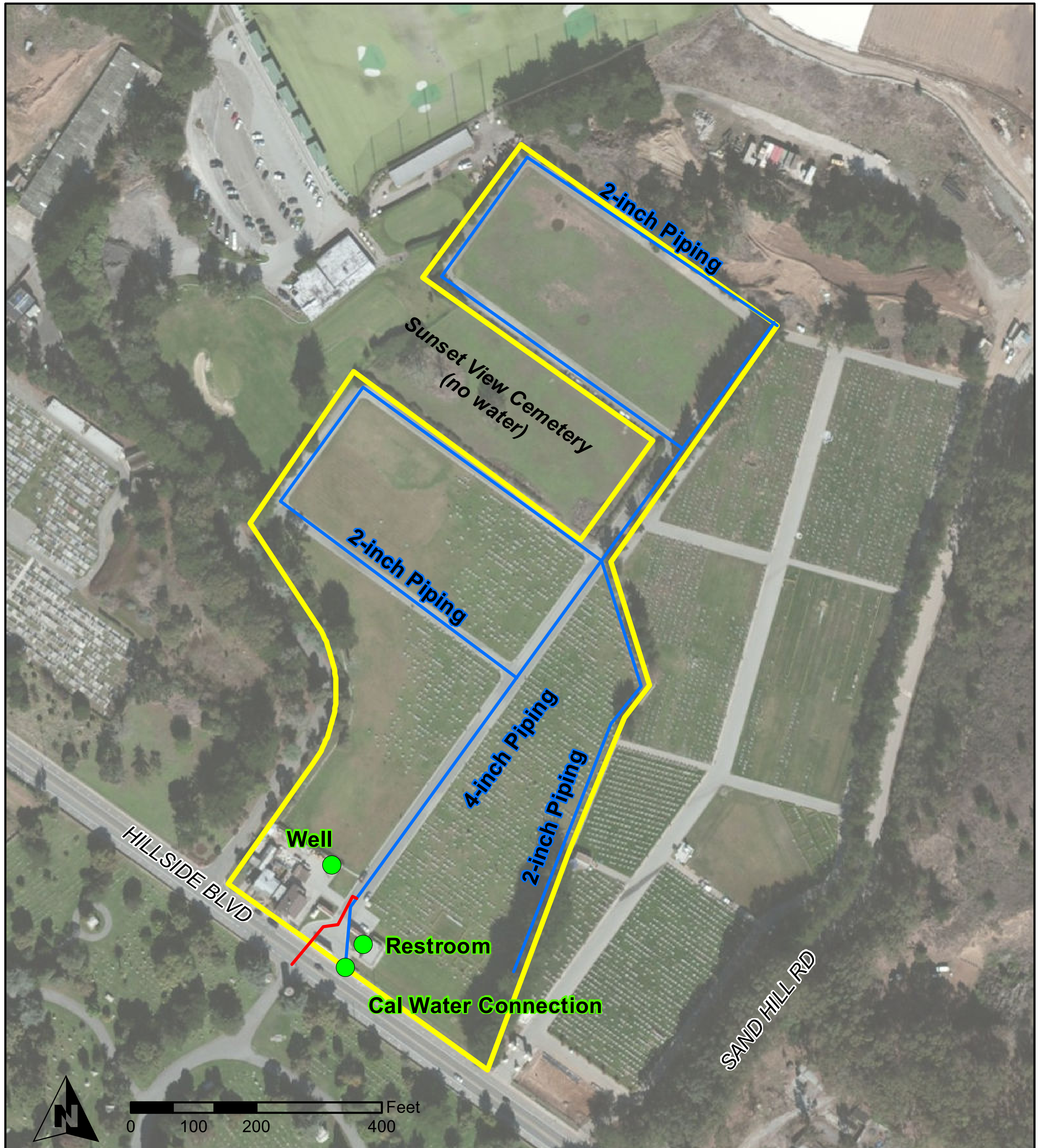
ASSUMED RETROFIT

- Connect 370' service line to existing storage tank.
- Keep well connection to existing storage tank as a back up.
- Signage on hose bibbs
- Meter

Key

Points of Interest
Service Line
BART Line
Eternal Home Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Per Chinese tradition, Chinese do not like to be buried by water / piping.
- Does not use irrigation piping; uses individual hose bibbs throughout the cemetery to irrigate and for vase filling.
- Irrigable acreage: 9.8 acres; Design demand: 0.14 MGD
- Current water supply is Cal Water and private well (well water since 3/2015).
- Well is 700 feet deep and capacity is approximately 30 gpm
- Piping is along roads.
- It takes approximately 5 days to water entire area.
- During irrigation, 9 sprinklers are running simultaneously.
- Plans to demolish house and build new funeral home (current as of 2016).

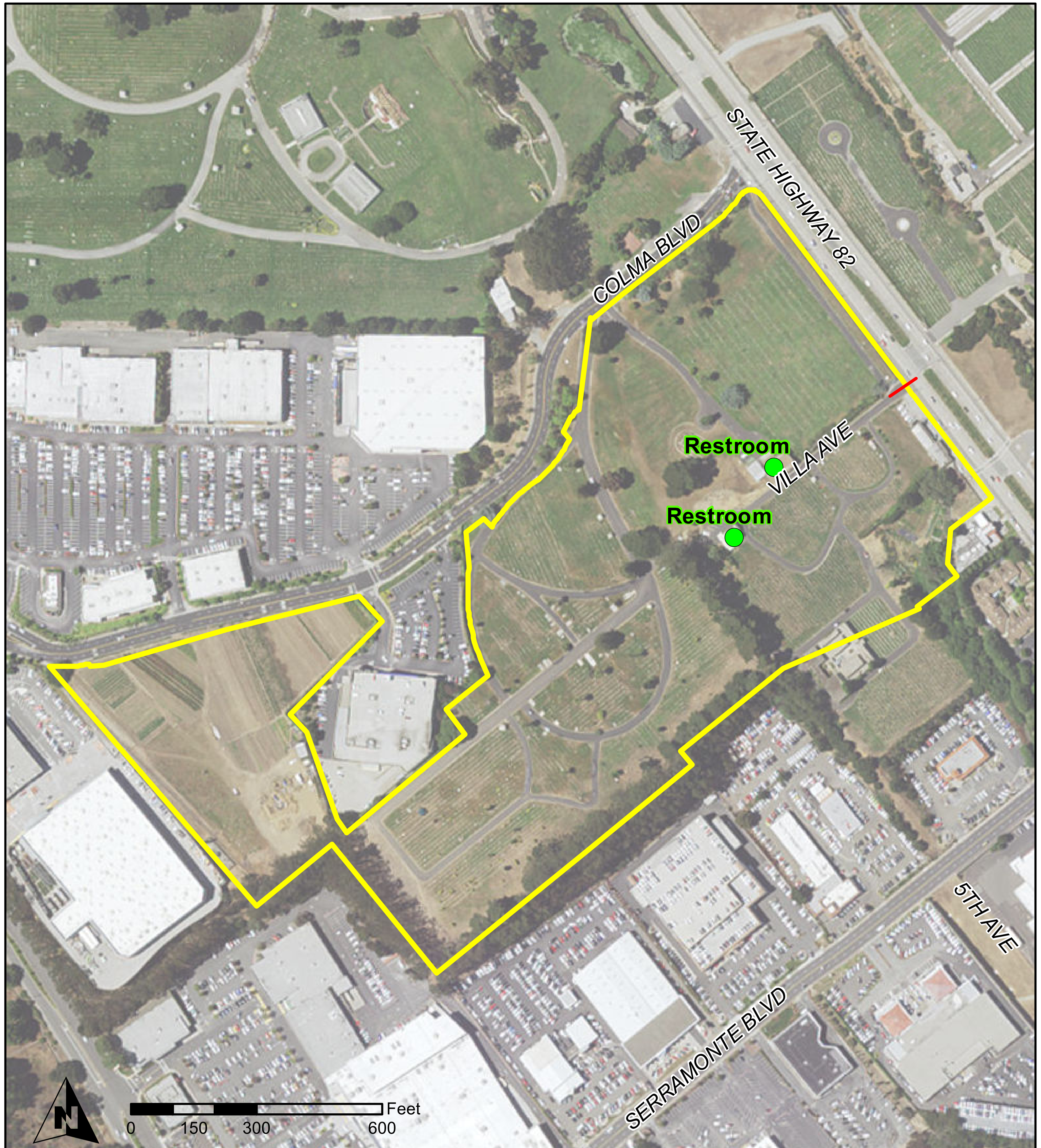
ASSUMED RETROFIT

- Connect 65' service line to existing 4" irrigation line, downstream of the well.
- Cap and cut line from Cal Water supply and existing well.
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Other Piping
- Golden Hill Memorial Park

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 31.5 acres; Design demand: 0.45 MGD
- Current water supply is Cal Water (need to confirm if this is for the whole site).
- No drinking fountains. Only restrooms at offices.
- There are existing graves by the Home Depot area. These graves are being irrigated.

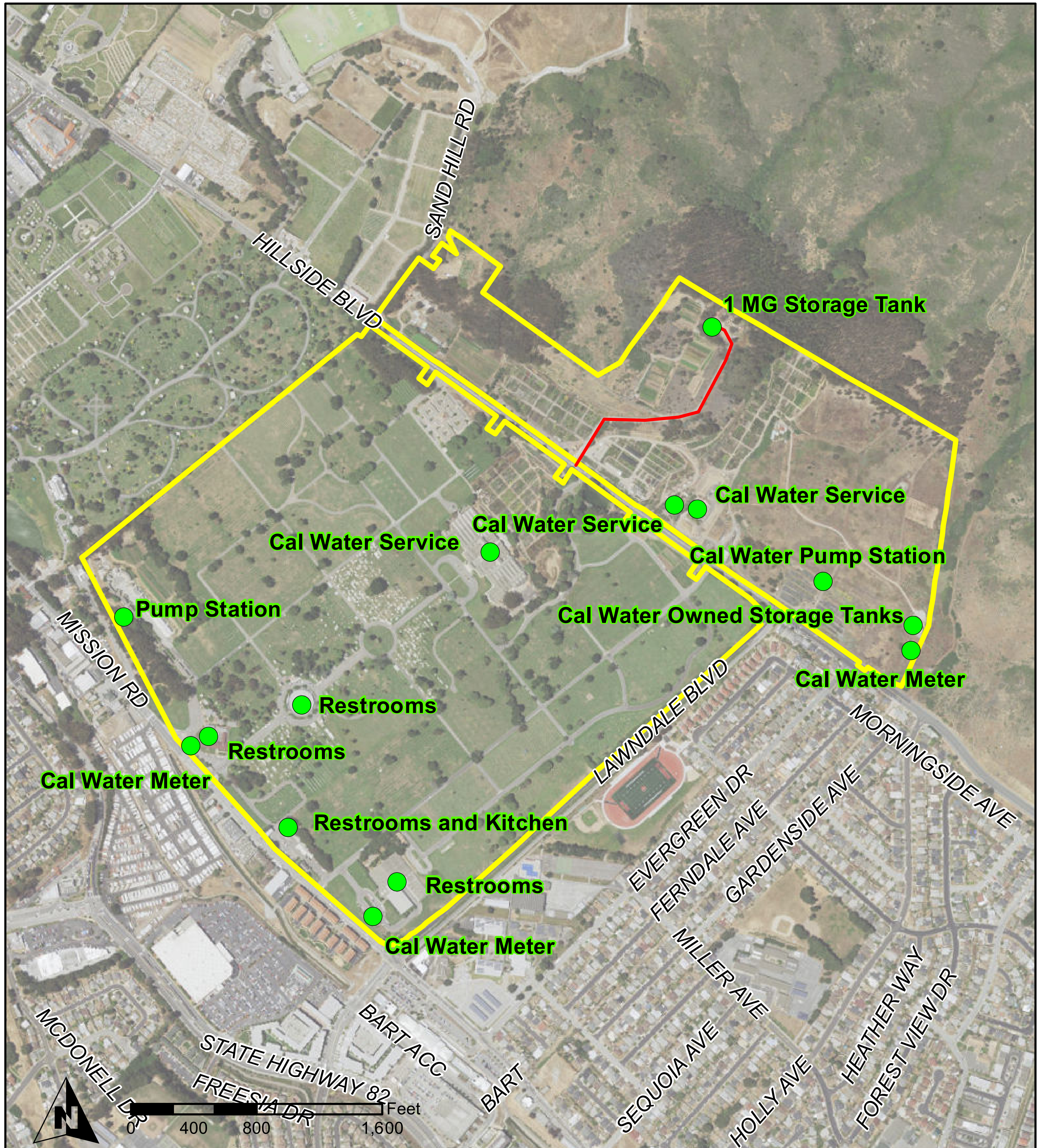
ASSUMED RETROFIT

- Connect 75' service line to existing irrigation line
- Cap and cut line from all restrooms and offices
- Connect potable system to Cal Water
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Greenlawn Memorial Cemetery and Greek Orthodox Memorial Park

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 250.0 acres; Design demand: 3.56 MGD
- Existing 1 MG storage tank. Possible 1 MG expansion in the future (for additional 175 acres of irrigation).
- Existing pump station for irrigation.
- Cal Water owns facilities (pump station and storage tanks) on undeveloped cemetery property.
- Has water stations throughout the site for vase filling.
- Cemetery would consider a storage tank on their property that would be used for the recycled water system.
- Irrigation system is separated from potable water system.

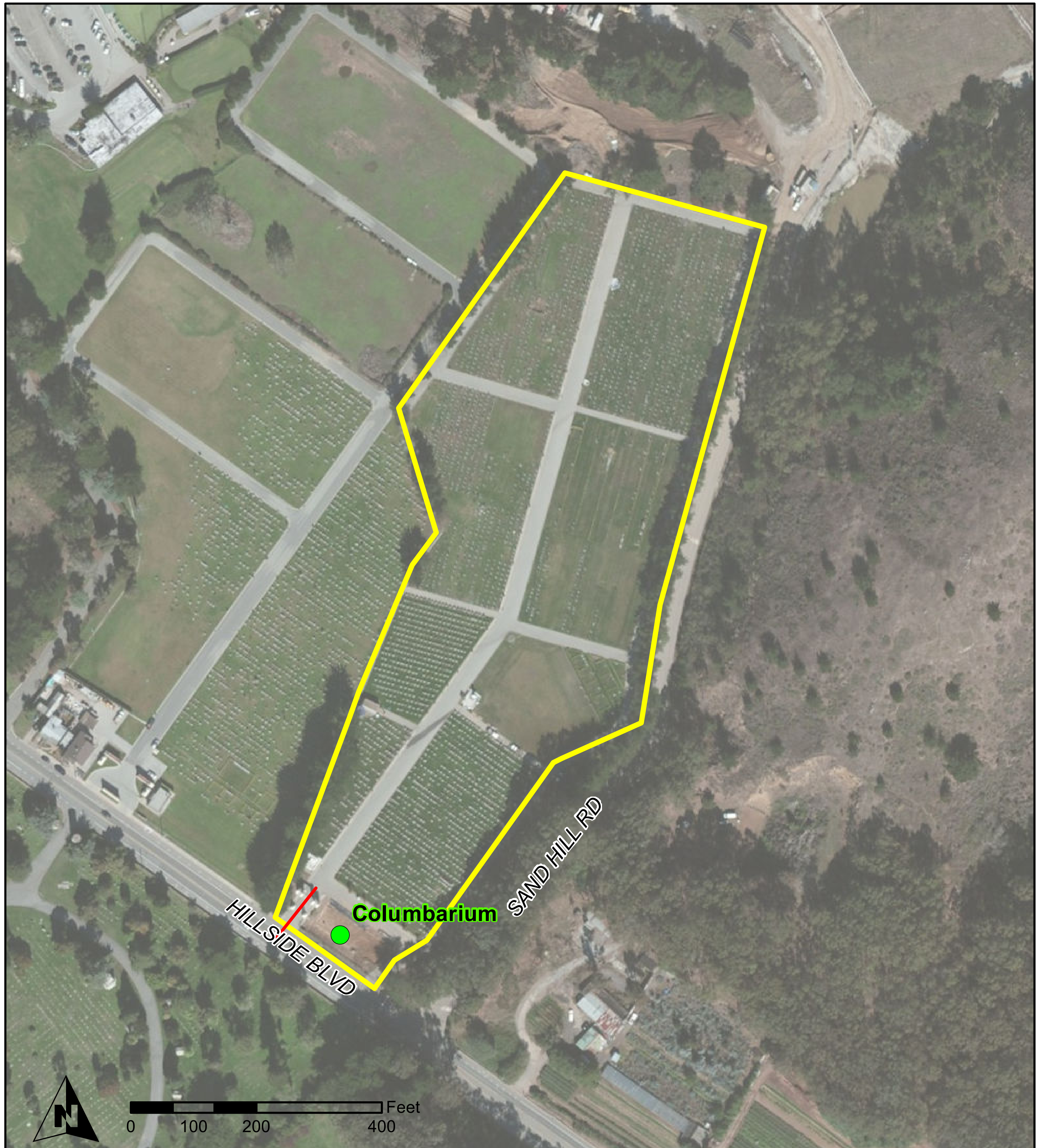
ASSUMED RETROFIT

- Connect 1,630' service line to existing storage tank
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Holy Cross Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Office not open / no one at site.
- Per Chinese tradition, Chinese do not like to be buried by water / piping.
- Does not use irrigation piping; uses individual hose bibbs throughout the cemetery to irrigate and for vase filling.
- Irrigable acreage: 8.8 acres; Design demand: 0.13 MGD
- Current water supply is Cal Water.
- Assumed to have a common connection w/ Golden Hill Memorial Park.

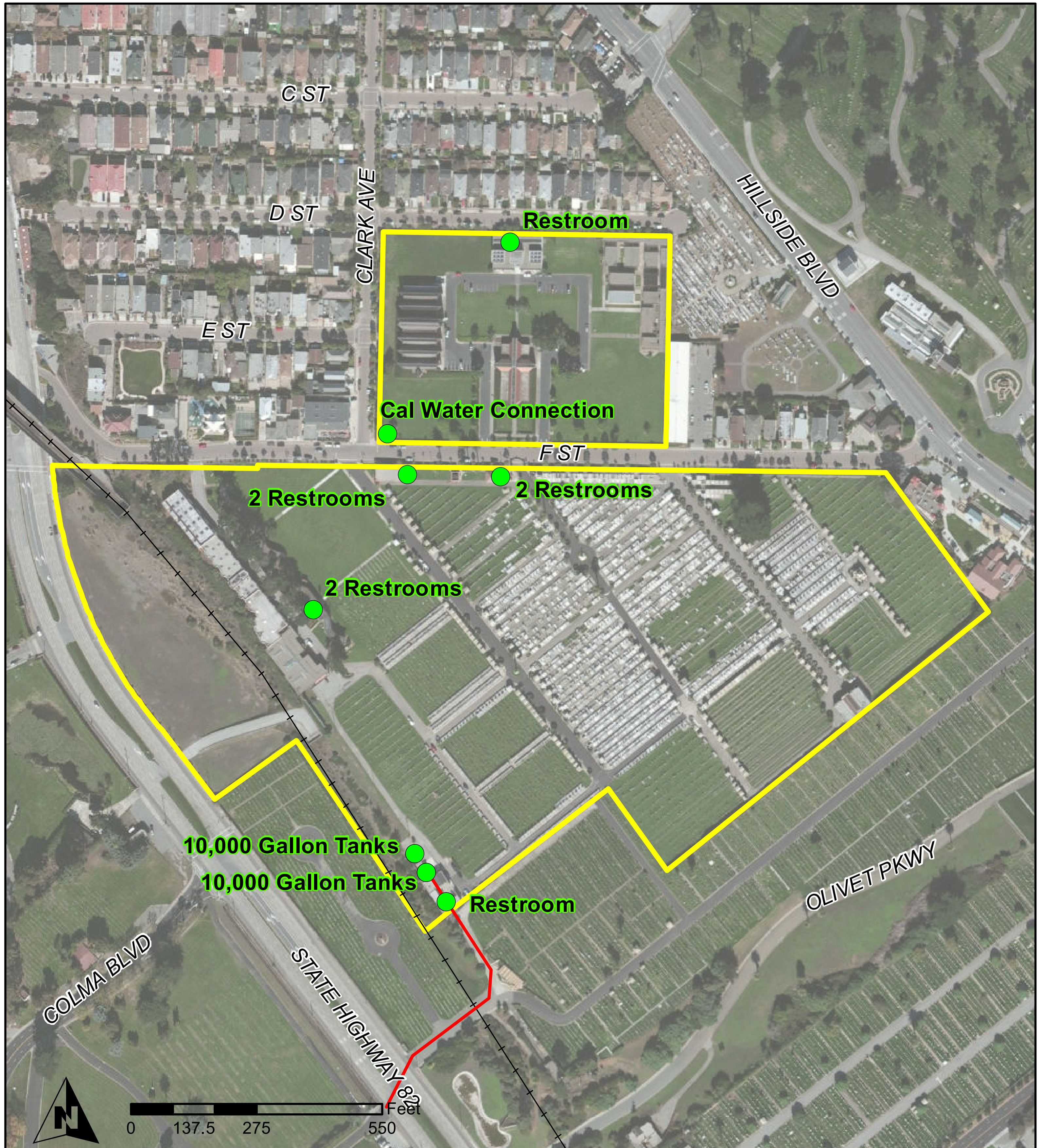
ASSUMED RETROFIT

- Connect 65' service line to existing irrigation line.
- Cap and cut line from Cal Water supply.
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Hoy Sun Memorial Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 21.3 acres; Design demand: 0.30 MGD
- Future irrigable acreage: 3 acres.
- Typically on well water but has a backup Cal Water connection if the well is down (i.e. no potable water is used).
- No potable water.
- 80% of irrigation is at night. Irrigation schedule is 6PM - 6AM.
- Two 10,000 gallon tanks.
- Well is 450 - 470 feet deep.
- Proposed project storage tank location is their best piece of property for future expansion.

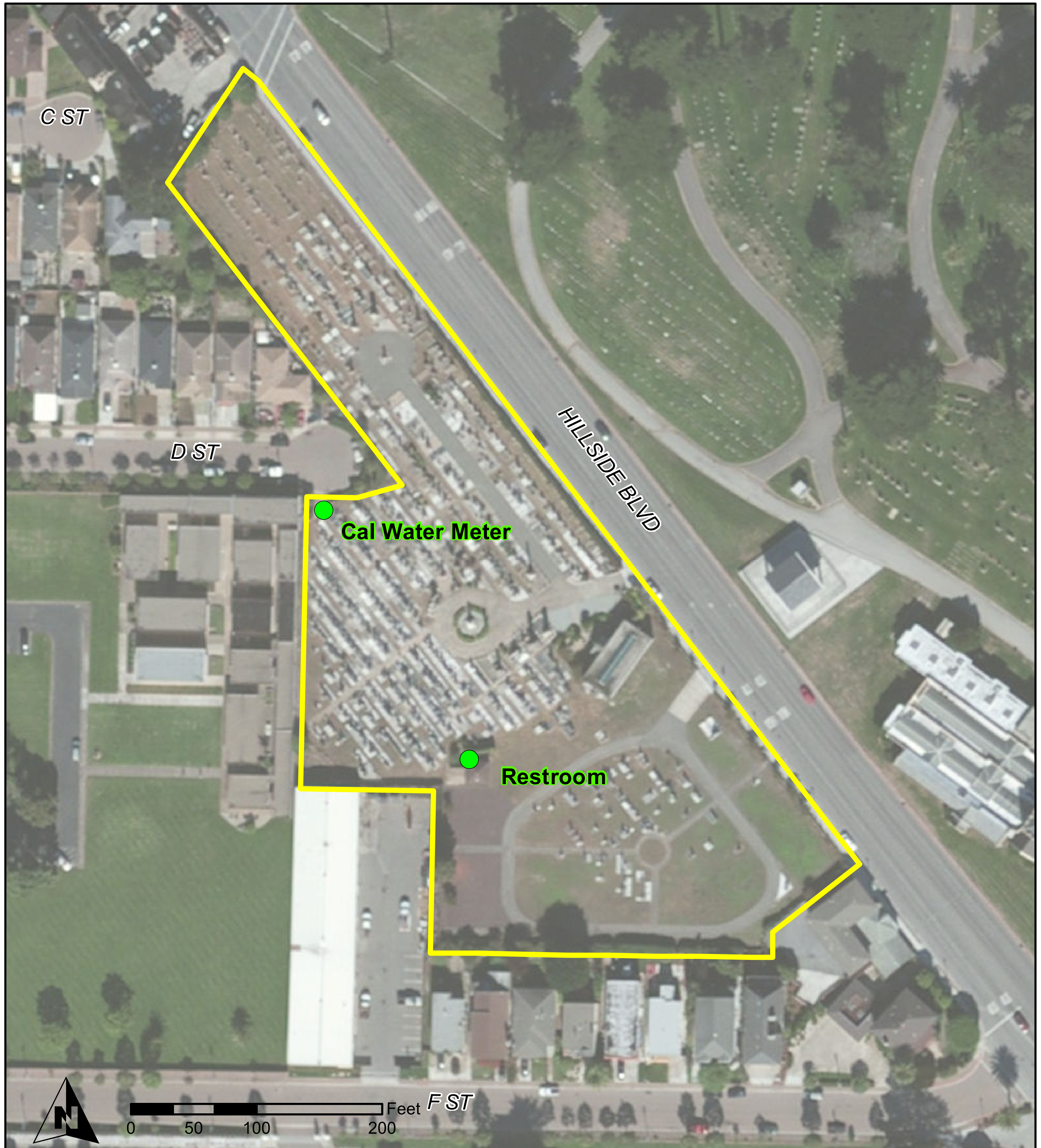
ASSUMED RETROFIT

- Connect 480' service line to existing storage tank.
- Cap and cut line from all restrooms
- Connect potable system to Cal Water
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- BART Line
- Italian Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Since there is no irrigable acreage at this cemetery, this cemetery has been removed as a potential customer.
- There are only hosebibbs for handwashing and vases.
- Current water supply is Cal Water

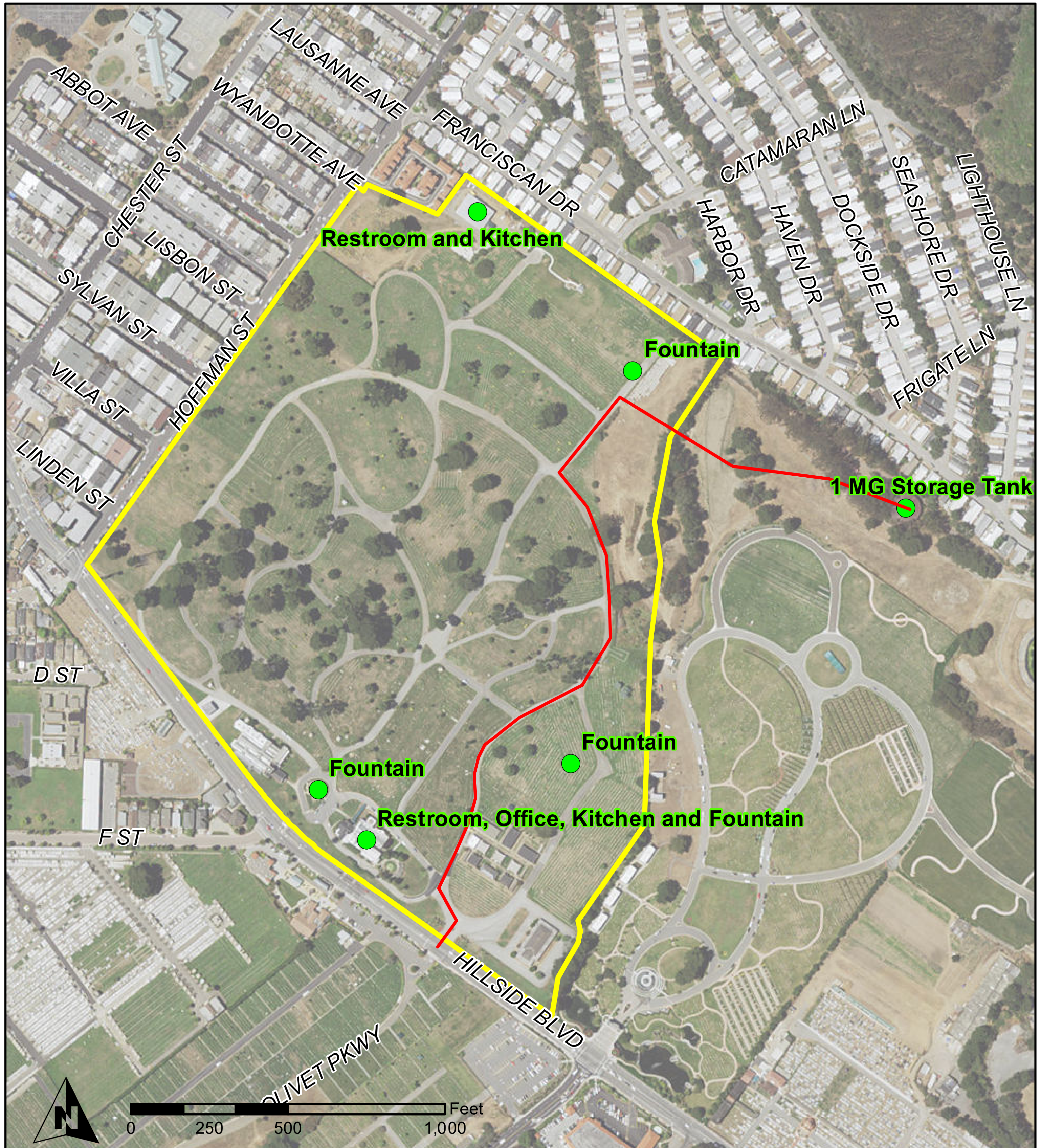
ASSUMED RETROFIT

- Delete from further consideration due to minimal irrigation potential.

Key

- Points of Interest
- Japanese Benevolent Society

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 56.7 acres; Design demand: 0.81 MGD
- Pump station.
- 1 MG storage tank.
- Sprinkler system is used for irrigation.
- Irrigation system is separated from potable water system.

ASSUMED RETROFIT

- Connect 3,140' service line to existing 1 MG storage tank.
- Meter

Key

- Points of Interest
- Service Line
- Olivet Memorial Park

Overview

PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 0.6 acres; Design demand: 0.01 MGD
- Current water supply is Cal Water.
- Cemetery currently pulls from the house for irrigation use on the cemetery. The cemetery is planning for a new sprinkler system if they get a new water meter.
- Cemetery applied to Cal Water for a 2-inch meter for irrigation but their application was rejected.

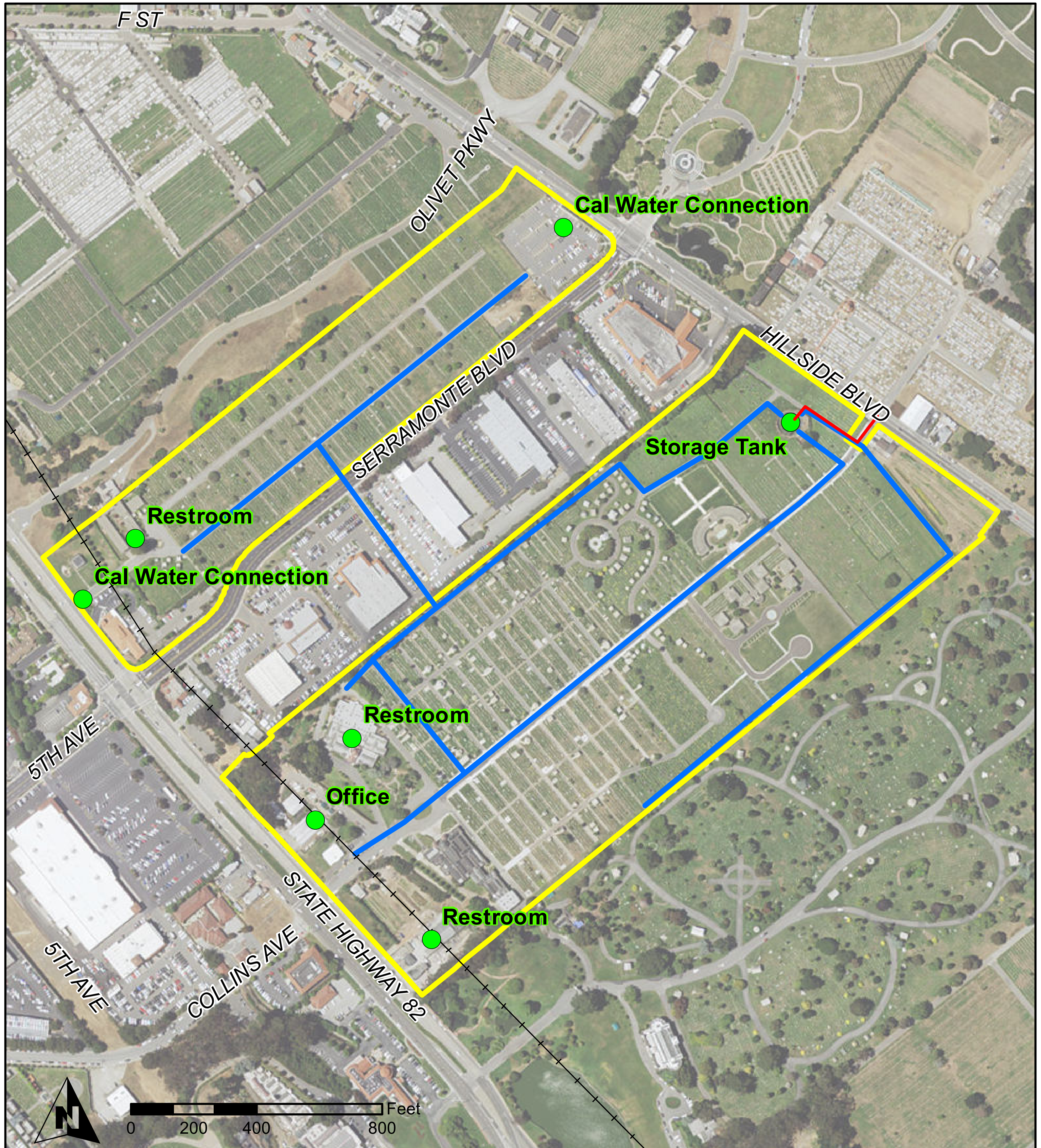
ASSUMED RETROFIT

- Connect 100' service line to existing irrigation system.
- Cap and cut line from Cal Water supply.
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Pet's Rest Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 43.2 acres; Design demand: 0.62 MGD
- No drinking water on site. Office, hose bibbs, handwash stations, etc are all on the same water system.
- Vase filling stations are marked with don't drink.
- No Cal Water service but does have a connection.
- BART runs through the site at Salem.
- There is Alhambra drinking water outside of restrooms.
- There is an existing 0.5 MG tank. During peak demands, the cemeteries drain 1/2 - 3/4 of the tank for 3 days per week.
- Existing well is 650 feet deep.
- Questions / Concerns from the cemeteries:
  - Can existing wells be use for potable water?
  - Will quality of recycled water damage any headstones?

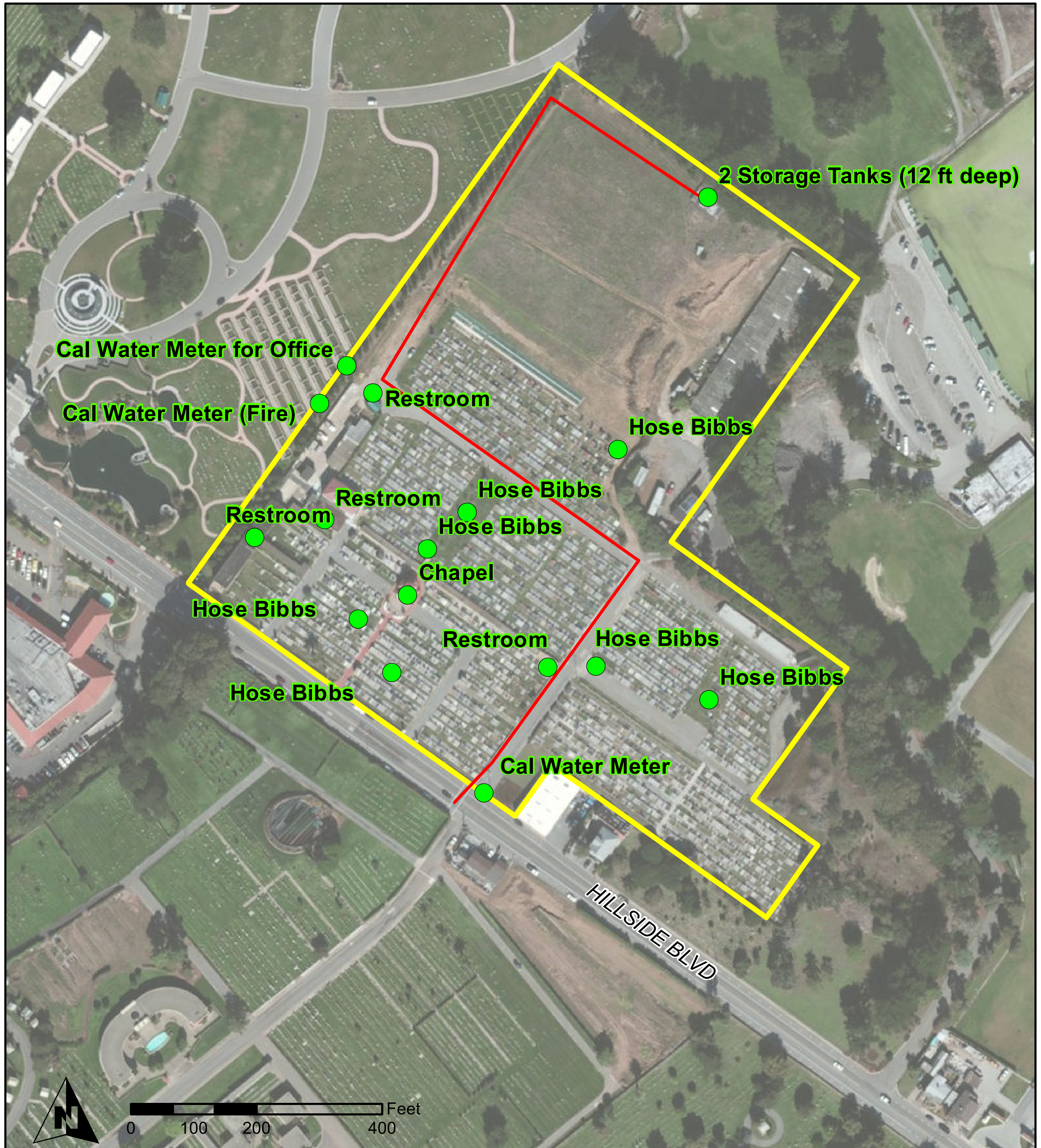
ASSUMED RETROFIT

- Connect 360' service line to existing storage tank.
- Cap and cut line from all restrooms, offices, handwash stations
- Connect potable system to Cal Water
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Other Piping
- Salem Cemetery, Hills of Eternity and Home of Peace
- BART Line

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 0.3 acres; Design demand: 0.004 MGD
- Current water supply is Cal Water.
- 2 storage tanks on site not currently used. Could be reconnected for hosebibbs / vase filling.
- Minimal irrigation potential.
- Plans to expand with minimal irrigation potential (i.e. grave-to-grave with sidewalks in between).

ASSUMED RETROFIT

- Delete from further consideration due to minimal irrigation potential.

Key

- Points of Interest
- Service Line
- Serbian Cemetery

Overview

PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 49.5 acres; Design demand: 0.71 MGD
- Old water storage tanks are located at the highest elevation. Planning to redo/rehabilitate the tanks in 1 - 2 years.
- Well is 500' deep and pumps to the lake.
- There is an existing pump station on site but a new one is required to pump to the old water tanks.
- Plans to reline the lake.
- There are hose bibbs throughout the cemetery (~20' intervals) that use well water.
- Irrigation is done in two days. Half the site is irrigated on the first day while the other half of the site is irrigated on the second day.
- There is an SFPUC easement that runs through the site. There are no graves within the SFPUC easement.
- Irrigation system is separated from potable water system.

ASSUMED RETROFIT

- Connect 3,450' service line to old water storage tanks (not currently in service).
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Woodlawn Cemetery
- SFPUC Easement

APPENDIX E – PROJECT MEMORANDUM 03 - RECYCLED WATER STORAGE TANK VOLUME

Engineers...Working Wonders With Water®

PROJECT MEMORANDUM - 03

Project Name:	Recycled Water Facilities Expansion Predesign Project (Project)	**Updated Date:**	May 9, 2016
Client:	City of Daly City	**Project Number:**	10076 A10
Prepared By:	Darren Baune and Ron Papa		
Reviewed By:	Tracy Clinton		
Subject:	Recycled Water Storage Tank Volume		

1.0 PURPOSE

The purpose of this memorandum is to define the storage tank volume based on recent customer outreach, irrigation demand estimates, and the proposed capacity increase of the Daly City tertiary facilities.

2.0 BACKGROUND

The Recycled Water Treatment and Delivery System Expansion Feasibility Study (Carollo, 2009) (Feasibility Study) estimated the storage tank volume to serve the cemeteries in Colma at 3 million gallon (MG). The tank size calculations were based on the following assumptions:

- The average day demand is 2.29 million gallons per day (mgd) and the peak day demand is 2.98 mgd.
- For an average day, irrigation occurs 8 hours per day (from 9:00 PM to 5:00 AM) at an average day demand of 6.87 mgd (the average day demand over 8 hours).
- For peak day, irrigation occurs 8 hours per day (from 9:00 PM to 5:00 AM) at a peak day demand of 8.94 mgd (the peak day demand over 8 hours).
- The tank would fill for 16 hours per day. The available supply from the Daly City Wastewater Treatment Plant (WWTP) was assumed to be 3.00 mgd for the full 16 hours.
- Storage requirements were calculated by subtracting the design production flow from the maximum hourly demand and multiplying the difference by the amount of time the demand will take place.

This memorandum updates the storage tank size calculations and sizing criteria based on recent customer outreach and updated irrigation demand estimates and the proposed capacity increase of the tertiary treatment process.

3.0 RECYCLED WATER DEMANDS

3.1 Customer Outreach

The project team conducted site visits with all of the potential recycled water customers except Daly City's City hall, the schools, and parks sites. The primary goal of the site visits was to identify the physical characteristics (i.e. point of connection and details of the existing distribution system), irrigable acreage, water use, and well location. Assumptions were made for the school and park sites. Table 1 lists potential recycled water customers and summarizes the physical characteristics of each site. Appendix A includes aerial maps of each cemetery to describe the physical characteristics. Refer to the memorandum titled "Recycled Water Customer Outreach" (Carollo, 2016) for a complete description of the customer outreach.

Table 1 Potential Recycled Water Customers
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Name	Location	Irrigation Water Supply	Potable Water Supply	Connection Point	Retrofit Requirement	Existing Storage Tank/Pond (Volume)
1	Benjamin Franklin Intermediate School	Broadmoor	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service	No
2	Garden Village Elementary School	Broadmoor	Daly City Water	Daly City Water	Irrigation Line	Cut and cap line from Daly City Water service	No
3	City Hall	Daly City	Daly City Water	Daly City Water	Irrigation Line	Cut and cap line from Daly City Water service	No
4	M. Pauline Brown Elementary School	Daly City	Daly City Water	Daly City Water	Irrigation Line	Cut and cap line from Daly City Water service	No
5	Cypress Lawn Memorial Park - East and West Campus	Colma	Private Well	Cal Water	Storage Pond	Irrigation system is already separated	Yes (1 MG)
6	Eternal Home	Colma	Private Well	Cal Water	Storage Tank	Irrigation system is already separated	Yes (0.065 MG)
7	Greenlawn Memorial Park	Colma	Cal Water	Cal Water	Irrigation Line	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.	No
8	Italian Cemetery	Colma	Private Well	Private Well	Storage Tank	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.	Yes (0.020 MG)
9	Alta Loma Middle School	South San Francisco	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service	No
10	Alta Loma Park	South San Francisco	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service	No
11	El Camino High School	South San Francisco	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service	No

Table 1	Potential Recycled Water Customers Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City						
No.	**Name**	**Location**	**Irrigation Water Supply**	**Potable Water Supply**	**Connection Point**	**Retrofit Requirement**	**Existing Storage Tank/Pond (Volume)**
12	Sunshine Gardens Elementary	South San Francisco	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service	No
13	Winston Manor Park	South San Francisco	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service	No
14	Cypress Hills Golf Course	Colma	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service	No
15	Cypress Lawn Memorial Park - Hillside Campus	Colma	Cal Water	Cal Water	Irrigation Line	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.	No
16	Golden Hill Memorial Park	Colma	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service and well	No
17	Hills of Eternity and Home of Peace and Salem Cemetery	Colma	Private Well	Private Well	Storage Tank	Cut and cap lines from all restrooms, offices and handwash stations. Connect potable water system to Cal Water.	Yes (0.50 MG)
18	Holy Cross Cemetery	Colma	Private Well	Cal Water	Storage Tank	Irrigation system is already separated	Yes (1 MG)
19	Hoy Sun Cemetery	Colma	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service	No
20	Olivet Memorial Park	Colma	Private Well	Cal Water	Storage Tank	Irrigation system is already separated	Yes (1 MG)
21	Pet's Rest Cemetery	Colma	Cal Water	Cal Water	Irrigation Line	Cut and cap line from Cal Water service	No
22	Woodlawn Cemetery	Colma	Private Well	Cal Water	Storage Tank	Irrigation system is already separated	Yes
~~23~~	~~Japanese Benevolent Society~~	~~Colma~~	~~Cal Water~~	~~Cal Water~~		REMOVED DUE TO MINIMAL IRRIGATION POTENTIAL	
~~24~~	~~Serbian Cemetery~~	~~Colma~~	~~Cal Water~~	~~Cal Water~~		REMOVED DUE TO MINIMAL IRRIGATION POTENTIAL	

3.2 Recycled Water Demand Estimates

The project team updated the recycled water demand estimates based on the customer outreach. Table 2 shows the latest list of customers and estimated recycled water demands for customers in Broadmoor, Daly City, Colma and South San Francisco. The customers include city parks, schools, a golf course driving range, and cemeteries.

Table 2 Recycled Water Demands
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Name	Existing Irrigated Acreage	Average Annual Demand (afy)[2]	Average Day Demand (mgd)[3]	Peak Day Demand (mgd)[4]	Peak Day Demand over 8 hrs (mgd)[5]
1	Benjamin Franklin Intermediate School[7]	9.5	16	0.03	0.05	0.135
2	Garden Village Elementary School[7]	2.3	4	0.01	0.01	0.033
3	City Hall[7]	1.7	3	0.01	0.01	0.024
4	M. Pauline Brown Elementary School[7]	9.0	15	0.03	0.04	0.128
5	Cypress Lawn Memorial Park - East and West Campus	124.0	211	0.44	0.59	1.767
6	Eternal Home	12.6	21	0.04	0.06	0.180
7	Greenlawn Memorial Park	31.5	54	0.11	0.15	0.449
8	Italian Cemetery	21.3	36	0.08	0.10	0.303
9	Alta Loma Middle School	8.5	14	0.03	0.04	0.121
10	Alta Loma Park	5.4	9	0.02	0.03	0.077
11	El Camino High School	13.0	22	0.05	0.06	0.185
12	Sunshine Gardens Elementary	3.4	6	0.01	0.02	0.048
13	Winston Manor Park	1.4	2	0.01	0.01	0.021
14	Cypress Hills Golf Course	8.0	14	0.03	0.04	0.114
15	Cypress Lawn Memorial Park - Hillside Campus	28.0	48	0.10	0.13	0.399
16	Golden Hill Memorial Park	9.8	17	0.03	0.05	0.140
17	Hills of Eternity and Home of Peace and Salem Cemetery	43.2	73	0.15	0.21	0.616
18	Holy Cross Cemetery	250.0	425	0.89	1.19	3.562
19	Hoy Sun Cemetery	8.8	15	0.03	0.04	0.125
20	Olivet Memorial Park	56.7	96	0.20	0.27	0.808
21	Pet's Rest Cemetery	0.6	1	0.00	0.00	0.009
22	Woodlawn Cemetery	49.5	84	0.18	0.24	0.705
	Total	**698.5**	**1,186**	**2.49**	**3.32**	**9.95**

Notes:
(1) Based on discussions with potential recycled water customers and GIS data.
(2) Based on a demand rate of 1.7 acre feet per acre
(3) Based on the maximum month demand (0.33 acre feet per acre, which is 20% of average annual demand) averaged over 30 days.
(4) Based on a peaking factor of 1.33.
(5) Based on 8 hours of irrigation per day.
(6) Not included in the previous Feasibility Study.
(7) Serbian Cemetery was removed as a potential customer due to its minimal irrigation potential.

The demand calculations are based on the following formulas and assumptions.

- $Average\ Annual\ Demand = Existing\ Irrigated\ Acreage * 1.7\ \frac{acre-feet}{acre-year}$
- $Average\ Day\ Demand = Ex.Irr.Acre * 0.33\ \frac{acre-feet}{acre-month} * \frac{325{,}851\ Gallons}{1\ acre-feet} \frac{1\ MG}{1{,}000{,}000\ Gallons} * \frac{1\ Month}{30.417\ Days}$
- $Peak\ Day\ Demand = Average\ Day\ Demand * 1.33\ Peaking\ Factor$
- $Peak\ Day\ Demand\ Over\ 8\ Hour\ Period = Peak\ Day\ Demand * \frac{24\ hours}{8\ hours}$

Assumptions:

- The annual average irrigation requirement of 1.7 acre-feet/acre/year is based on the 2008 South San Francisco Feasibility Study and the Daly City Feasibility Study.
- The average daily irrigation requirement of 0.33 acre-feet/acre/month is based on the 2008 South San Francisco Feasibility Study and the Daly City Feasibility Study.
- The peaking factor of 1.33 was used in the Daly City Feasibility Study.

4.0 RECYCLED WATER SUPPLY

The recycled water will be supplied from the new tertiary process expansion at the Daly City Wastewater Treatment Plant (WWTP). Based on a preliminary review of Daly City plant flow data, the supply available for recycled water during a dry year is approximately 5.50 mgd over 24 hours. This includes 2.77 mgd for the existing recycled water system and 2.73 mgd for the new recycled water system. This memorandum assumes the average recycled water supply is 2.73 mgd for 24 hours a day and the peak capacity will be 3.0 mgd. A final tertiary treatment capacity analysis will be presented in an upcoming memorandum.

5.0 STORAGE TANK SIZE

5.1 General

The total estimated average daily demand is shown in Table 2 at 2.49 mgd. The first four customers in Table 2 are located upstream of the storage tank. Since the storage tank will only supply downstream customers, the storage tank must supply 2.41 mgd during an average day. This is equivalent to a demand of 7.24 mgd over an 8 hour period.

The total supply from the tertiary treatment system is estimated at 2.73 mgd for 24 hours a day. Since a portion of the total flow has to be delivered to customers upstream of the storage tank, the total supply to the storage tank during an average day is only 2.65 mgd. This means that during average day conditions, the tank will drain and then fill completely since the supply is greater than the demand.

The estimated peak day demand is shown in Table 2 as 3.32 mgd. Not including customers upstream, the storage tank must supply 3.21 mgd during a peak day. This is equivalent to a demand of 9.63 mgd over an 8 hour period.

As mentioned previously, the supply from the WWTP is estimated at 2.73 for 24 hours a day. Taking into account the flow being provided to customers upstream of the storage tank, the total supply to the storage tank during a peak day is approximately 2.65 mgd. This means that during peak day conditions, the tank will drain but it will not fill completely since there is a lack of supply of approximately 0.59 MG. The tank will need approximately 2.5 days between peak events for the tank to fill completely.

We reviewed recycled water use data for several recycled water customers within Daly City (Olympic Club Golf Course, San Francisco Golf Club, and Lake Merced Country Club) and the peak demand scenarios typically occurred infrequently and not for consecutive days in a row. However, to prevent against not having adequate supply during peak demand we recommend installing a backup supply to each system. The backup supply could be a backup connection to Cal-Water or by using the cemeteries existing groundwater wells.

5.2 Tank Volume: 24 hour per day tank fill

The storage tank volume estimate performed during the Feasibility Study was based on a key assumption of filling the tank for 16 hours per day. Based on conversations with operations and maintenance staff, this assumption was based on the typical daily operating procedures of the existing tertiary process. However, the new tertiary treatment facility will be designed to operate 24 hours per day and we recommend revising the tank sizing calculation to account for continuous production of recycled water. The storage calculation is based on the following assumptions:

- The supply from the WWTP is 2.73 mgd. This is based on the reliable dry weather capacity of the new tertiary treatment facility.
- The tank is filled for 24 hours per day. This was revised from 16 hours per day, which was assumed during the Feasibility Study.
- The peak demand the storage tank must satisfy is 9.63 mgd over 8 hours. When the tank is draining, there is also 2.41 mgd of supply coming into the tank. The flows from the customers upstream of the storage tank have been subtracted from both the supply and the demand.

Based on these assumptions, the calculations show a tank volume of 2.41 million gallons (MG) is required. Figure 1 shows the average day fill/drain cycle over 32 hours and Figure 2 shows the peak day fill/drain cycle over 32 hours.

Figure 1 - Average Day, Storage Tank Fill and Drain Cycle

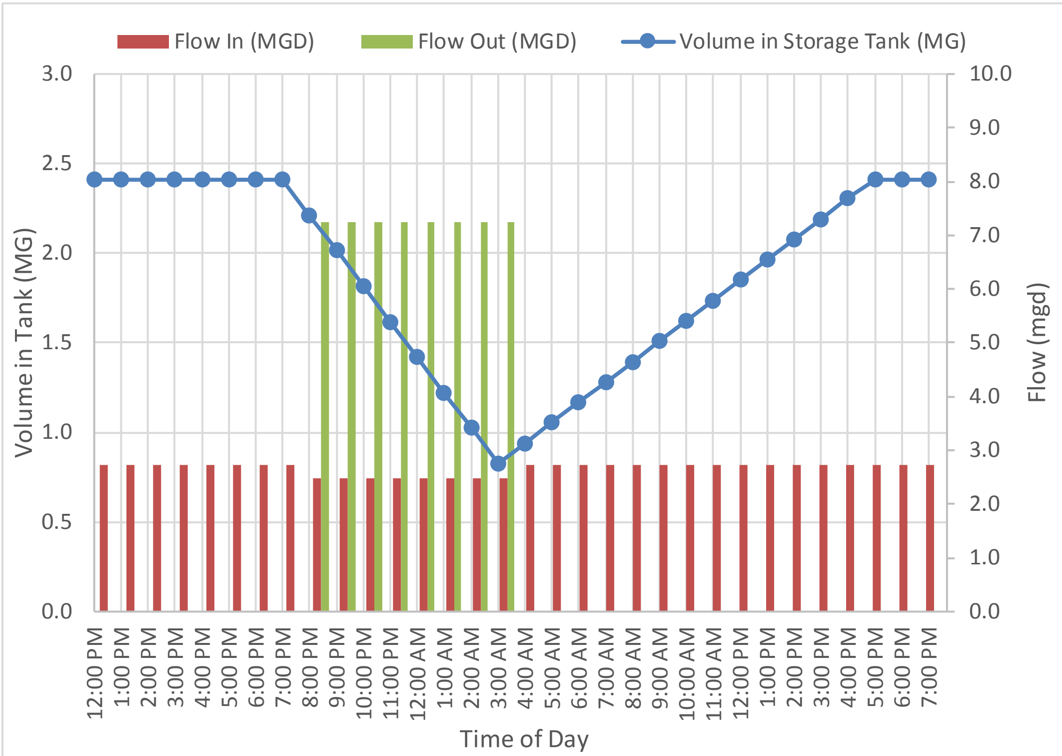
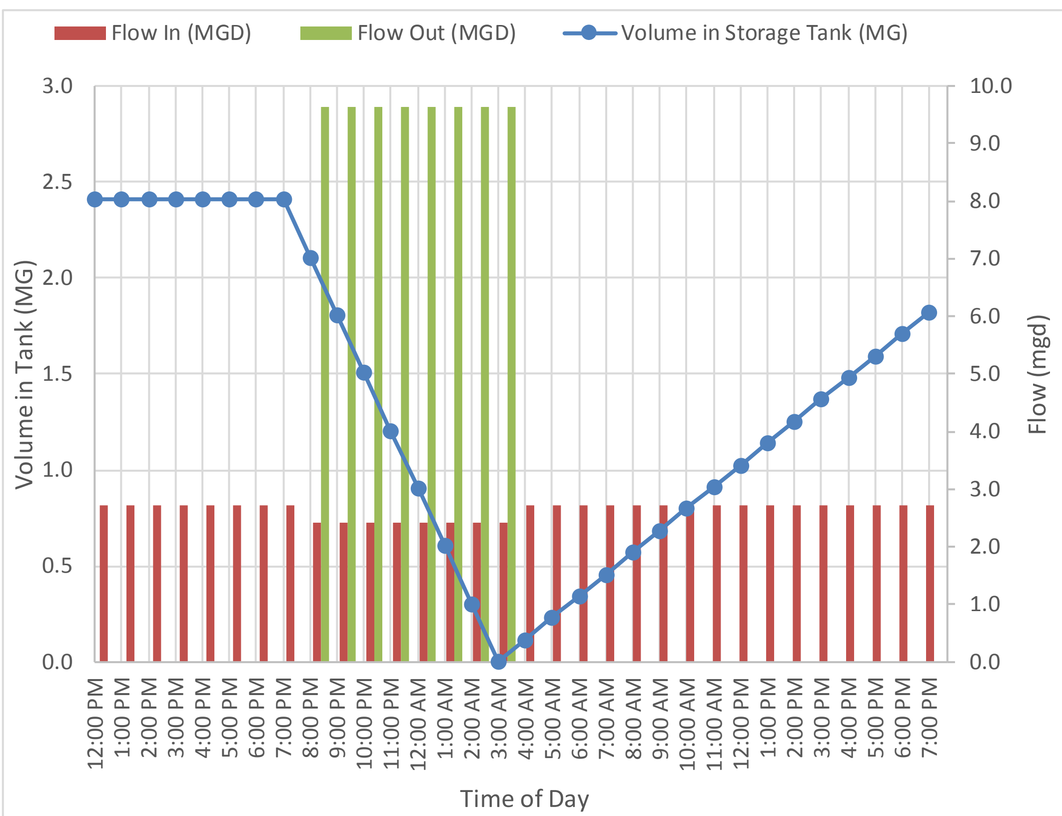


Figure 2 - Peak Day, Storage Tank Fill and Drain Cycle



5.3 Tank Volume: Utilize existing on-site storage

There are seven potential recycled water customers with storage ponds or tanks at their site (customers 5, 6, 8, 17, 18, 20, and 22), refer to Table 3 for a summary of existing storage. This scenario considers the volume of existing on-site storage in the calculations. These customers would continue to irrigate during the irrigation period, but their irrigation period demand would be satisfied by on-site storage and would not receive supply from the storage tank during the daily irrigation period (i.e. 9 AM - 5 PM). This scenario is based on the following assumptions:

- The supply from the WWTP is 2.73 mgd which is the average capacity of the expanded tertiary treatment facility at the Daly City WWTP.
- The seven potential recycled water customers with on-site tanks (customers 5, 6, 8, 17, 18, 20, and 22) utilize their tanks for on-site storage.
- The tank is filled for 24 hours per day. This was revised from 16 hours per day, which was assumed during the Feasibility Study.
- Since existing customer storage is being utilized, the storage demand the storage tank must satisfy is 7.07 mgd over 8 hours and the irrigation demand the storage tank must satisfy is 2.55 mgd over 8 hours.

Based on these assumptions, the calculations show a tank volume of 1.50 MG is required. Figure 3 shows the average day fill/drain cycle over 32 hours and Figure 4 shows the peak day fill/drain cycle over 32 hours.

Figure 3 - Average Day, Storage Tank Fill and Drain Cycle

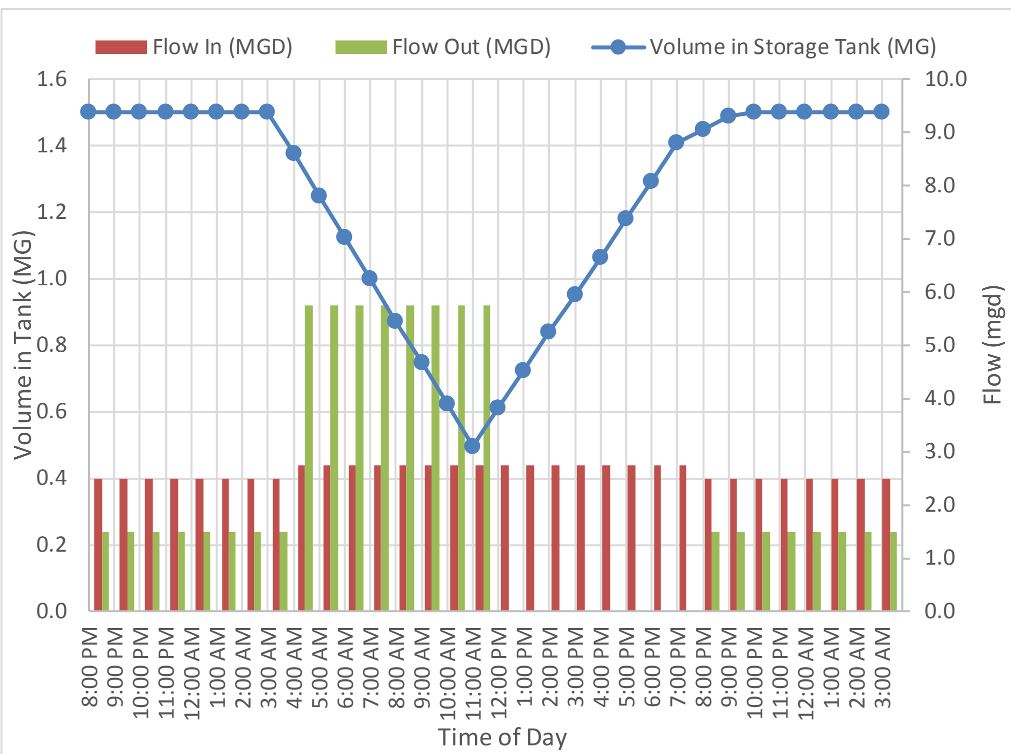


Figure 4 - Peak Day, Storage Tank Fill and Drain Cycle

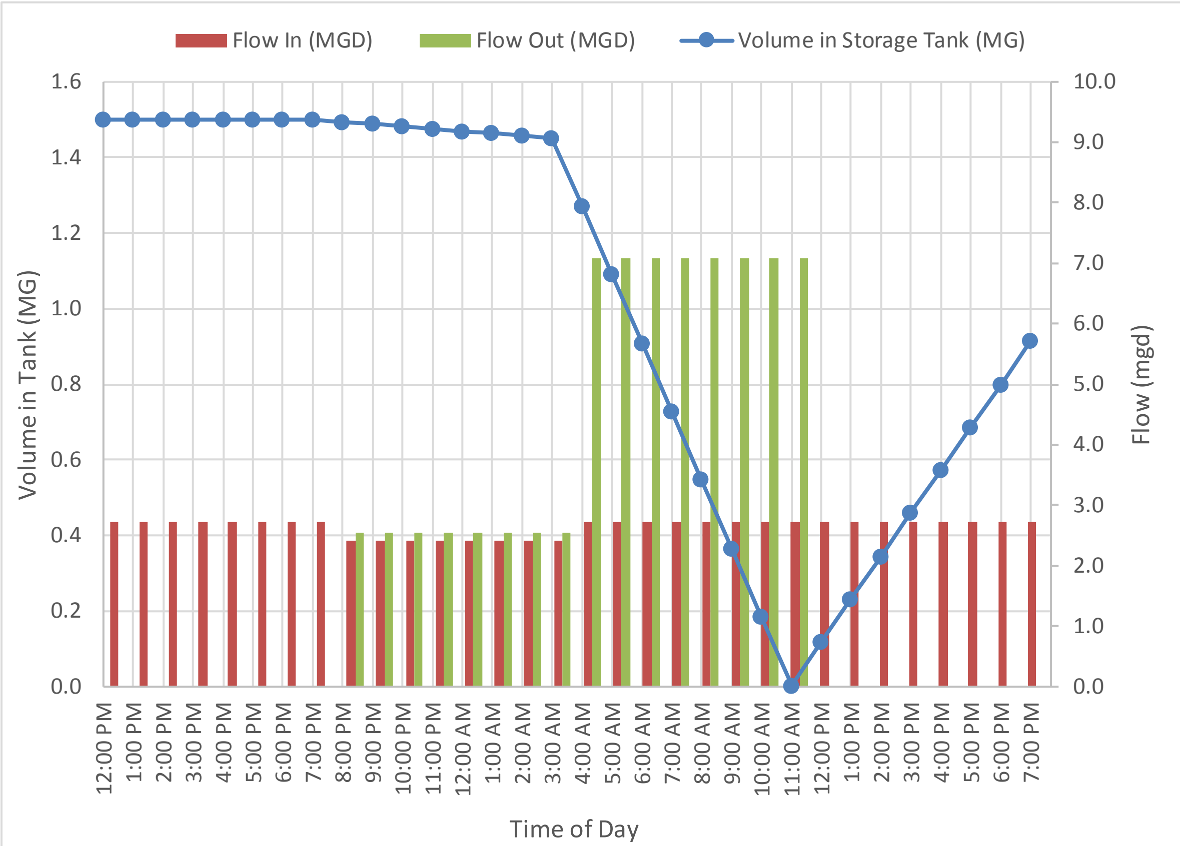


Table 3 shows the volume of the Italian Cemetery tank at 20,000 gallons. This is much less than the estimated irrigation demand of the Italian Cemetery required over an 8-hour period of 101,162 gallons and would require filling the tank during the 8-hour irrigation period multiple times. Because of these reasons, we did not consider the volume of the Italian Cemetery storage tank in the calculations.

Table 3 also shows the volume of the Holy Cross storage tank at 1,000,000 gallons. This is also less than the estimated irrigation demand of the Holy Cross cemetery required over an 8-hour period of 1,187,347 gallons. Unfortunately, we have been unable to reach the Holy Cross Cemetery to discuss the project. We recommend discussing typical peak day use with the Holy Cross Cemetery.

Table 3 Recycled Water Demand, Accounting for Existing Storage
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Name	Peak Day Demand Over 8 hrs (mgd)	Existing Storage Tank/Pond	Volume Requirement Over Irrigation Period (gallons)[1]	Irrigation Period Demand (mgd)[2,3]	Storage Filling Demand (mgd)[4]
1	Benjamin Franklin Intermediate School	0.135	No	45,119	0.135	0.000
2	Garden Village Elementary School	0.033	No	10,924	0.033	0.000
3	City Hall	0.024	No	8,074	0.024	0.000
4	M. Pauline Brown Elementary School	0.128	No	42,745	0.128	0.000
5	Cypress Lawn Memorial Park - East and West Campus	1.767	Yes 1,000,000 Gallons	588,924	0.000	1.767
6	Eternal Home	0.180	Yes 65,000 Gallons	59,824	0.000	0.180
7	Greenlawn Memorial Park	0.449	No	149,606	0.449	0.000
8	Italian Cemetery[5]	0.303	Yes 20,000 Gallons	101,162	0.303	0.000
9	Alta Loma Middle School	0.121	No	40,370	0.121	0.000
10	Alta Loma Park	0.077	No	25,647	0.077	0.000
11	El Camino High School	0.185	No	61,742	0.185	0.000
12	Sunshine Gardens Elementary	0.048	No	16,148	0.048	0.000
13	Winston Manor Park	0.021	No	6,839	0.021	0.000
14	Cypress Hills Golf Course	0.114	No	37,995	0.114	0.000
15	Cypress Lawn Memorial Park - Hillside Campus	0.399	No	132,983	0.399	0.000
16	Golden Hill Memorial Park	0.140	No	46,544	0.140	0.000
17	Hills of Eternity and Home of Peace and Salem Cemetery[2]	0.616	Yes 500,000 Gallons	205,174	0.000	0.616
18	Holy Cross Cemetery	3.562	Yes 1,000,000 Gallons	1,187,347	0.562	3.000
19	Hoy Sun Cemetery	0.125	No	41,795	0.125	0.000
20	Olivet Memorial Park[2]	0.808	Yes 1,000,000 Gallons	269,290	0.000	0.808
21	Pet's Rest Cemetery	0.009	No	2,850	0.009	0.000
22	Woodlawn Cemetery	0.705	Yes Not Currently in Use	235,095	0.000	0.705
	Total	**9.949**		**3,316,214**	**2.874**	**7.075**

Notes:
(1) Peak Day Demand Over 8 Hours x 8 Hours.
(2) Customers without an existing storage tank/pond only have an irrigation period demand.
(3) Customers with an existing storage tank/pond have an irrigation period demand if their existing storage tank/pond cannot meet all the site's irrigation demands.
(4) Customers with an existing storage tank/pond have a storage filling demand. The storage fill occurs 8 hours a day. The Italian Cemetery is an exception to this.
(5) Since the Italian Cemetery's storage volume is significantly smaller than the volume requirement over the irrigation period, the Italian Cemetery was treated like it did not have existing storage.
(6) Holy Cross Cemetery indicated a peak day demand of 0.8 mgd, which would indicate that their existing tank has enough capacity for a peak day scenario. A larger peak day demand was used to allow for allowance in the tank volume sizing.

6.0 RECOMMENDATION

We recommend sizing the tank to provide an operational capacity of 2.41 MG at this time. We are reviewing potential storage tank sites and recommend assuming the storage tank volume is 2.41 MG to develop the preliminary site layouts.

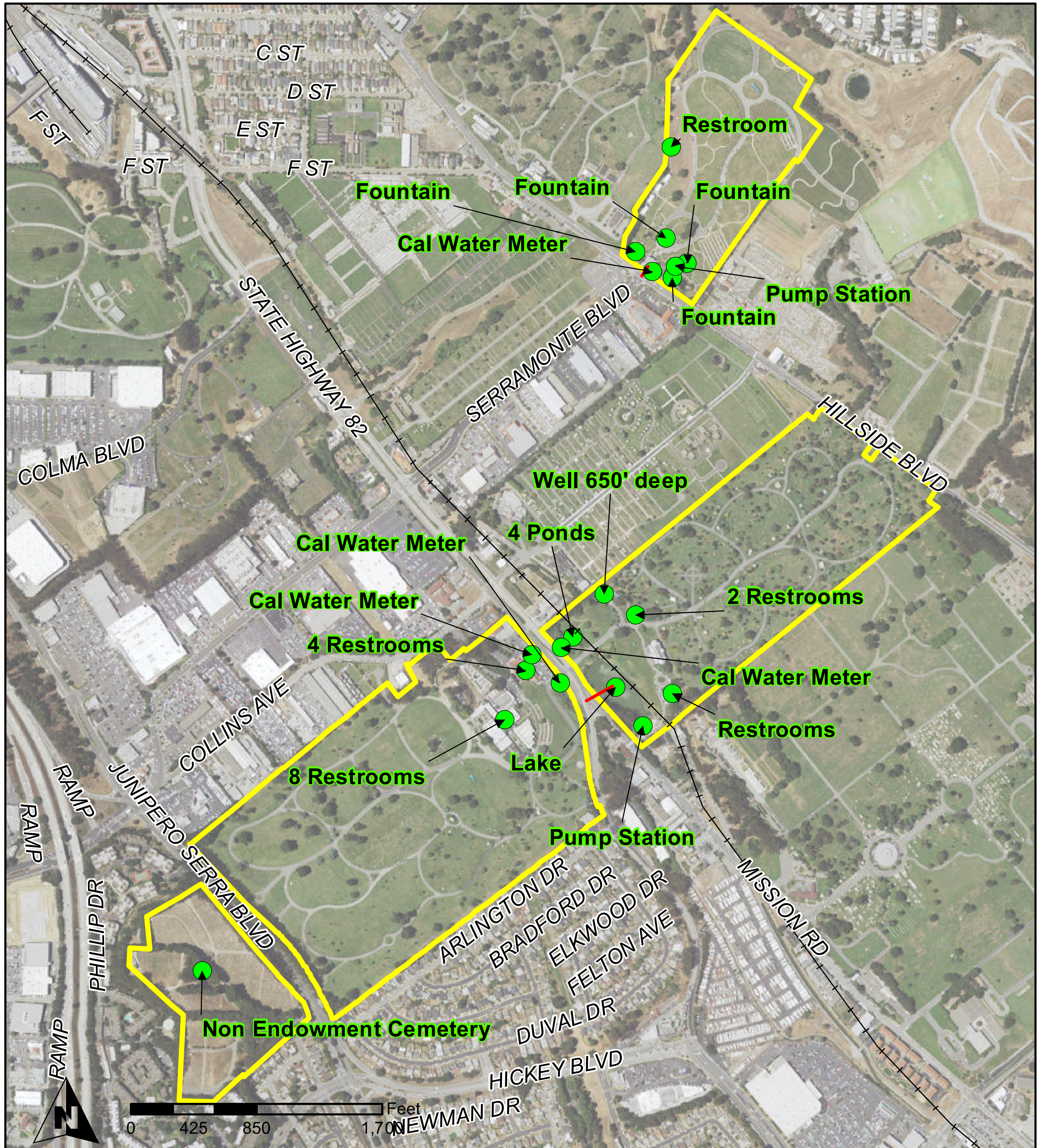
This memorandum shows it is possible to reduce the tank volume by utilizing the existing storage of customers 5, 6, 8, 17, 18, 20, and 22 listed in Table 3. The Harding Park Recycled Water Project performed during the 2009 retrofit Project set a precedence for using existing on-site storage at the Olympic, Lake Merced and San Francisco golf courses.

We recommend discussing the potential of using the existing storage tank volume with the cemeteries. It should be noted one customer has an outdoor storage pond and we recommend discussing the use of the outdoor pond for recycled water storage. If the cemeteries are amenable to continuing use of their on-site storage, the storage tank volume could be reduced to 1.50 MG. The storage tank volume calculations will need to be adjusted based on the practicality of using the existing storage ponds.

APPENDIX A

Customer Site Visits

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 152.0 acres; Design demand: 2.17 MGD
- Cal Water serves restrooms, office, kitchen - all potable uses.
- Irrigation and hose bibbs / vase fills are on the well.
- Propery to the south of Hillside Boulevard, hose bibbs are 60' apart. Property to the north of Hillside Boulevard, hose bibbs are 20' apart.
- Well is 650' deep.
- The 4 ponds are interconnected to the lake.
- There are two pump stations. Pump station by the lake has two 100 hp pumps (700 gpm). Booster pump station to the north of Hillside Boulevard is 40 hp (500 gpm).
- Total irrigation storage of 1 MG in all four lakes.
- Irrigation occurs a maximum of four times a week (Mon, Wed, Fri, Sun; 6PM - 6AM).
- East and West campuses are on well water. Hillside campus is on Cal Water.

ASSUMED RETROFIT

- For East and West campuses, connect 200' service line to existing storage pond
- For Hillside campus, connect 80' service line to irrigation line. Cap and cut line for all restrooms. Connect potable system to Cal Water.
- Signage on hose bibbs
- Meter

Key

- Service Line
- Points of Interest
- Cypress Lawn
- BART Line

Overview

PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 12.6 acres; Design demand: 0.18 MGD.
- Future expansion: 4.6 irrigable acres.
- Well is 600 feet deep.
- 65,000 gallon storage tank.
- Site has hose bibbs every 50' for hoses / vase fills.
- Cal Water service in restrooms / offices along El Camino
- Well water for irrigation, hose bibbs, and toilet along Hillside Blvd.
- Automatic sprinkler system.
- Restroom on Hillside Blvd is on well water w/ septic holding tank. Currently uses bottled water for drinking.

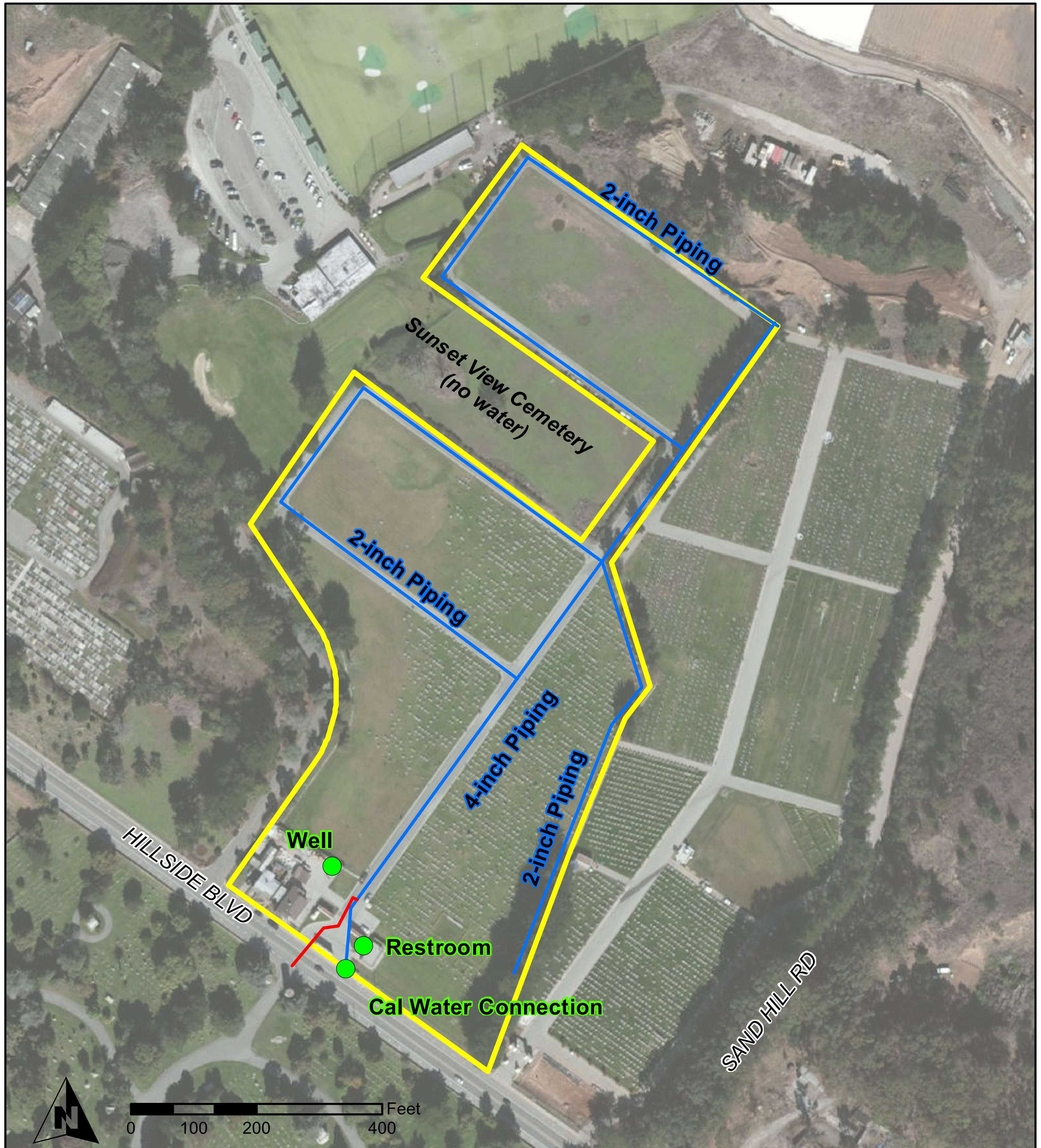
ASSUMED RETROFIT

- Connect 370' service line to existing storage tank.
- Keep well connection to existing storage tank as a back up.
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- BART Line
- Eternal Home Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Per Chinese tradition, Chinese do not like to be buried by water / piping.
- Does not use irrigation piping; uses individual hose bibbs throughout the cemetery to irrigate and for vase filling.
- Irrigable acreage: 9.8 acres; Design demand: 0.14 MGD
- Current water supply is Cal Water and private well (well water since 3/2015).
- Well is 700 feet deep and capacity is approximately 30 gpm
- Piping is along roads.
- It takes approximately 5 days to water entire area.
- During irrigation, 9 sprinklers are running simultaneously.
- Plans to demolish house and build new funeral home (current as of 2016).

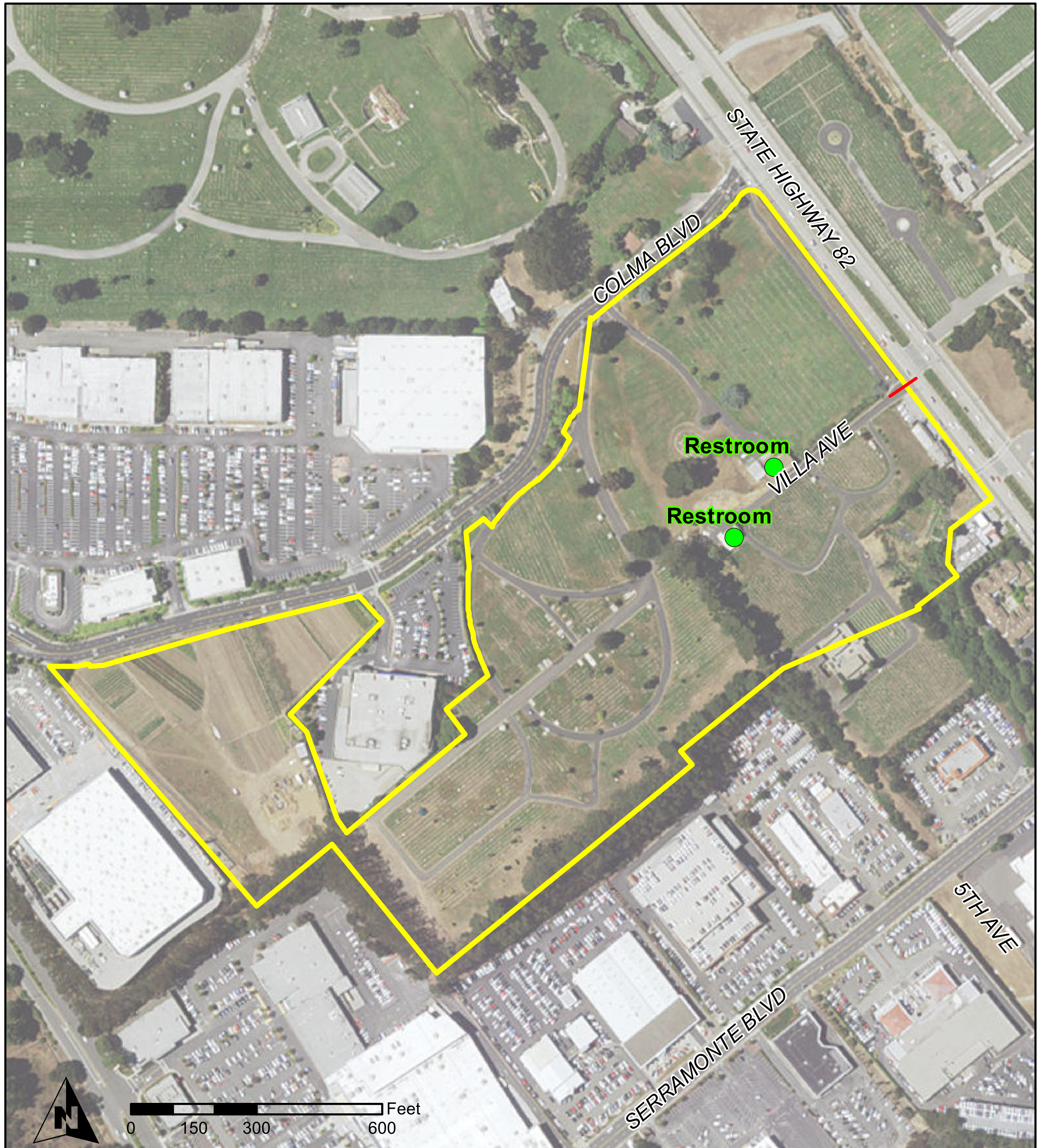
ASSUMED RETROFIT

- Connect 65' service line to existing 4" irrigation line, downstream of the well.
- Cap and cut line from Cal Water supply and existing well.
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Other Piping
- Golden Hill Memorial Park

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 31.5 acres; Design demand: 0.45 MGD
- Current water supply is Cal Water (need to confirm if this is for the whole site).
- No drinking fountains. Only restrooms at offices.
- There are existing graves by the Home Depot area. These graves are being irrigated.

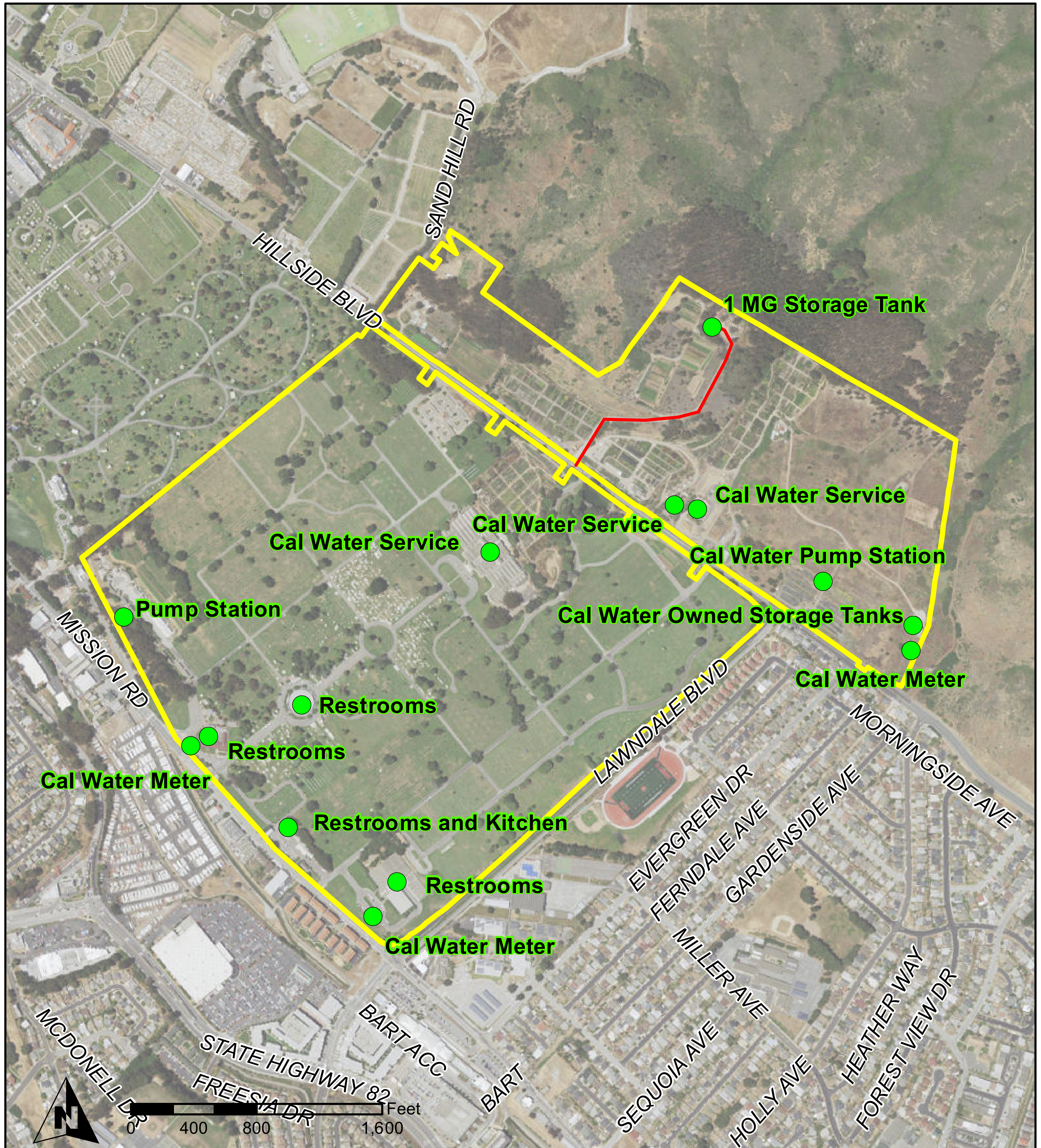
ASSUMED RETROFIT

- Connect 75' service line to existing irrigation line
- Cap and cut line from all restrooms and offices
- Connect potable system to Cal Water
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Greenlawn Memorial Cemetery and Greek Orthodox Memorial Park

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 250.0 acres; Design demand: 3.56 MGD
- Existing 1 MG storage tank. Possible 1 MG expansion in the future (for additional 175 acres of irrigation).
- Existing pump station for irrigation.
- Cal Water owns facilities (pump station and storage tanks) on undeveloped cemetery property.
- Has water stations throughout the site for vase filling.
- Cemetery would consider a storage tank on their property that would be used for the recycled water system.
- Irrigation system is separated from potable water system.

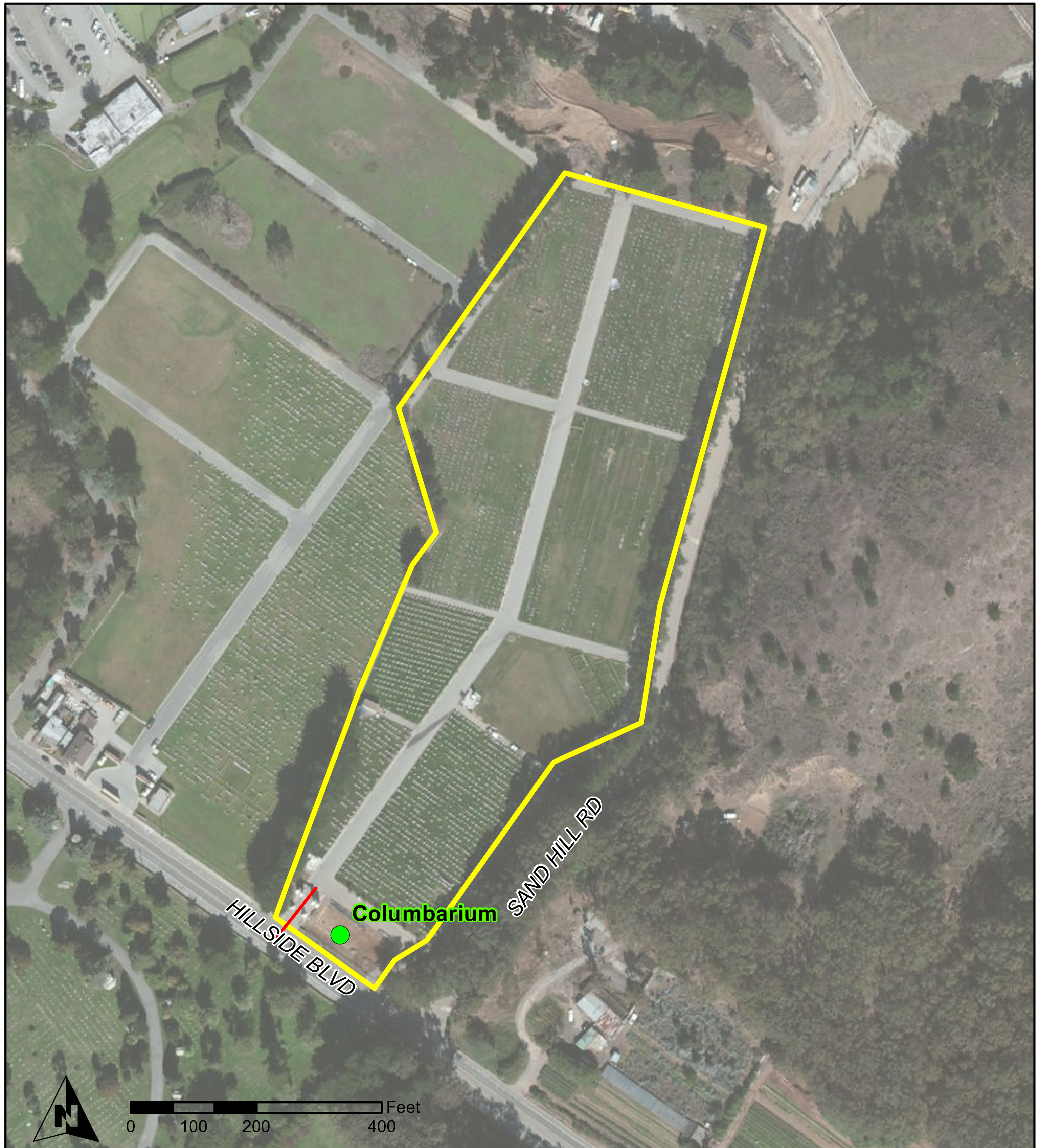
ASSUMED RETROFIT

- Connect 1,630' service line to existing storage tank
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Holy Cross Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Office not open / no one at site.
- Per Chinese tradition, Chinese do not like to be buried by water / piping.
- Does not use irrigation piping; uses individual hose bibbs throughout the cemetery to irrigate and for vase filling.
- Irrigable acreage: 8.8 acres; Design demand: 0.13 MGD
- Current water supply is Cal Water.
- Assumed to have a common connection w/ Golden Hill Memorial Park.

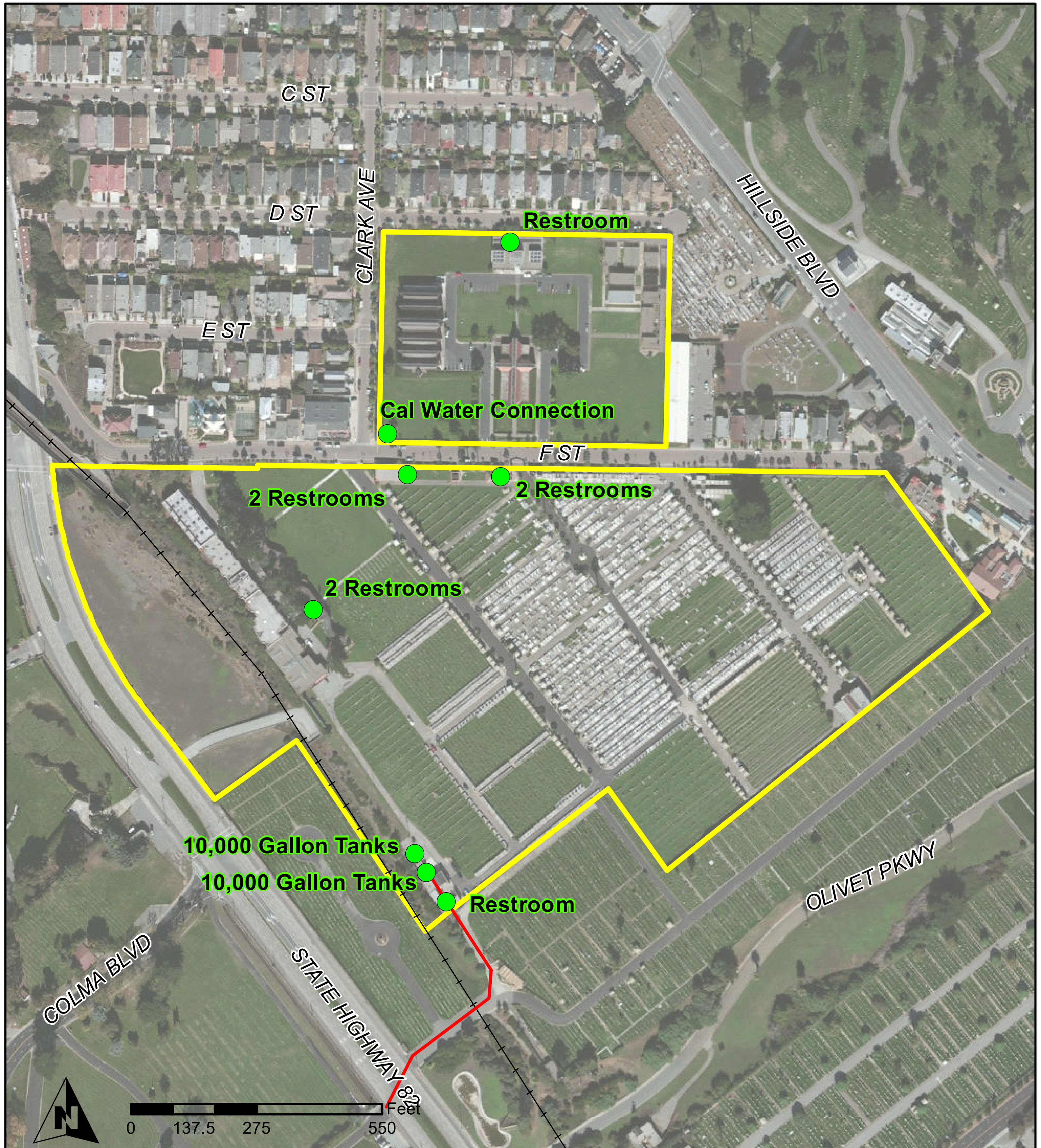
ASSUMED RETROFIT

- Connect 65' service line to existing irrigation line.
- Cap and cut line from Cal Water supply.
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Hoy Sun Memorial Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 21.3 acres; Design demand: 0.30 MGD
- Future irrigable acreage: 3 acres.
- Typically on well water but has a backup Cal Water connection if the well is down (i.e. no potable water is used).
- No potable water.
- 80% of irrigation is at night. Irrigation schedule is 6PM - 6AM.
- Two 10,000 gallon tanks.
- Well is 450 - 470 feet deep.
- Proposed project storage tank location is their best piece of property for future expansion.

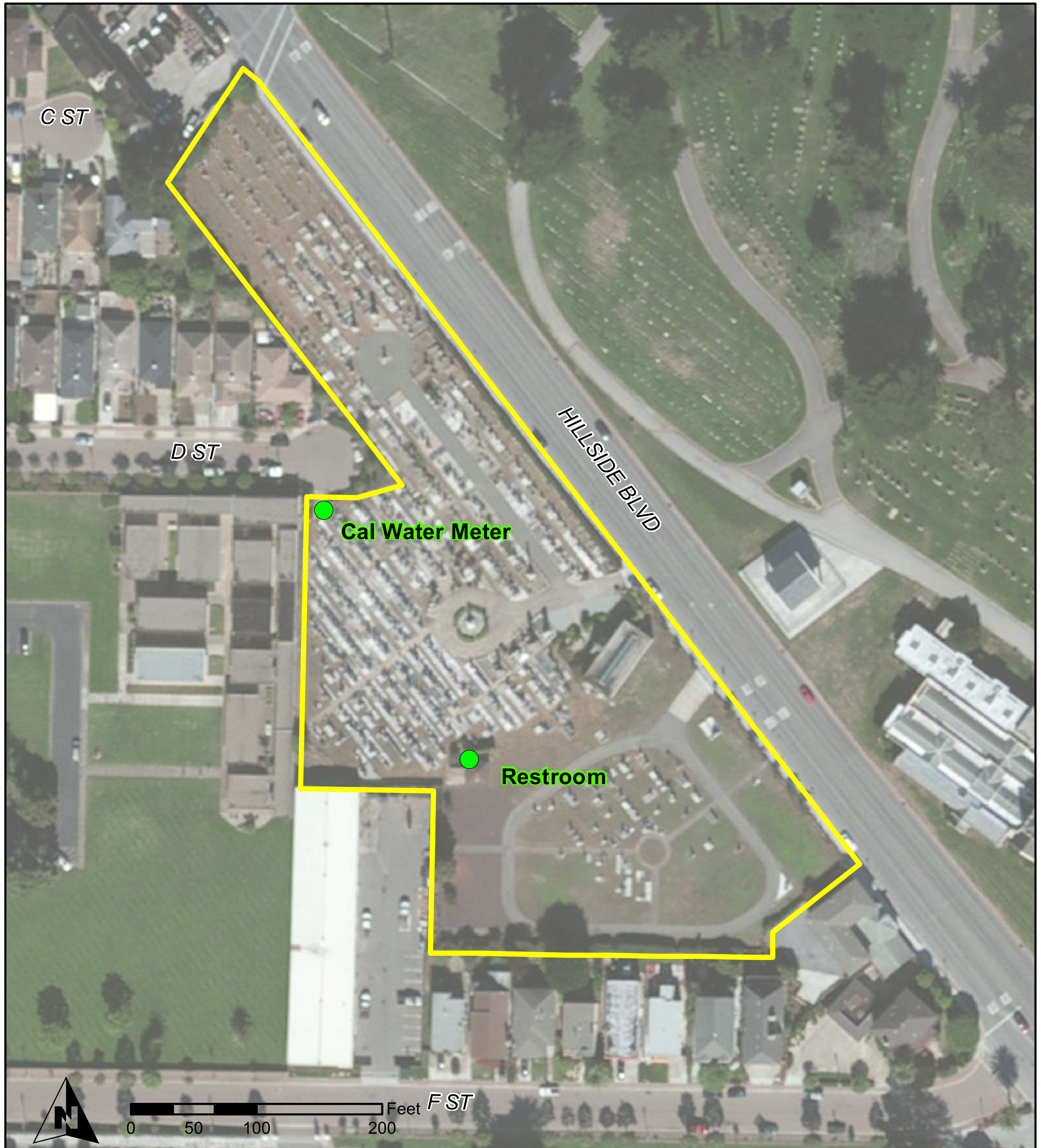
ASSUMED RETROFIT

- Connect 480' service line to existing storage tank.
- Cap and cut line from all restrooms
- Connect potable system to Cal Water
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- BART Line
- Italian Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Since there is no irrigable acreage at this cemetery, this cemetery has been removed as a potential customer.
- There are only hosebibbs for handwashing and vases.
- Current water supply is Cal Water

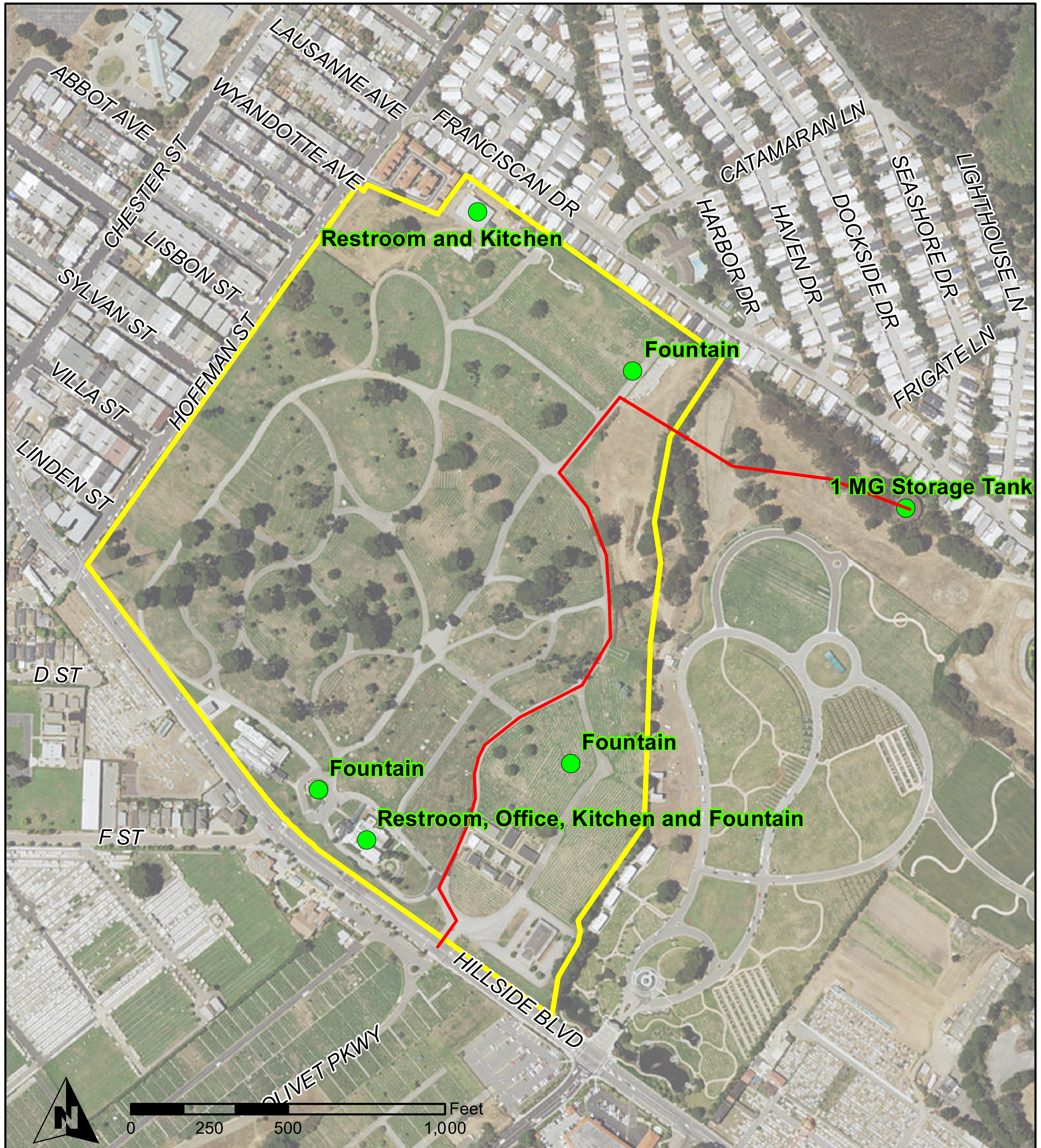
ASSUMED RETROFIT

- Delete from further consideration due to minimal irrigation potential.

Key

- Points of Interest
- Japanese Benevolent Society

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 56.7 acres; Design demand: 0.81 MGD
- Pump station.
- 1 MG storage tank.
- Sprinkler system is used for irrigation.
- Irrigation system is separated from potable water system.

ASSUMED RETROFIT

- Connect 3,140' service line to existing 1 MG storage tank.
- Meter

Key

- Points of Interest
- Service Line
- Olivet Memorial Park

Overview

PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 0.6 acres; Design demand: 0.01 MGD
- Current water supply is Cal Water.
- Cemetery currently pulls from the house for irrigation use on the cemetery. The cemetery is planning for a new sprinkler system if they get a new water meter.
- Cemetery applied to Cal Water for a 2-inch meter for irrigation but their application was rejected.

ASSUMED RETROFIT

- Connect 100' service line to existing irrigation system.
- Cap and cut line from Cal Water supply.
- Signage on hose bibbs
- Meter

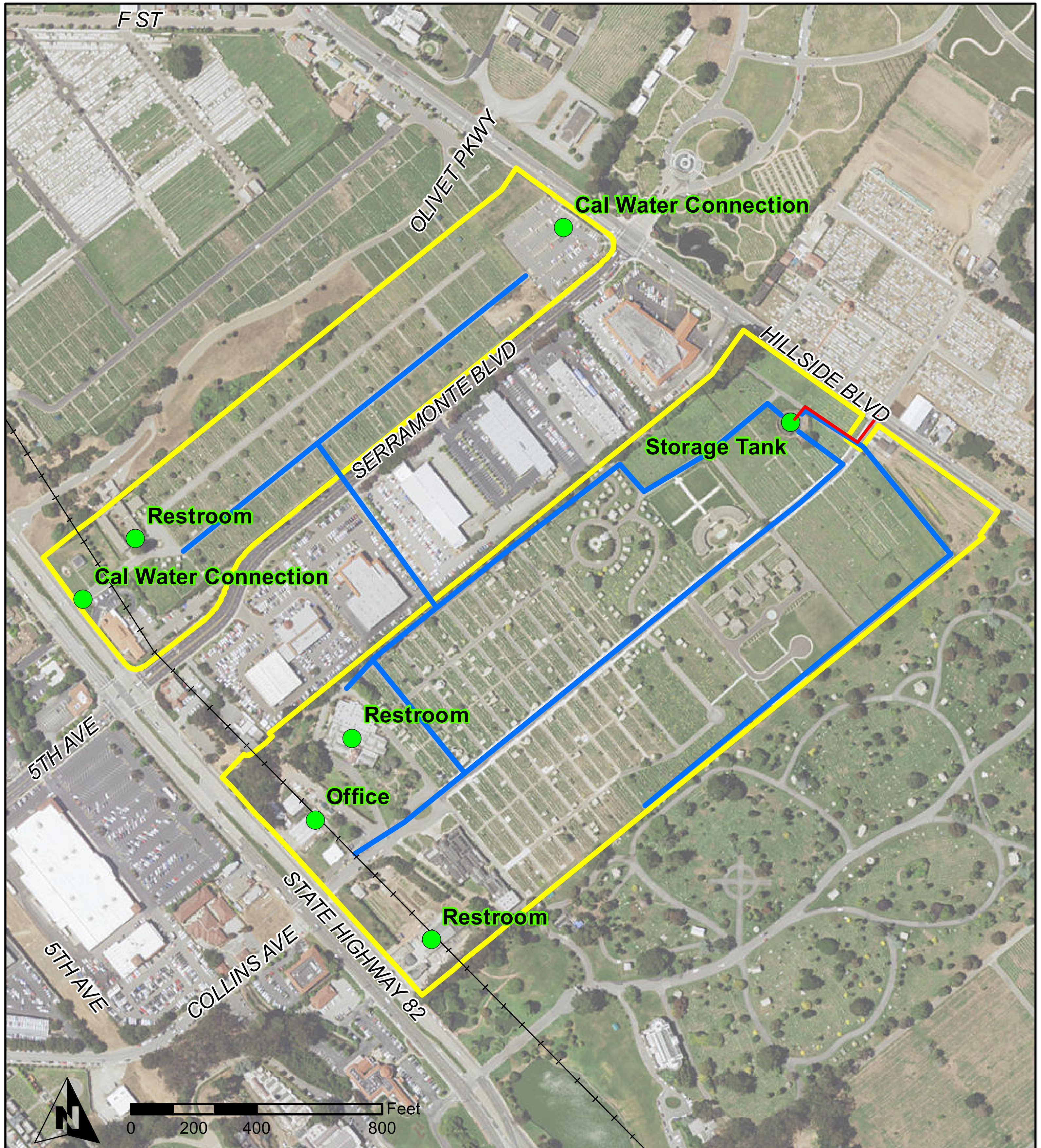
Key

Points of Interest

Service Line

Pet's Rest Cemetery

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 43.2 acres; Design demand: 0.62 MGD
- No drinking water on site. Office, hose bibbs, handwash stations, etc are all on the same water system.
- Vase filling stations are marked with don't drink.
- No Cal Water service but does have a connection.
- BART runs through the site at Salem.
- There is Alhambra drinking water outside of restrooms.
- There is an existing 0.5 MG tank. During peak demands, the cemeteries drain 1/2 - 3/4 of the tank for 3 days per week.
- Existing well is 650 feet deep.
- Questions / Concerns from the cemeteries:
  - Can existing wells be use for potable water?
  - Will quality of recycled water damage any headstones?

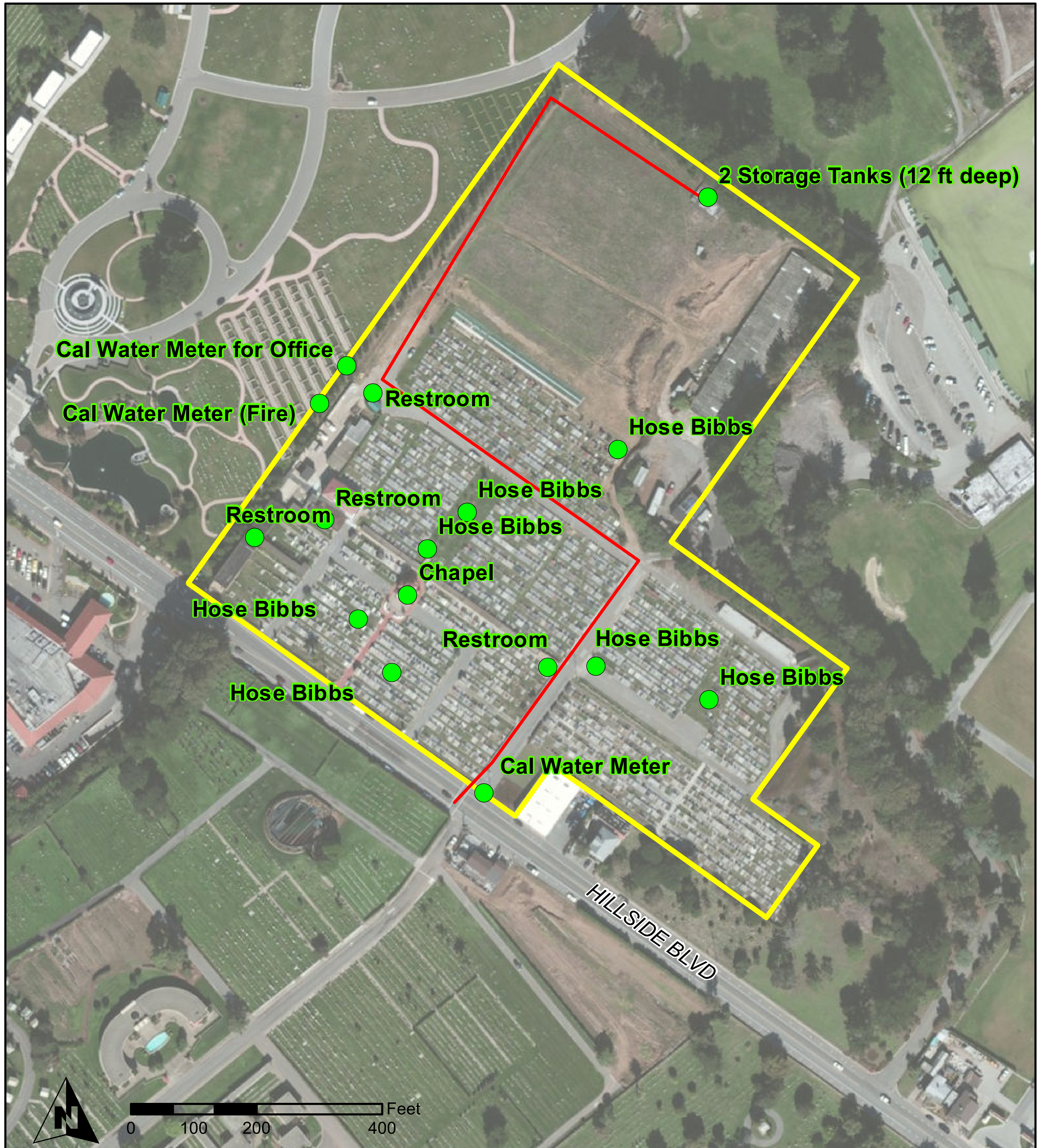
ASSUMED RETROFIT

- Connect 360' service line to existing storage tank.
- Cap and cut line from all restrooms, offices, handwash stations
- Connect potable system to Cal Water
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Other Piping
- Salem Cemetery, Hills of Eternity and Home of Peace
- BART Line

Overview



PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 0.3 acres; Design demand: 0.004 MGD
- Current water supply is Cal Water.
- 2 storage tanks on site not currently used. Could be reconnected for hosebibbs / vase filling.
- Minimal irrigation potential.
- Plans to expand with minimal irrigation potential (i.e. grave-to-grave with sidewalks in between).

ASSUMED RETROFIT

- Delete from further consideration due to minimal irrigation potential.

Key

- Points of Interest
- Service Line
- Serbian Cemetery

Overview

PLAN VIEW

NOTES FROM JANUARY 2016 SITE VISIT

- Irrigable acreage: 49.5 acres; Design demand: 0.71 MGD
- Old water storage tanks are located at the highest elevation. Planning to redo/rehabilitate the tanks in 1 - 2 years.
- Well is 500' deep and pumps to the lake.
- There is an existing pump station on site but a new one is required to pump to the old water tanks.
- Plans to reline the lake.
- There are hose bibbs throughout the cemetery (~20' intervals) that use well water.
- Irrigation is done in two days. Half the site is irrigated on the first day while the other half of the site is irrigated on the second day.
- There is an SFPUC easement that runs through the site. There are no graves within the SFPUC easement.
- Irrigation system is separated from potable water system.

ASSUMED RETROFIT

- Connect 3,450' service line to old water storage tanks (not currently in service).
- Signage on hose bibbs
- Meter

Key

- Points of Interest
- Service Line
- Woodlawn Cemetery
- SFPUC Easement

APPENDIX F – PROJECT MEMORANDUM 07 - TERTIARY CAPACITY EXPANSION ASSESSMENT

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DRAFT PROJECT MEMORANDUM - 07

Project Name:	Feasibility of Expanded Tertiary Recycled Water Facilities (Project)	**Updated Date:**	October 13, 2016
Client:	City of Daly City	**Project Number:**	10076A.10
Prepared By:	Ron Appleton, Katie Belluomini, and Darren Baune		
Reviewed By:	Dan Hugaboom		
Subject:	Tertiary Expansion Capacity Assessment		

1.0 PURPOSE

The purpose of this project memorandum (PM) is to define the new tertiary treatment system capacity based on the availability of secondary effluent flow.

2.0 BACKGROUND

2.1 Recycled Water Expansion

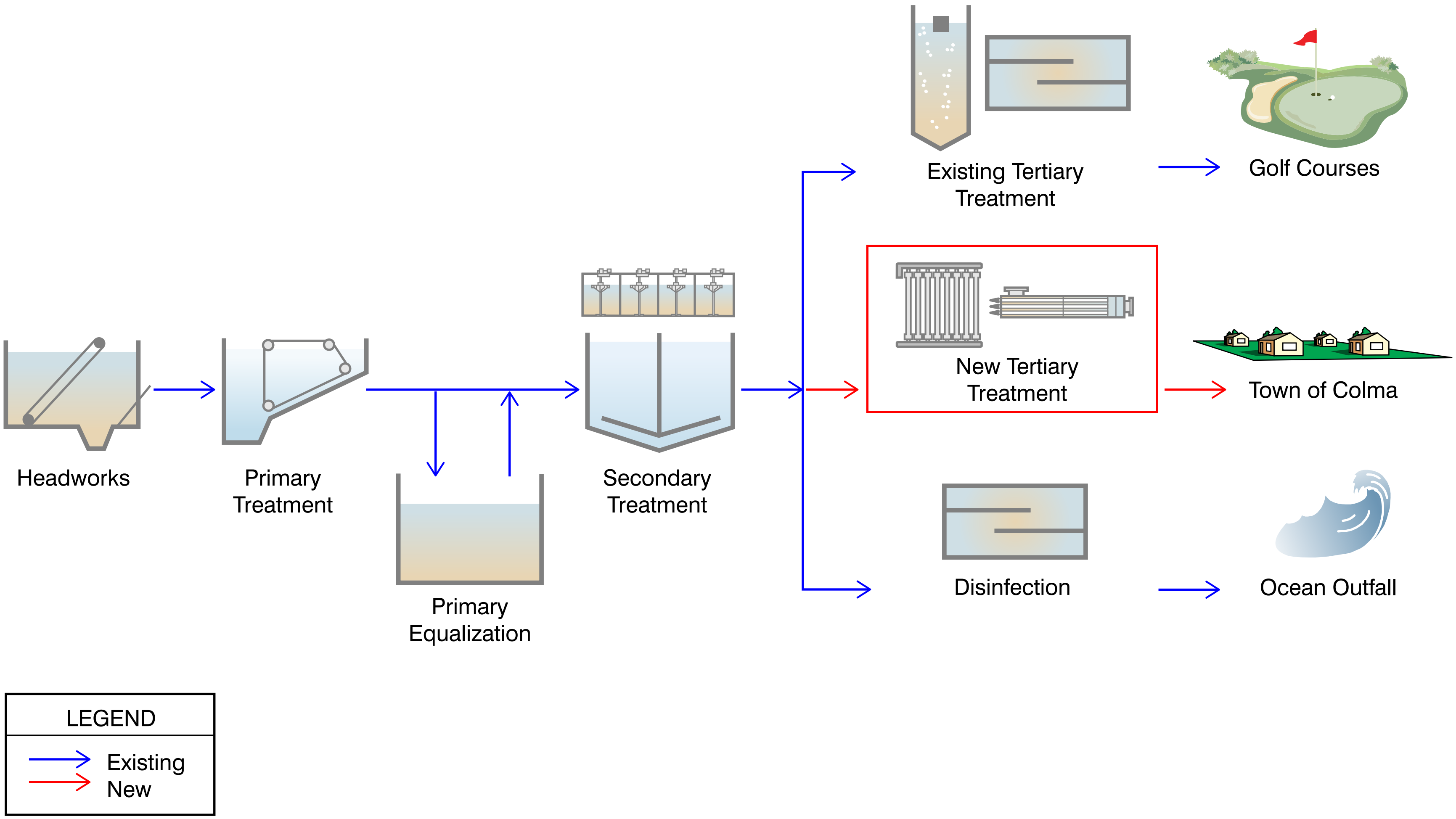
The City of Daly City (City) is currently permitted to produce up to 2.77 million gallons per day (mgd) of recycled water with its existing tertiary treatment facility. The tertiary process treats equalized secondary effluent and produces recycled water for nearby golf courses. The remaining secondary effluent is disinfected and discharged into the ocean.

The City is considering expanding their recycled water system to utilize the remaining flow and provide irrigation water to cemeteries within the Town of Colma, as shown in Figure 1. The new tertiary treatment facility will be sized based on the availability of secondary effluent or the recycled water demands, whichever is less. PM 02 - Recycled Water Customer Outreach (Carollo, 2016) identified the average daily recycled water demand as 2.49 mgd based on 22 potential customers.

2.2 Current Operation

The Daly City Wastewater Treatment Plant (plant) has two primary effluent equalization basins on-site with a combined capacity of 1.49 million gallons (MG). The equalization basins are designed to equalize the varying influent flow throughout the day and provide a relatively constant flow to the secondary treatment process. Figure 2 shows the flow path of primary effluent and equalized primary effluent.

The operators manually set the primary effluent pump station flowrate, Q2 in Figure 2, and the flowrate to the secondary treatment process, Q5 in Figure 2. If the influent flowrate is greater than the primary effluent pump station flowrate setpoint, the difference is routed to the



PROCESS FLOW DIAGRAM

FIGURE 1

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TERTIARY EXPANSION CAPACITY ASSESSMENT

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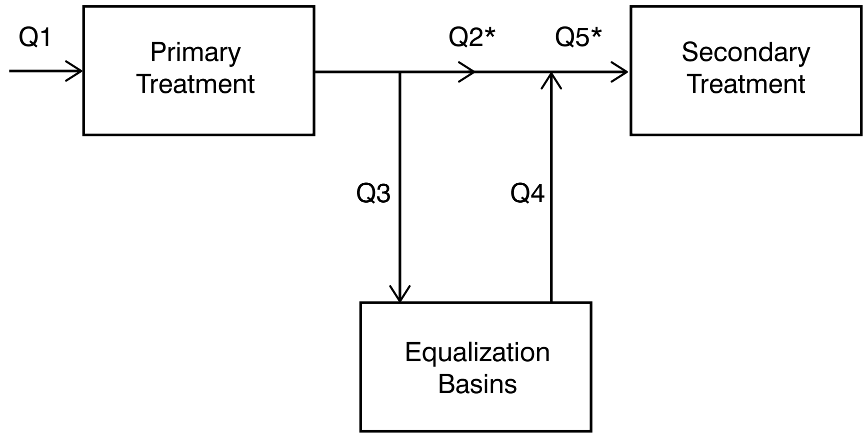

Q1 = Influent Flow
Q2*= Primary Effluent Flow from Primary Effluent Pump Station
Q3 = Primary Effluent Flow to Equalization Basins
Q4 = Equalized Primary Effluent Flow from Equalization Basins
Q5*= Equalized Primary Effluent Flow to Secondary Treatment

*Operator Setpoint

PRIMARY EFFLUENT FLOW PATH

FIGURE 2

CITY OF DALY CITY
TERTIARY EXPANSION CAPACITY ASSESSMENT

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equalization basins by gravity. If the influent flowrate is less than the primary effluent pump station flowrate setpoint, stored flow is pumped from the equalizations basins to the secondary treatment process to make up the difference.

In general, the operators try to fill and drain the equalization basins each day by slowly filling the equalization basins during the day and draining the equalization basins during the night. Throughout the day, the flow setpoints and corresponding flow to the secondary treatment process are constantly changing. However, the available secondary effluent flow is typically sufficient with this operating strategy to meet the existing tertiary system demand, so there has not been a need to optimize the equalization strategy.

3.0 TERTIARY CAPACITY ANALYSIS

3.1 Flow Data

The tertiary capacity analysis described below is based on hourly plant influent flow data from 2012 and 2015. The data from 2015 is considered representative of recent dry years and the data from 2012 is considered representative of more typical, average rainfall years.

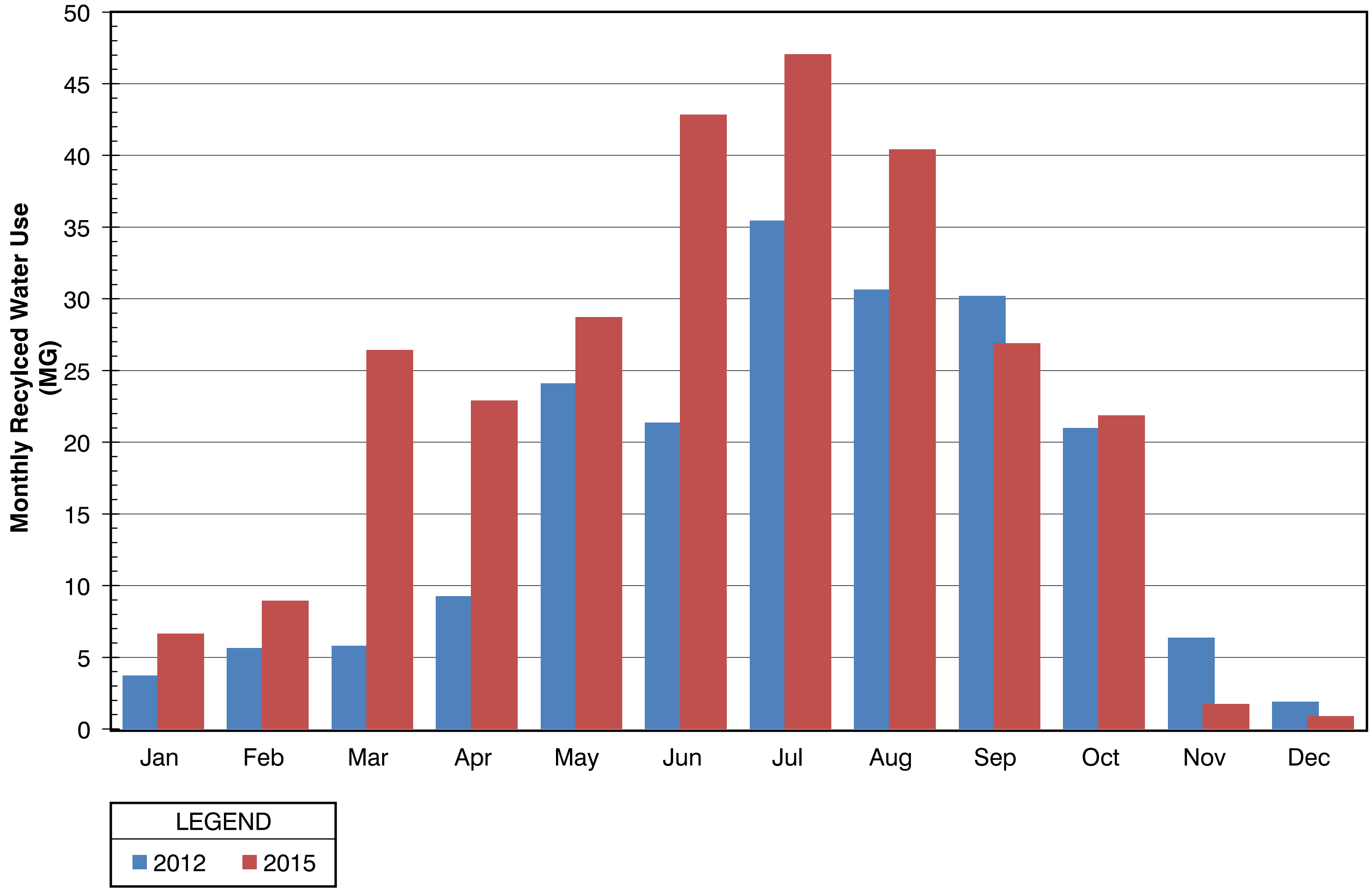
Monthly recycled water usage for the existing customers in 2012 and 2015 is shown in Figure 3. The majority of the recycled water was used for turf grass irrigation at nearby golf courses. Approximately 75 to 80 percent of the annual usage occurred from May through October. Therefore, these months defined the irrigation season and were used to determine the average secondary effluent flow available. Also, the maximum usage has consistently occurred in July, so the amount of recycled water that is reliably available during this time is of particular interest.

3.2 Optimization of Equalization Basin Operation

3.2.1 Ideal Equalization Scenario

In order to maximize the water available for the tertiary treatment system, operation of the equalization basins must be optimized. Figure 4 shows an example of the diurnal influent flow pattern into the plant in relation to the daily average flow. The goal of equalization is to provide a relatively constant flow to secondary treatment and tertiary treatment.

The ideal scenario would be for the equalized flow rate to equal the daily average flow rate, represented by the horizontal line in Figure 4. When the influent flow is greater than the daily average flow, the excess primary effluent is stored in the equalization basin. When the influent flow is less than the daily average flow, the deficit is pumped from the equalization basin. However, this ideal scenario cannot be achieved, because the actual daily average flow rate is not known in advance. In practical operation, if the selected secondary treatment flow setpoint is higher than the actual daily average flow, then not enough water will be diverted to the equalization basins and the basins won't be able to supplement low influent flow, resulting in a decrease of secondary treatment flow. Conversely, if the selected secondary treatment flow setpoint is lower than the actual daily average flow, then too much water will be diverted to the



EXISTING MONTHLY RECYCLED WATER USAGE

FIGURE 3

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TERTIARY EXPANSION CAPACITY ASSESSMENT

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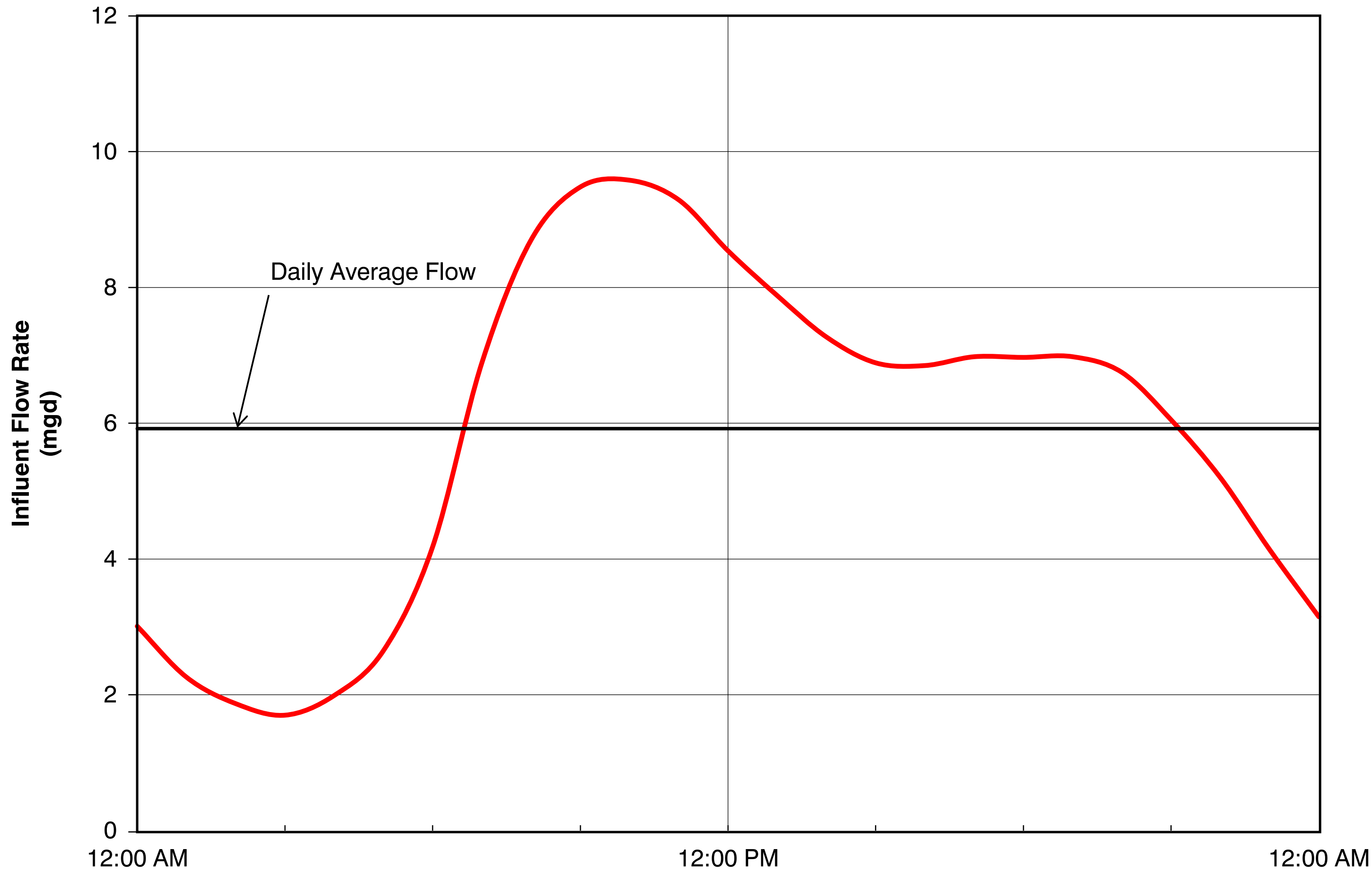

DIURNAL INFLUENT FLOW

FIGURE 4

CITY OF DALY CITY
TERTIARY EXPANSION CAPACITY ASSESSMENT

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equalization basins and the basins will not be able to store any more water during the next diurnal cycle, which would result in an increase of secondary treatment flow.

3.2.2 Revised Operation Strategy

Although the daily average flow varies on a day to day basis, the ratio of hourly flow to daily average flow (diurnal peaking factor) follows a fairly consistent pattern throughout the May through October irrigation season. The 2015 historical data were used to develop normalized hourly flow patterns for each day of the week. Then, these patterns were used to create operating guidelines for draining and filling the equalization basin based on the time of day, day of the week, and real-time influent flow rate. Table 1 summarizes the duration, start time, and end time of the seven distinct drain and fill cycles used for this evaluation. Along with the drain and fill schedule, a set of constants were developed to calculate the equalization basin drain and fill flow rates. These constants are specific to the time of day and day of the week. The fill flow rate is calculated as the hourly constant multiplied by the instantaneous plant influent flow rate. The drain flow rate is calculated as the hourly constant multiplied by the equalization volume to be drained. This approach relies only on information available within the SCADA system (i.e., plant influent flow rate, equalization basin volume). Full-scale implementation of this operation strategy would require SCADA programming changes to automate the equalization fill and equalization drain flow setpoint calculation.

Table 1 Equalization Basin Operating Schedule
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Operation		Duration (hr)	Start Time	End Time	Residual Volume in EQ Basin at End of Drain Cycle
Friday/Saturday	Drain	8	2300	0700	0%
Saturday	Fill	15	0700	2200	-
Saturday/Sunday	Drain	9	2200	0700	0%
Sunday	Fill	15	0700	2200	-
Sunday/Monday	Drain	8	2200	0600	17%
Weekday	Fill	17	0600	2300	-
Weekday	Drain	7	2300	0600	16.5%

4.0 ANALYSIS

A flow routing analysis was performed to estimate equalized secondary effluent flow available for recycled water production by applying the revised operating strategy discussed in the previous section to the 2012 and 2015 hourly influent flow data.

4.1 2012 - Typical Year

Figure 5 shows the 2012 hourly plant influent flow rate with the 24-hour moving average trend. Figure 6 shows how the 2012 diurnal flows could have been equalized by applying the revised operating strategy previously discussed. As shown, the range of hourly equalized flow rates is a lot smaller than the range of hourly influent flow rates. The new membrane system will be capable of ramping up and down, based on the equalized flow rate, however the system does have limitations. Since the membrane building is constrained by footprint, the maximum instantaneous capacity that is supported by the proposed membrane system configuration is 3.60 mgd. Therefore any flows in excess of 6.37 mgd, the combined maximum capacity of both systems, would be diverted to the outfall.

Based on these limitations and assuming that the existing tertiary system utilizes 2.77 mgd throughout the irrigation season, Figure 7 shows the remaining equalized flow available for the new tertiary system. The daily secondary effluent available for the new tertiary system would be at least 2.84 mgd in July and on average 3.11 mgd throughout the irrigation season. In this scenario, 99 percent of the plant influent flow would be recovered as recycled water during the irrigation season.

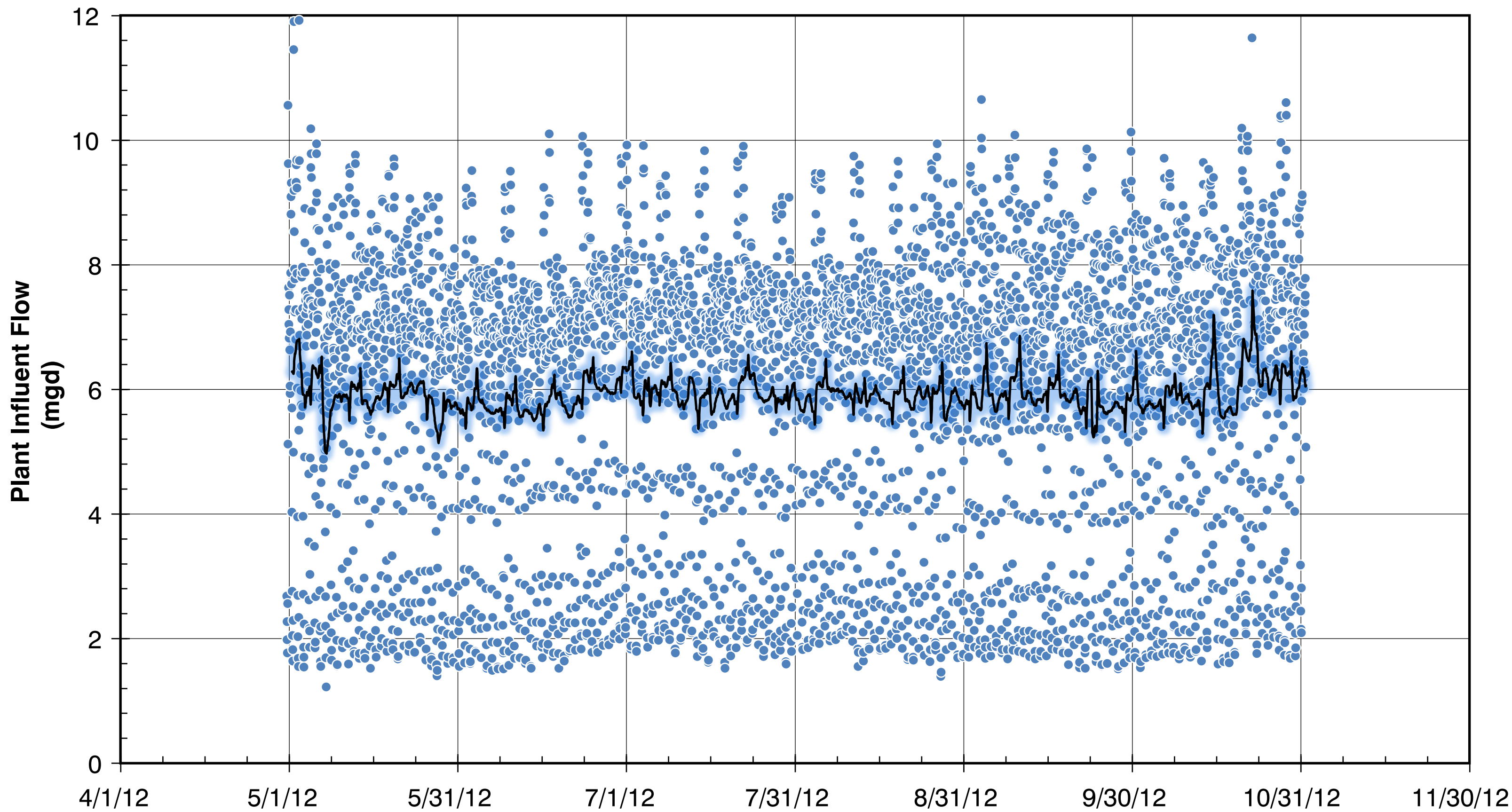
4.2 2015 - Dry Year

Figure 8 shows the 2015 hourly plant influent flow rate with the 24-hour moving average trend. Figure 9 shows how the 2015 diurnal flows could have been equalized by applying the revised operating strategy previously discussed.

Based on the capacity limits discussed in the previous section and assuming that the existing tertiary system produces at maximum capacity throughout the irrigation season, Figure 10 shows the remaining equalized flow available for the new tertiary system. The daily secondary effluent available for the new tertiary system would be at least 2.51 mgd in July and on average 2.80 mgd throughout the irrigation season. In this scenario, 100 percent of the plant influent flow would be recovered as recycled water during the irrigation season.

5.0 RECOMMENDATION

Assuming the equalization system is optimized and 2012 and 2015 are representative years, the plant influent will be sufficient to meet the average daily recycled water demand of 2.49 mgd. In order to meet this demand, the membrane facility will need to ramp up to a maximum instantaneous capacity of 3.60 mgd at certain times of the day. Therefore, Carollo recommends sizing the tertiary system to meet the maximum capacity supported by the proposed membrane system configuration of 3.60 mgd.



2012 PLANT INFLUENT FLOW

FIGURE 5

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TERTIARY EXPANSION CAPACITY ASSESSMENT

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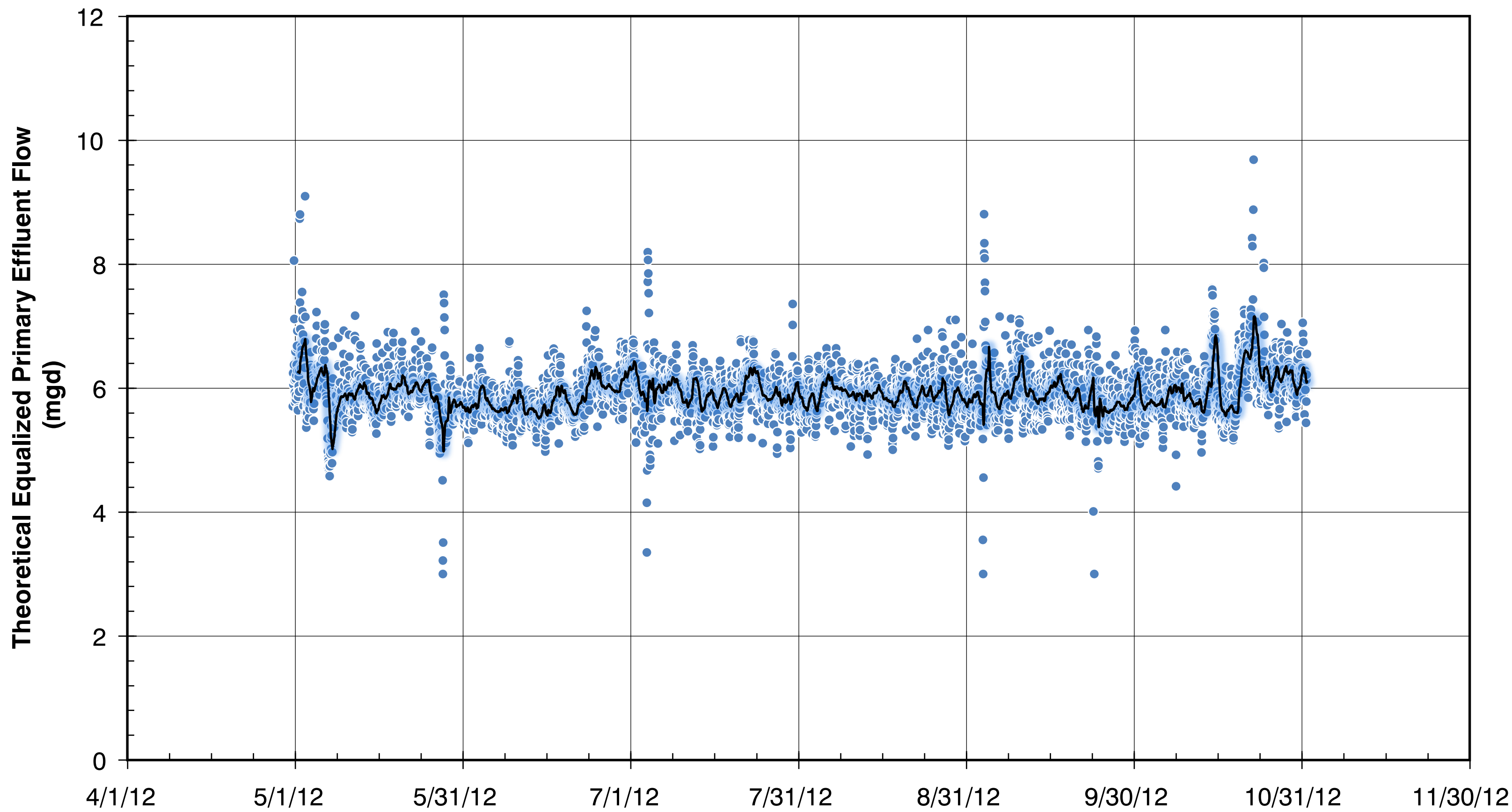

2012 THEORETICAL EQUALIZED PRIMARY EFFLUENT FLOW

FIGURE 6

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TERTIARY EXPANSION CAPACITY ASSESSMENT

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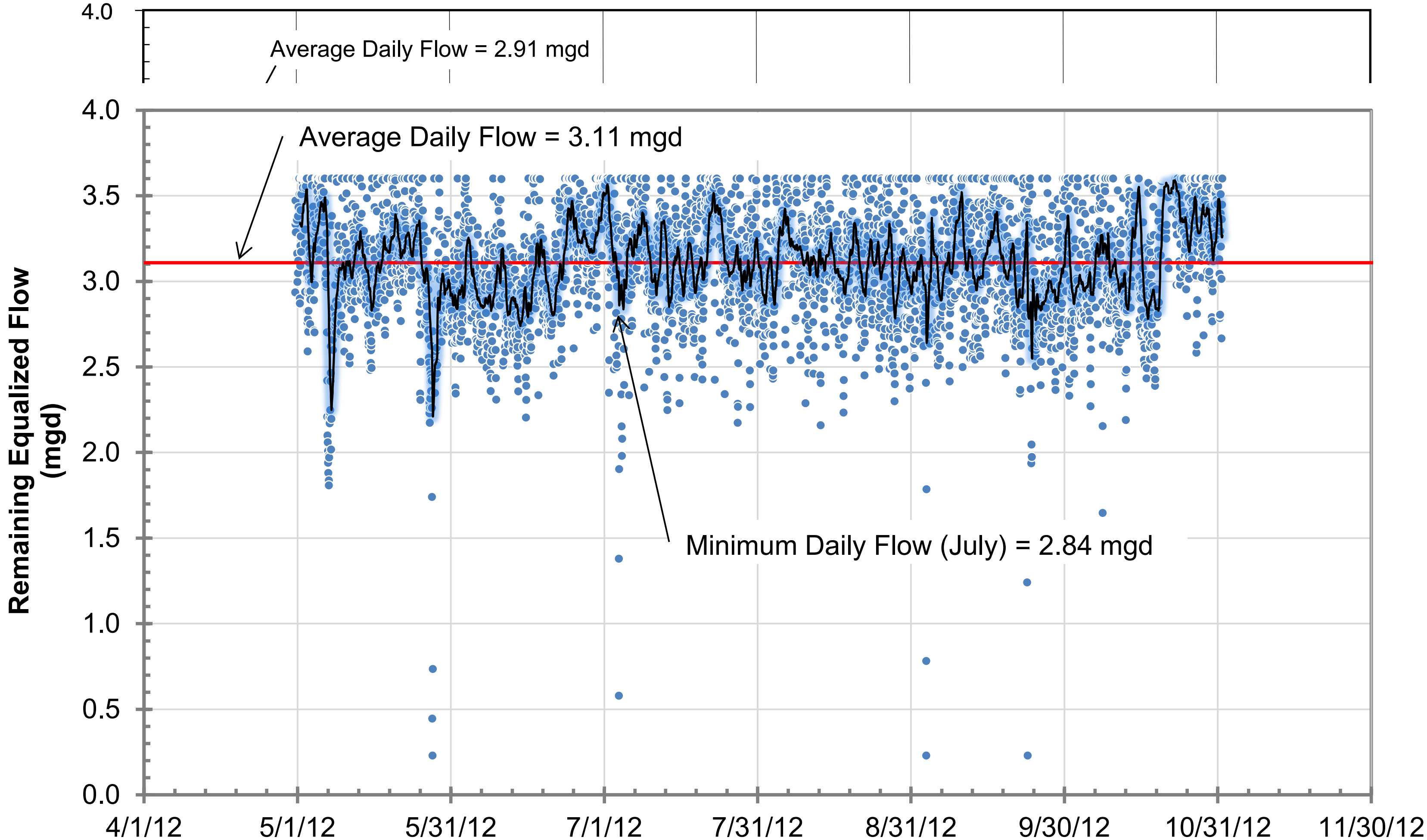

2012 REMAINING EQUALIZED FLOW FOR NEW TERTIARY SYSTEM

FIGURE 7

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TERTIARY EXPANSION CAPACITY ASSESSMENT

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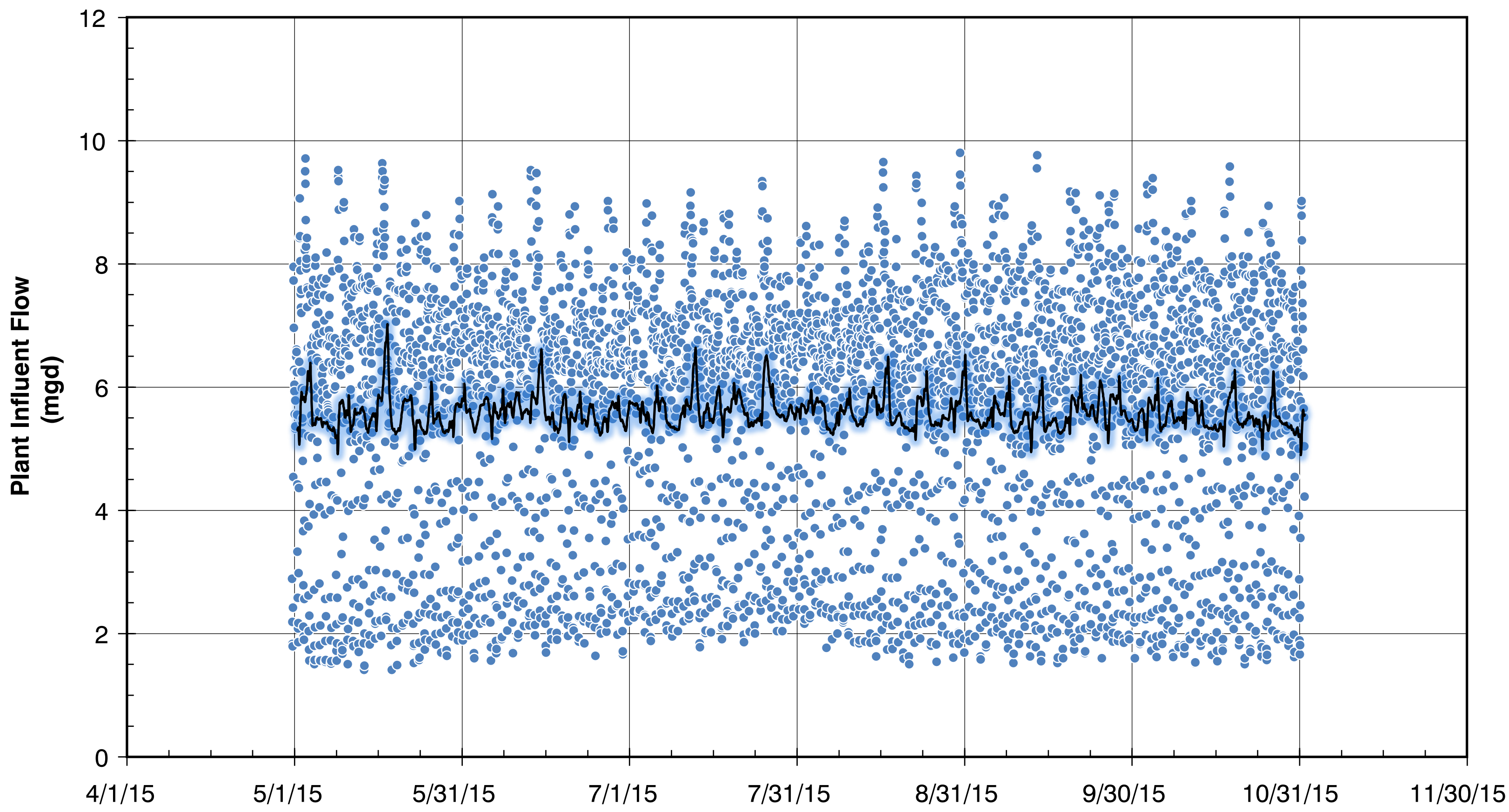

2015 PLANT INFLUENT FLOW

FIGURE 8

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TERTIARY EXPANSION CAPACITY ASSESSMENT

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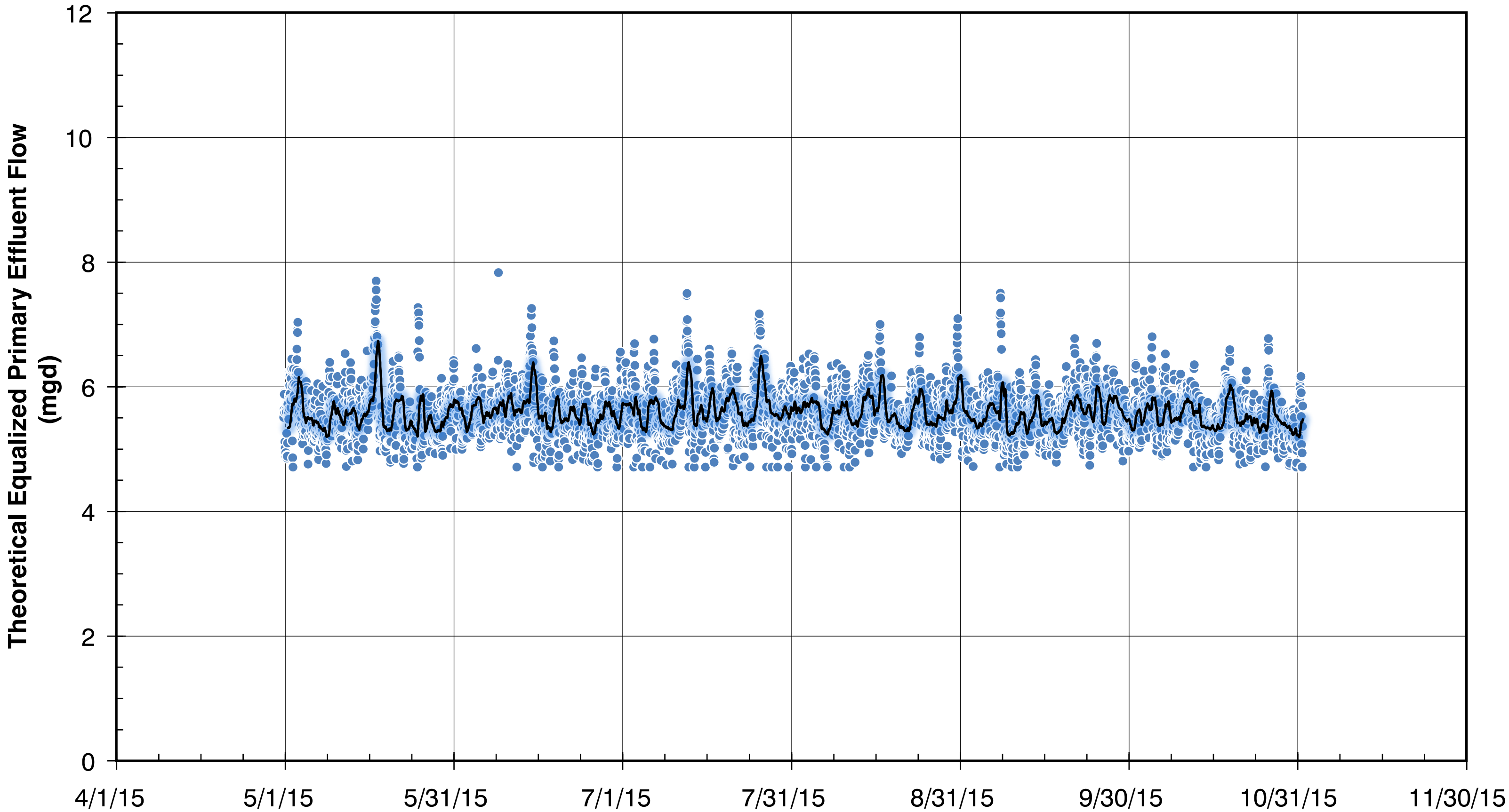

2015 THEORETICAL EQUALIZED PRIMARY EFFLUENT FLOW

FIGURE 9

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TERTIARY EXPANSION CAPACITY ASSESSMENT

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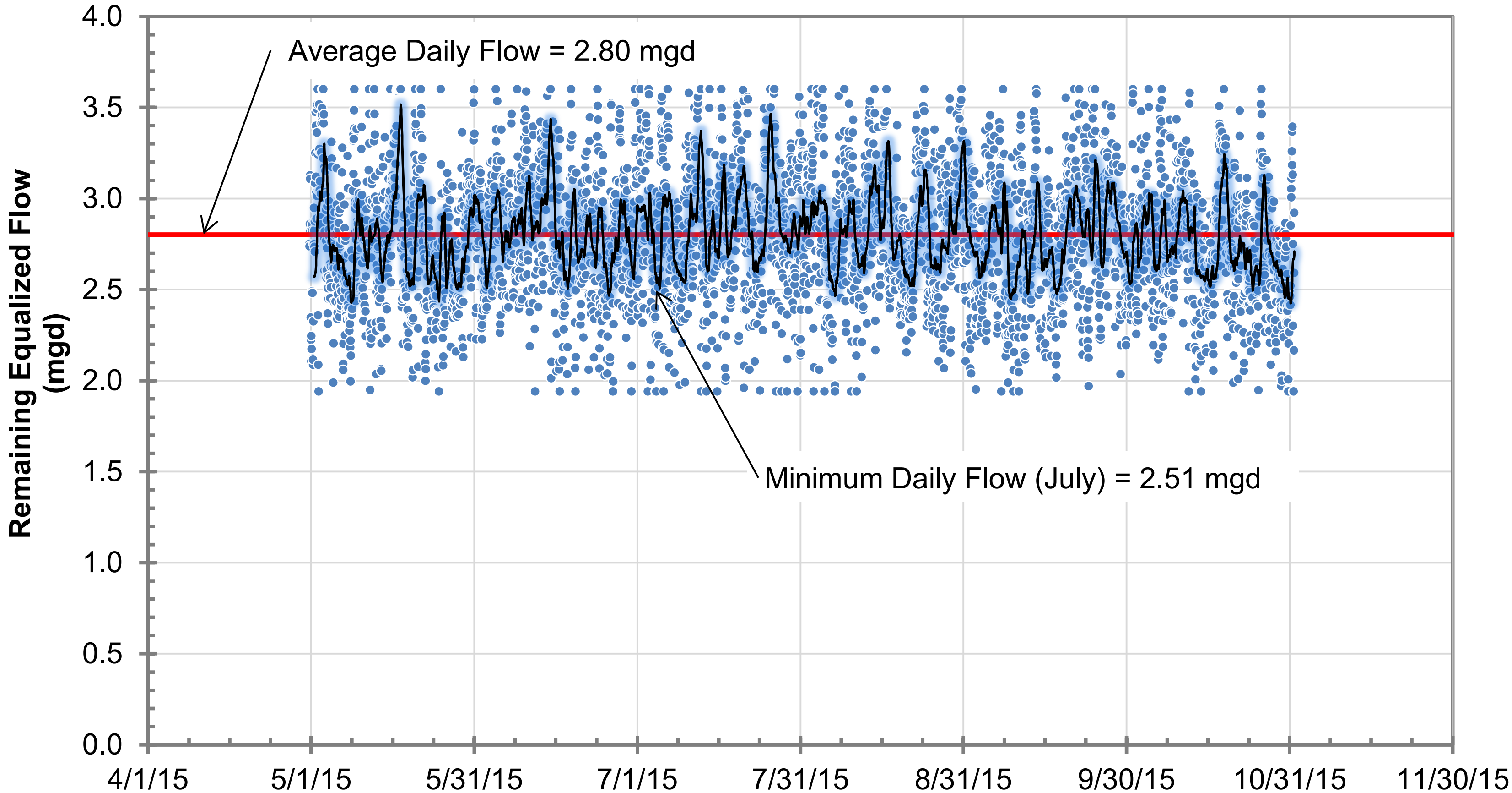

2015 REMAINING EQUALIZED FLOW FOR NEW TERTIARY SYSTEM

FIGURE 10

CITY OF DALY CITY
TERTIARY EXPANSION CAPACITY ASSESSMENT

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APPENDIX G – PROJECT MEMORANDUM 06 - NORTHERN PIPE ALIGNMENT EVALUATION

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DRAFT PROJECT MEMORANDUM - 06

Project Name:	Recycled Water Facilities Expansion Predesign Project (Project)	**Updated Date:**	July 8, 2016
Client:	City of Daly City	**Project Number:**	10076 A.10
Prepared By:	Darren Baune and Ron Papa		
Reviewed By:	Tracy Clinton		
Subject:	Northern Pipeline Alignment Evaluation		

1.0 PURPOSE

The purpose of this memorandum is to evaluate an alternate pipeline alignment (Northern Alignment) to convey recycled water from the Daly City WWTP to the cemeteries in Colma. The Northern Alignment crosses I-280 at the John Daly Boulevard Bridge and continues through Daly City to the recycled water storage tank.

2.0 BACKGROUND

Figure 1 shows the pipeline alignment recommended by the Recycled Water Treatment and Delivery System Expansion Feasibility Study (Feasibility Study) (Carollo, 2009) which is routed from the WWTP to the recycled water storage tank located at the Italian Cemetery. This alignment was selected as the preferred alternative during the Feasibility Study because it was the most favorable route in terms of construction cost as well as non-economic criteria (ease of permitting, community acceptance, constructability, access to easements, utility conflicts, traffic, and, operation and maintenance (O&M)).

During recent project review meetings, Daly City requested that the project team consider a Northern Alignment as an alternative to the Feasibility Study Alignment. The Northern Alignment crosses I-280 at the John Daly Boulevard Bridge and is routed through Daly City to the cemeteries in Colma. Daly City staff expressed concerns with utility congestion and permitting requirements along the following areas of the Feasibility Study Alignment:

- The Westlake Village Apartments by Coronado Avenue and Palmcrest Drive.
- The intersection of MacArthur Boulevard, Washington Street and 88th Street.
- Pierce Street, between Edgeworth Avenue and Sullivan Avenue.
- The SFPUC Right-of-Way (ROW) east of I-280 has several large pipelines in the right of way.
- Portions of the alignment travel nearby Bay Area Rapid Transit (BART).

Daly City WWTP

Feasibility Study Storage Tank Location

Recycled Water Transmission Main

SFPUC ROW

0 750 1,500 Feet

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FEASIBILITY STUDY RECOMMENDED PIPELINE ALIGNMENT

FIGURE 1

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

The project team has screened potential storage tank sites to the Atwood Site, Holy Cross Site, and Salem Cemetery in the memorandum titled "Daly City Storage Tank Site Initial Screening," (Carollo, 2016). Since the location of the storage tank site has not been finalized, this memorandum assumes the storage tank is located at the Atwood Property to simplify the analysis. If an alternate storage tank is selected, the results of this analysis would not change significantly. This memorandum compares the following three alignments:

- Feasibility Study Alignment.
- Northern Alignment A - Marchbank Park.
- Northern Alignment B - Hillside Boulevard.

3.0 FEASIBILITY STUDY ALIGNMENT

3.1 General Description

The Feasibility Study Alignment is routed from the Daly City WWTP to the recycled water storage tank at the Atwood Property as shown in Figure 1. The alignment crosses I-280 at the existing pipeline utility bridge and is approximately 14,370 feet in length. The Feasibility Study recommended an 18-inch diameter pipe and the diameter at the utility bridge crossing is 16-inch.

3.2 Existing Utilities and Permitting

The project team reviewed maps of existing utilities from the Daly City Engineering Department, GIS information, and discussed permitting requirements with staff. The following list summarizes the existing utilities and permitting required for this alignment:

- **Westlake Village Apartments:** An easement will be needed from the Westlake Village Apartment owner since the pipeline is located on their property from the intersection of Lake Merced Boulevard and Southgate Avenue to the intersection of Park Plaza Drive and Palmcrest Drive.
- **Broadmoor:** Coordination will be needed with Broadmoor since the alignment is within their jurisdiction from the intersection of Park Plaza Drive and Palmcrest Drive to the intersection of Annie Street and Washington Street.
- **Congested Utility Corridors West of I-280:** Based on available utility drawings and discussions with Daly City staff, several congested utility corridors have been identified which may present difficulties during pipeline construction. The congested utility corridors are the following:
  - Water, sewer, and stormwater pipes in the intersection of MacArthur Drive, Washington Street and 88th Street.
  - Fiber optics cables on Pierce Street between Edgeworth Avenue and Sullivan Avenue.

- **I-280 Pipe Utility Bridge:** In order to cross I-280, this alignment uses an existing 16-inch pipeline that is located on an existing utility bridge with other utilities.
- **SFPUC ROW:** The recycled water pipeline is routed through an existing SFPUC ROW from B Street to F Street and is assumed to be constructed with open cut methods. The SFPUC owns four large diameter pipelines that are routed through their ROW, they include: the 54-inch San Andreas Pipeline (SAPL) No. 2, the 66-inch SAPL No. 3, the 30-inch Baden-Merced Pipeline (BMPL), and the 60-inch Sunset Pipeline. The SFPUC is also constructing three well sites as part of the Regional Groundwater Storage and Recovery Project within the ROW. It is possible to route the recycled water delivery pipeline either adjacent to, or in the place of the Baden-Merced, but this will require coordination with the SFPUC. There are also several highly congested areas along the SFPUC ROW and an additional easement outside the ROW will be required.

  Based on discussion with SFPUC, they are open to the idea of using their ROW for the recycled water pipeline.
- **Bay Area Rapid Transit (BART):** The alignment is routed through F Street and a portion of which is owned by BART.
- **California Department of Transportation (Caltrans):** The alignment travels along El Camino Real from F Street to Olivet Parkway. El Camino Real is owned by Caltrans and would require permits from Caltrans.

3.3 Pipeline Length, Pumping Requirements and Cost

In addition to the utility congestion and permitting required, the pipeline length, pumping requirements, and annualized project cost (capital and annual pumping cost) should be considered in the alignment evaluation. The properties of the Feasibility Study Alignment are summarized below:

- The total length is 14,370 feet.
- The Feasibility Study recommended an 18-inch diameter pipeline. Based on the latest estimates of recycled water demand, and available supply at the Daly City treatment plant, the maximum tertiary capacity is estimated at 3 mgd. This comparison assumes the pipeline diameter is reduced to 14-inch for the alternatives, which will have adequate capacity for a maximum tertiary production of 3 mgd.
- The pipeline high-point elevation is at the intersection of Pierce Street and Edgeworth at approximate elevation 213 feet.
- The storage tank site is located at the Atwood Property.

Table 1 summarizes the capital and annual pumping costs for the Feasibility Study Alignment. The capital cost is based on an assumption of $24/inch-diameter per foot of pipeline, which is a budgetary cost estimate for planning purposes only. The annual pumping cost was estimated based on the estimated total pump station horsepower, current electricity costs, and an assumed operating time of 24 hours for 7 months per year.

Table 1 Feasibility Study Alignment - Budgetary Cost Estimate
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Capital Pipeline Cost ($)[1]	Annual Pumping Cost ($)[2]	Yearly Amortized Cost ($)[3]
$4,828,320	$83,700	$471,140

Assumptions:
(1) Pipe Characteristics: 14,370 ft of 14-inch pipeline.
Pipe Cost: $24 per inch-foot of pipe.
(2) Pump Characteristics: 2.73 mgd, at 195 ft of head, 85% efficiency.
Electricity Costs: $0.20 per KwH.
(3) Based on a project life of 20 years and an interest rate of 5%

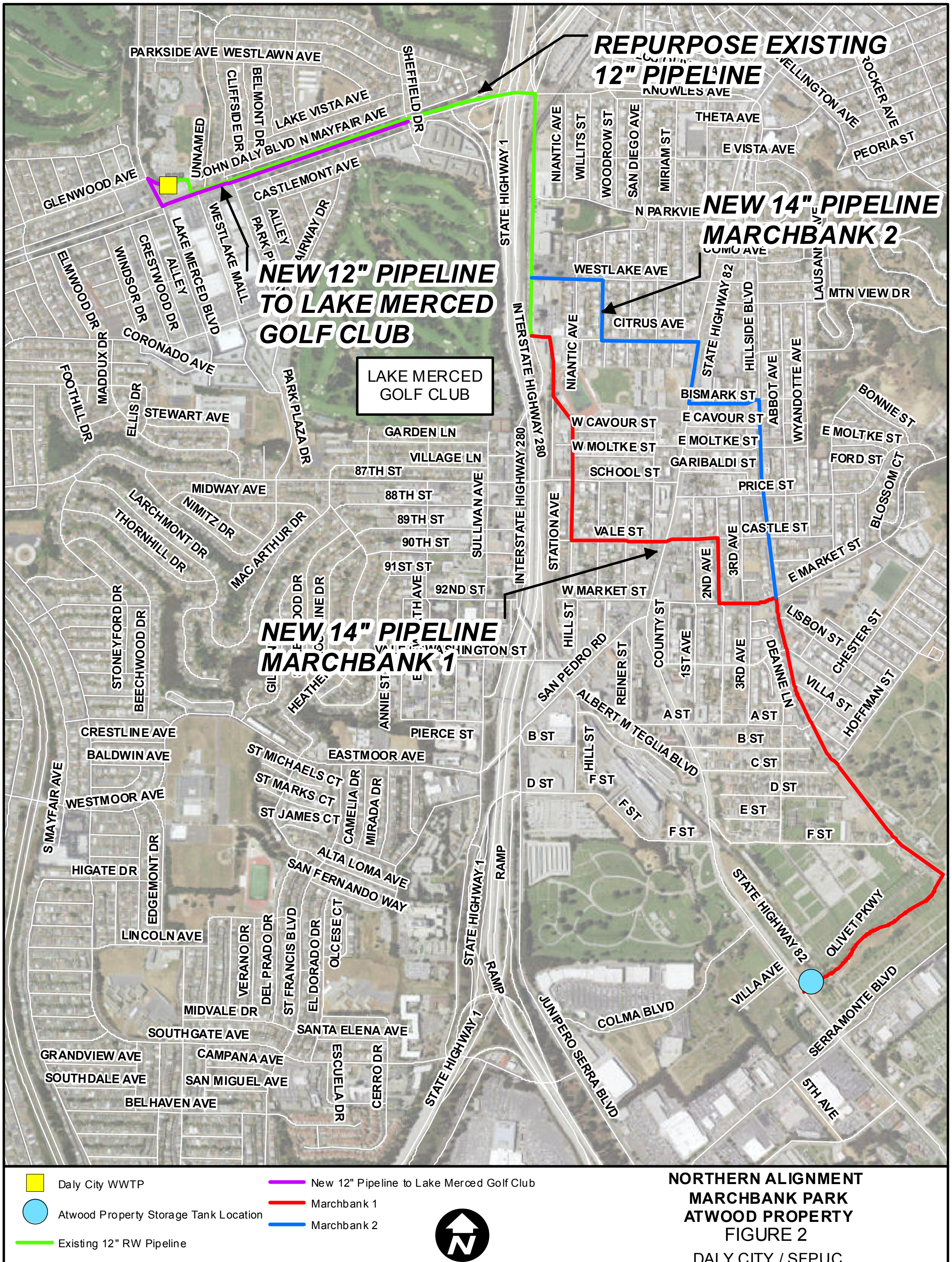
4.0 NORTHERN ALIGNMENT A - MARCHBANK PARK

4.1 General Description

The Marchbank Park Alignment repurposes an existing 12-inch recycled water pipeline owned by Daly City that crosses I-280 at the John Daly Bridge. The existing pipeline serves the Lake Merced Golf Club and Marchbank Park on the eastern side of I-280. Based on the latest estimates of the recycled water demand, and available supply at the Daly City WWTP, the existing 12-inch recycled water pipeline is adequate to convey the estimated recycled water flow of 3 mgd.

To utilize the existing 12-inch pipeline for the recycled water deliveries to Colma, a new 12-inch recycled water pipeline is needed to serve the Lake Merced Golf Club. The existing 12-inch pipeline that serves Lake Merced Golf Club does not have adequate capacity to serve the existing demands at the golf club and the cemetery demands at Colma.

The Marchbank Park Alignment has two potential alternatives. The Marchbank Park 1 Alignment connects at Junipero Serra Boulevard and Citrus Avenue and goes through a parking lot at 2201 Junipero Serra Boulevard (Daly City property), continues through the Jefferson Union High School District service yard, and through public right-of-way to the tank site. The Marchbank Park 2 Alignment connects at Junipero Serra Boulevard and Westlake Avenue and continues on through public right-of-way to the tank site. The Marchbank Park 1 Alignment is the preferred alternative because it has less static elevation gain and does not require the parallel easement along Highway 82. Refer to Figure 2 for an overview of the Marchbank Park alternatives.



NORTHERN ALIGNMENT
MARCHBANK PARK
ATWOOD PROPERTY
FIGURE 2

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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The Marchbank Park Alignments have the potential advantage of avoiding the SFPUC easement nearby the Baden-Merced pipeline. This may be advantageous if the SFPUC prefers to reserve area within the easement for other future facilities.

Because of the revised pipeline alignment, the Marchbank Park Alignment does not serve four recycled water customers that were identified for the Feasibility Study Alignment. The total peak day demand (over eight hours) for these four customers is approximately 0.32 mgd. The four customers are:

- Benjamin Franklin.
- Garden Village Elementary School.
- City Hall of Daly City.
- Margaret Pauline Brown Elementary School.

However, this Marchbank Park Alignment has a potential to add the Marchbank Park and Jefferson Union High School. Marchbank Park is an existing customer that will be switched from the original tertiary treatment system to the new tertiary treatment system. Daly City staff identified Jefferson Union High School as a potential recycled water customer due to their football and baseball fields. The total peak day demand spread over 8 hours for these two customers is approximately 0.12 mgd.

4.2 Existing Utilities and Permitting

This section summarizes the existing utilities and permitting required for the Marchbank Park Alignment. Refer to Figure 2 for an overview of the alignment:

- **Junipero Serra Boulevard Parking Lot:** The Marchbank Park 1 Alignment goes through a private parking lot at 2201 Junipero Serra Boulevard.
- **Daly City Property:** The Marchbank Park 1 Alignment goes through Daly City owned land by Jefferson Union High School District.
- **Jefferson Union High School District:** The Marchbank Park 1 Alignment goes through a service yard owned by the Jefferson Union High School District.
- **Mission Street (State Route 82):** Both Marchbank Park Alignments cross Mission Street, and a Caltrans maintained road. The Marchbank 1 Alignment crosses Mission Street at Vale Street and Castle Street. The Marchbank 2 Alignment travels along Mission Street from Citrus Avenue to Bismark Street.
- **Olivet Parkway:** An easement will be needed for all that Parkway since it is a private road owned by the Eternal Home Cemetery.

4.3 Pipeline Length, Pumping Requirements and Cost

The Marchbank Park Alignment properties are summarized below:

- 3,430 feet of new 12-inch pipe to serve the existing Lake Merced Golf Club.
- Marchbank Park 1 Alignment:
  - The total length is 18,920:
    - 11,370 feet of new 14-inch pipe to serve Colma.
    - Repurpose 7,550 feet of existing 12-inch recycled water pipe.
  - The pipeline high-point elevation is at Jefferson Union High School at approximate elevation 240 feet.
- Marchbank Park 2 Alignment:
  - The total length is 18,950:
    - 12,050 feet of new 14-inch pipe to serve Colma.
    - Repurpose 6,900 feet of existing 12-inch recycled water pipe.
  - The pipeline high-point elevation is at the intersection of Hillside Boulevard and Bismark Street at approximate elevation 333 feet.
- The storage tank is located at the Atwood Property.

Table 2 summarizes the capital and annual pumping costs for the Marchbank Park 1 and Marchbank Park 2 Alignments. The capital cost is based on an assumption of $24/inch-diameter per foot of pipeline and is a budgetary cost estimate for planning purposes only. The annual pumping cost was estimated based on the estimated total pump station horsepower, current electricity costs, and an assumed operating time of 7 months per year.

Table 2 Northern Alignment A - Marchbank Park Planning Cost Estimate
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Alternative	Capital Pipeline Cost ($)[1]	Annual Pumping Cost ($)[2]	Yearly Amortized Cost ($)[7]
Marchbank Park 1	$4,808,160[3]	$117,180[5]	$503,000
Marchbank Park 2	$5,036,640[4]	$155,810[6]	$559,970

Assumptions:
(1) Pipe Cost: $24 per inch-foot of pipe.
(2) Pump Operation: 7 months per year, 24 hours a day.
Electricity Costs: $0.20 per KwH.
(3) Pipe Characteristics: 3,430 ft of new 12-inch pipeline and 11,370 ft of new 14-inch pipeline.
(4) Pipe Characteristics: 3,430 ft of new 12-inch pipeline and 12,050 ft of new 14-inch pipeline.
(5) Pump Characteristics: 2.73 mgd, at 275 ft of head, 85% efficiency.
(6) Pump Characteristics: 2.73 mgd, at 365 ft of head, 85% efficiency.
(7) Based on a 20 year project life and a 5% interest rate.

5.0 NORTHERN ALIGNMENT B - HILLSIDE BOULEVARD

Similar to the Marchbank Park Alignment, the Hillside Boulevard Alignment repurposes the existing 12-inch recycled water pipeline (owned by Daly City) that crosses I-280 at the John Daly Bridge**.** The Hillside Boulevard Alignment has an intermediate elevation gain compared to the other alternatives. The elevation along John Daly Boulevard increases from 80 feet at the WWTP to 390 feet at Hillside. The Hillside Boulevard Alignment is shown on Figure 3.

Similar to the Marchbank Park Alignment, four customers identified in the Feasibility Study are not served with recycled water by this alignment. However, there are potential recycled water customers along the alignment that include: Marchbank Park, Our Lady of Perpetual Help (a church), Mission Plaza and Landmark Development. Marchbank Park is an existing customer that will be switched from the original tertiary treatment system to the new tertiary treatment system. The other users were identified by Daly City staff. The total peak day demand spread over 8 hours for these four customers is approximately 0.06 mgd.

The Marchbank Park has a potential advantage of avoiding the SFPUC easement nearby the Baden-Merced pipeline. This may be advantageous if the SFPUC prefers to reserve area within the easement for other future facilities.

5.1 Existing Utilities and Permitting

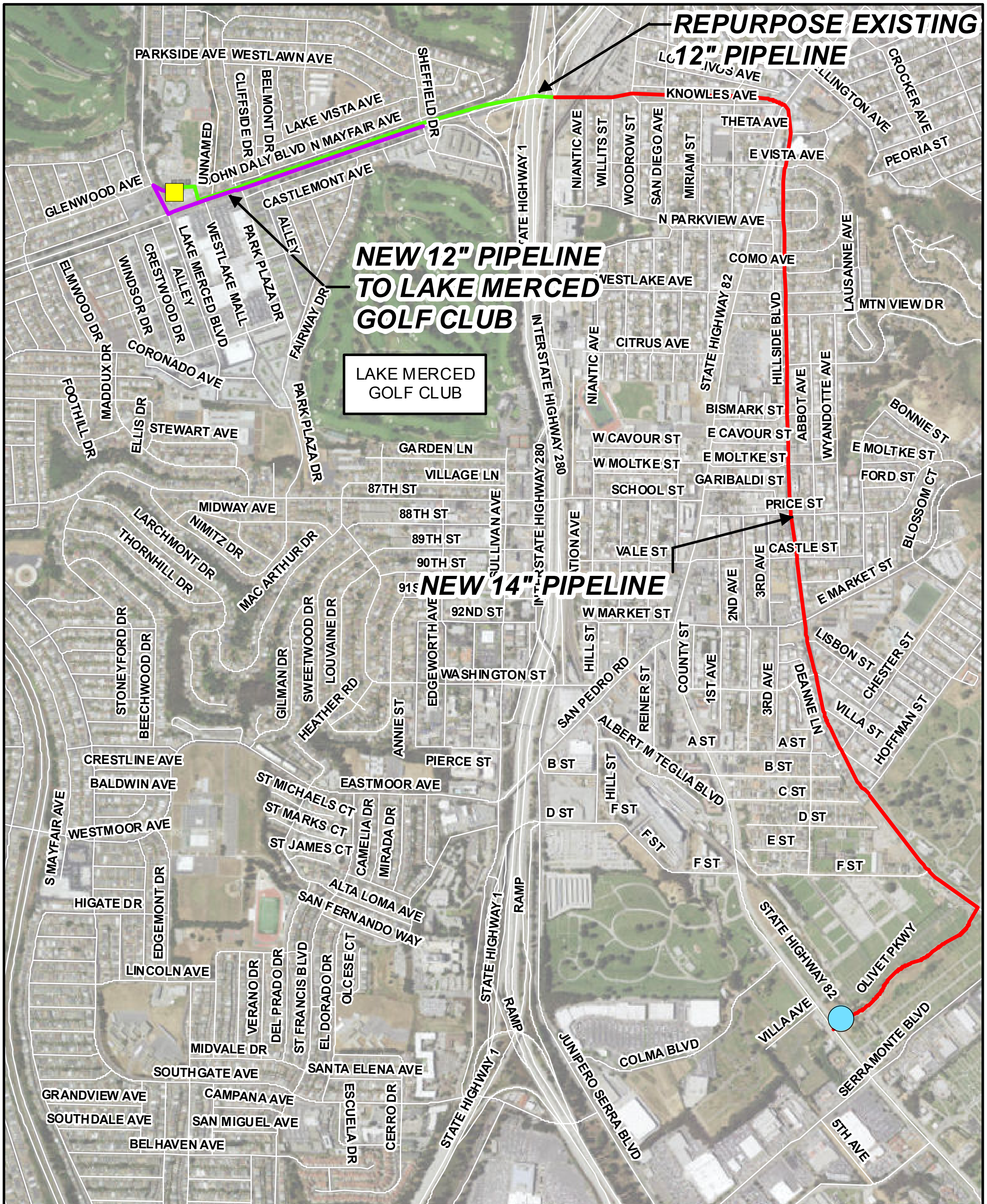
This section summarizes the existing utilities and permitting required for the Hillside Boulevard Alignment. Refer to Figure 3 for an overview of the alignment:

- **Mission Street (State Route 82):** This alignment crosses Mission Street, from John Daly Boulevard to Hillside Boulevard. Mission Street is maintained by Caltrans.
- **Olivet Parkway:** An easement will be needed for all that Parkway since it is a private road owned by the Eternal Home Cemetery.
- **Hillside Boulevard:** Based on discussions with City staff, utility conflicts along Hillside Boulevard are minimal. It is anticipated that the pipeline will be installed through open cut construction.

5.2 Pipeline Length, Pumping Requirements and Cost

The Hillside Boulevard Alignment properties are summarized below:

- The total length is 18,020 feet.
  - 3,430 feet of new 12-inch pipe and 13,670 feet of new 14-inch pipe.
  - Reuse 4,350 feet of existing 12-inch recycled water pipe.
- The pipeline high-point elevation is at the intersection of John Daly Boulevard and Hillside Boulevard at approximate elevation 390 feet.
- The storage tank is located at the Atwood Property.



Daly City WWTP

Atwood Property Storage Tank Location

New 14" Pipeline

New 12" Pipeline to Lake Merced Golf Club

Existing 12" RW Pipeline

Feet
0 800 1,600

NORTHERN ALIGNMENT HILLSIDE BOULEVARD ATWOOD PROPERTY

FIGURE 3

DAILY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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Table 3 summarizes the capital and annual pumping costs for the Hillside Boulevard Alignment. The capital cost is based on an assumption of $24/inch-diameter per foot of pipeline and is a budgetary cost estimate for planning purposes only. The annual pumping cost was estimated based on the estimated total pump station horsepower, current electricity costs, and an assumed operating time of 7 months per year.

Table 3 Northern Alignment B - Hillside Boulevard Planning Cost Estimate
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Scenario	Capital Pipeline Cost ($)[1]	Annual Pumping Cost ($)[2]	Yearly Amortized Cost ($)[5]
Hillside Alignment	$5,580,9603	$176,8504	$624,680

Assumptions:
(1) Pipe Cost: $24 per inch-foot of pipe.
(2) Pump Operation: 7 months per year, 24 hours a day.
Electricity Costs: $0.20 per KwH.
(3) Pipe Characteristics: 3,430 ft of new 12-inch pipeline and 13,670 ft of new 14-inch pipeline.
(4) Pump Characteristics: 2.73 mgd, at 415 ft of head, 85% efficiency.
(5) Based on a 20 year project life and a 5% interest rate.

6.0 SUMMARY

Table 4 summarizes the alignment evaluation considering annual pumping cost, capital cost, total annual cost, permitting requirements and utility congestion.

The Feasibility Study Alignment has the lowest yearly amortized cost and has the potential to save the City $30,000 a year. The total annual cost is the lowest for this alternative since it is the shortest length and pumps to a lower elevation. Both these factors minimize the pumping required which reduces the annual pumping cost. In terms of utility congestion, all the pipeline alternatives can be considered equal since all alternatives have utility congestion at certain sections.

We recommend moving forward with the Feasibility Study alternative because of the advantage listed above.

Table 4 Summary of Alternatives Evaluation
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Scenario	Pipeline Length (feet)	Capital Cost ($)	Annual Pumping Cost ($)	Yearly Amortized Cost ($)	Permitting Required	Utility Congestion
Feasibility Study	14,370	$4,828,320	$83,700	$471,140	• BART • Caltrans • SFPUC • Broadmoor • Westlake Village Apartments	• Westlake Village Apartments • Intersection of MacArthur Drive, Washington Street and 88th Street • Pierce Street between Edgeworth Avenue and Sullivan Avenue • SFPUC Easement
Marchbank Park 1 Alignment	18,920	$4,808,160	$117,180	$503,000	• Caltrans • Olivet Parkway • Jefferson Union High School District	• Portions along Hillside Boulevard • Portions along Vale Street and Castle Street
Marchbank Park 2 Alignment	18,950	$5,036,640	$155,810	$559,970	• Caltrans • Olivet Parkway	• Portions along Hillside Boulevard • Portions along Citrus Avenue
Hillside Boulevard	18,020	$5,580,960	$176,850	$624,680	• Caltrans • Olivet Parkway	• Portions along Hillside Boulevard

7.0 NEXT STEPS

The next steps to develop the 30 percent design of the pipeline alignment include:

- Coordinate with SFPUC to finalize the location of the pipeline alignment within their ROW.
- Perform the topographic survey and geotechnical investigations.

APPENDIX H – PROJECT MEMORANDUM 01 - COLMA TRANSMISSION PIPELINE ALIGNMENT

DRAFT PROJECT MEMORANDUM - 01

Project Name:	Feasibility of Expanded Tertiary Recycled Water Facilities Project (Project)	**Updated Date:**	February 1, 2016
Client:	City of Daly City	**Project Number:**	10076.A.10
Prepared By:	Darren Baune and Ron Papa		
Reviewed By:	Tracy Clinton		
Subject:	Colma Transmission Pipeline Alignment		

1.0 PURPOSE

The purpose of this memorandum is to update the Colma transmission pipeline alignment to accommodate customers added to the project since the Recycled Water Treatment and Delivery System Expansion Feasibility Study (Feasibility Study) (Carollo, 2009). Specifically, this memorandum considers revising the Colma transmission pipeline alignment to travel down Edgeworth Avenue instead of Washington Street.

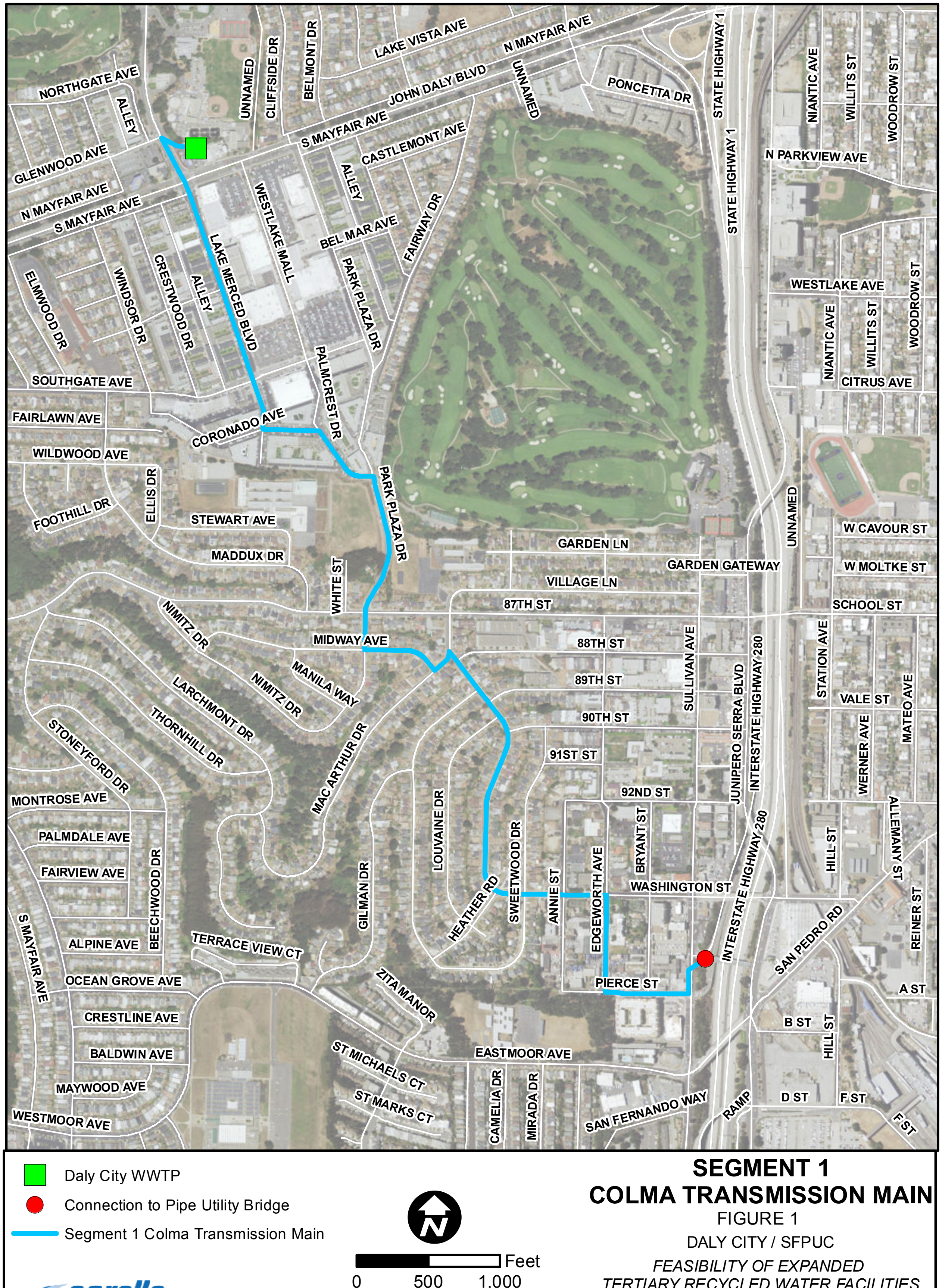
To maintain project schedule, the project team needs to begin the surveying and geotechnical investigations as soon as possible. In an effort to begin the field investigations, Carollo may start the investigations for the facilities west of Highway 280 once the Colma transmission pipeline alignment is finalized.

The pipeline alignment and storage tank site east of Highway 280 is also under review at this time. Based on recent conversations with the Italian Cemetery, the storage tank site assumed during the Feasibility Study may not be feasible. Since the pipeline alignment depends on the storage tank site, is important to finalize the storage tank site as soon as possible. Carollo will follow up with a memorandum describing potential storage tank sites and next steps.

2.0 BACKGROUND

Figure 1 shows the alignment from the City of Daly City's wastewater treatment plant to the pipeline utility bridge at Highway 280. This alignment was selected as the preferred alternative during the Feasibility Study because it was the most favorable route in terms of construction cost as well as non-economic criteria (ease of permitting, community acceptance, constructability, access to easements, utility conflicts, traffic, and, operation and maintenance).

At the request of Daly City, Segment 1 was re-reviewed and several customers not previously identified in the 2009 Feasibility Study were added to the alignment. Three of the new customers are located near the Segment 1 alignment but one of the new customers (Daly City City Hall) is not adjacent to the alignment. Carollo has compared the recommended alignment with a revised alignment to incorporate City Hall and the findings are summarized in this memorandum.



SEGMENT 1
COLMA TRANSMISSION MAIN
FIGURE 1
DALY CITY / SFPUC
FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

3.0 PIPELINE ALIGNMENT COMPARISON

3.1 Feasibility Study Alignment

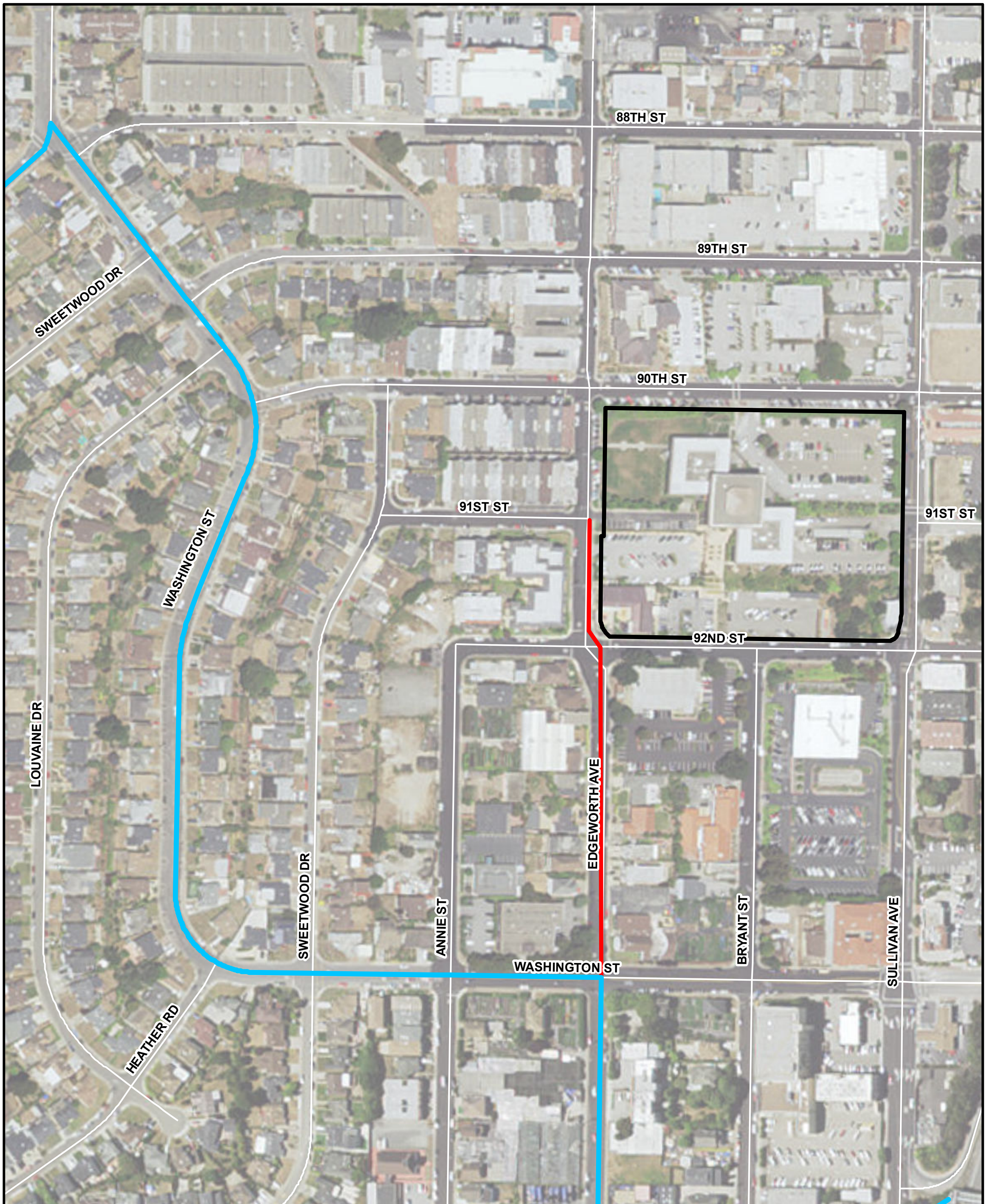
Figure 2 shows a section of the alignment recommended by the Feasibility Study near the City Hall of Daly City. The alignment travels along Washington Street which is a two-lane road with shoulder parking on both sides. Washington Street travels through a residential neighborhood comprised mainly of single-family homes. Based on the preliminary utility research conducted, there are two sanitary sewer lines (8-inch and 30-inch) along Washington Street from MacArthur Drive to 89th Street. There is also a 6-inch sanitary sewer line along Washington Street from 89th Street to Heather Road.

The recommended alignment from the intersection of Washington Street and 88th Street to the intersection of Washington Street and Edgeworth Avenue is approximately in 2,640 feet in length. The service connection to City Hall is approximately 920 feet in length. This alignment was selected as the preferred alternative during the Feasibility Study because it was the most favorable route in terms of construction cost as well as the non-economic criteria (defined above).

3.2 Possible Revised Alignment

The revised alignment is shown in Figure 3. The proposed alignment change would occur at the intersection of Washington Street and MacArthur Drive and end at the intersection of Washington Street and Edgeworth Avenue. The revised alignment would go East on 88th Street and head South on Edgeworth Avenue, which are both two lane streets with shoulder parking on both sides. The neighborhood along the updated alignment is primarily residential, composed of a mix of single family and multi-family homes.

Based on the utility research conducted, there are three sanitary sewer lines (6-inch and two 15-inch), three stormwater lines (24-inch, 36-inch, and 48-inch) and a water line (6-inch) along 88th Street. There are also three sanitary sewer lines (12-inch, 15-inch and 6-inch), a stormwater line (an 18-inch that drains to a 60-inch) and a water line (6-inch) along Edgeworth Avenue. The revised transmission main alignment is 2,790 feet in length.



Recommended Alignment

Service Connection

City Hall of Daly City

Feet
0 150 300

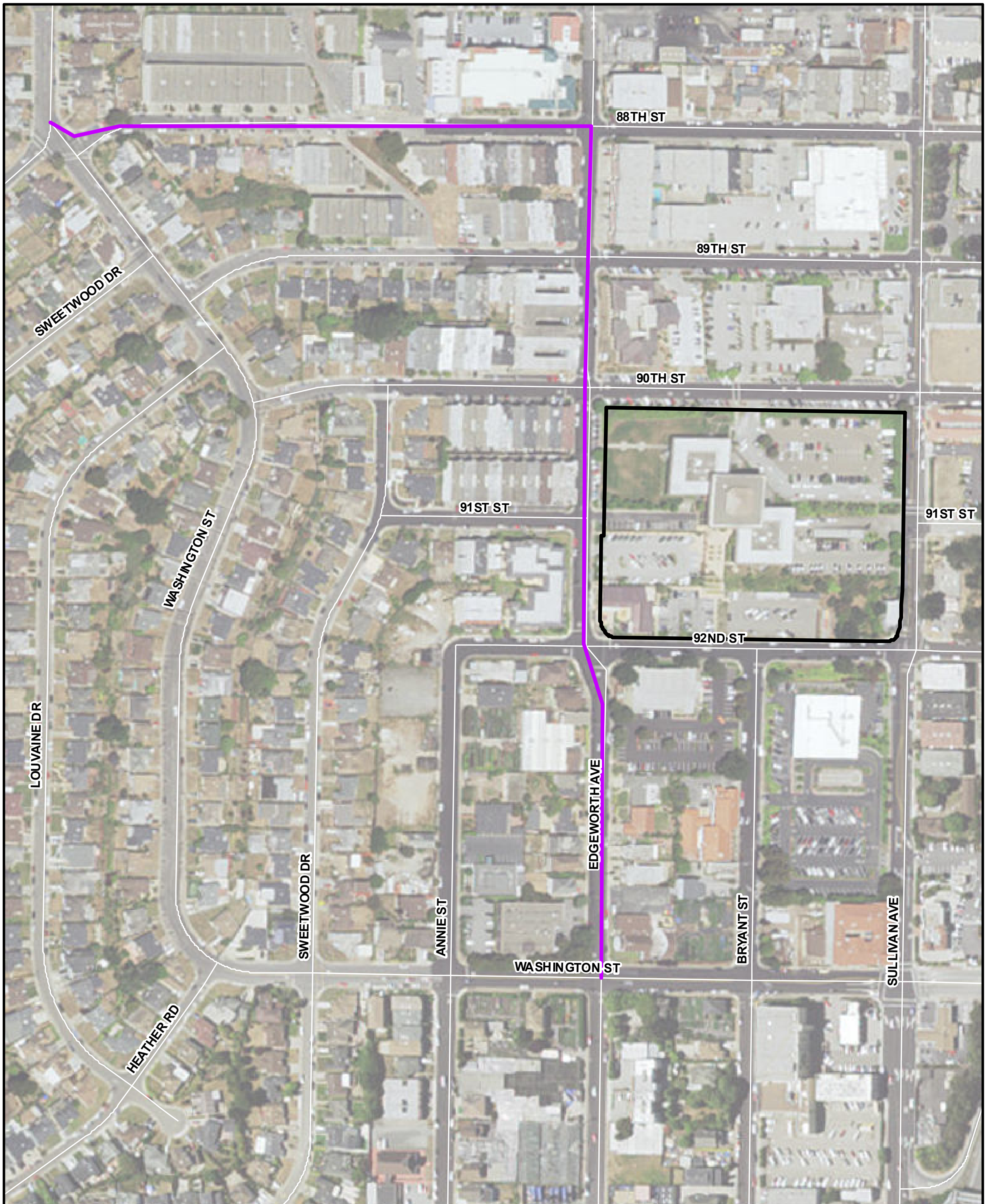
carollo

CITY HALL OF DALY CITY
RECOMMENDED ALIGNMENT

FIGURE 2

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED
TERTIARY RECYCLED WATER FACILITIES



Revised Alignment

City Hall of Daly City

Feet

0 150 300

carollo

CITY HALL OF DALY CITY REVISED ALIGNMENT

FIGURE 3

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

3.3 Evaluation

The alignments were 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. All the criteria were weighted equally. These are the same criteria and methodology that was used in the previous Feasibility Study. A summary of the evaluation is presented in Table 1.

Table 1 Non Economic Factor Evaluation
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Criteria	Feasibility Study Recommended Alignment		Possible Revised Alignment	
	Description	Score	Description	Score
Permitting	Majority of the alignment travels through Broadmoor.	2	Majority of the alignment travels through Daly City.	3
Community	Potential impacts to single family houses and an office building.	3	Potential impacts to single family houses, multi-family residential buildings, office buildings, a day care center and the Broadmoor Police Department building.	1
Constructability	Open cut construction is viable along alignment.	2	Open cut construction is viable along alignment.	2
Easements	Construction is expected to be entirely within public right-of-way.	2	Construction is expected to be entirely within public right-of-way.	2
Utilities	Minimal utilities along alignment; three sanitary sewer pipes.	3	Significant utilities along alignment; several sanitary sewer pipes, potable water lines and storm drains.	1
Traffic	SamTrans Bus Route 122 travels along this alignment entire alignment.	2	SamTrans Bus Route 121 travels along a portion of this alignment.	2
Operations and Maintenance	Routine maintenance access alignment consistent with facilities located in residential streets.	2	Routine maintenance access alignment consistent with facilities located in residential streets.	2
	Total	**16**	**Total**	**13**

Carollo also compared the cost of the two alternatives. The alignment presented in the Feasibility Study is approximately 150 feet shorter than the revised alignment. However, the Feasibility Study alignment also requires a 920 foot service connection (i.e. small diameter) to City Hall. We estimate that the cost of the service connection will offset the savings of the reduced alignment length and the estimated construction cost for the two alignments is expected to be similar.

4.0 RECOMMENDATION

Carollo recommends maintaining the alignment selected during the Feasibility Study phase of the project because the alignment has a reduced potential for utility conflicts. Based on review of the City's utility drawings, the revised alignment has several large diameter pipelines (on 88th Street: one 6-inch and two 15-inch sanitary pipelines, 24-inch, 36-inch and 48-inch stormwater pipes and a 6-inch water line, on Edgeworth Avenue: 6-inch, 12-inch and 15-inch sanitary pipelines, an 18-inch stormwater pipe and a 6-inch water line) along the roadway. The revised alignment is also along areas of high-density housing which would likely have busier traffic and potentially create challenges during construction.

APPENDIX I – PROJECT MEMORANDUM 10 - DALY CITY WIRELESS VIRTUAL ANALYSIS

DRAFT PROJECT MEMORANDUM - 10

Project Name:	Feasibility of Expanded Tertiary Recycled Water Facilities (Project)	**Updated Date:**	January 9, 2017
Client:	City of Daly City	**Project Number:**	10076A.10
Prepared By:	Amit Sahdev		
Reviewed By:	Chris Carvalho		
Subject:	Daly City Wireless Virtual Analysis		

1.0 PURPOSE

The purpose of this memorandum is to evaluate the possibility of a wireless communication link between Daly City's Wastewater Treatment Plant (WWTP) and the two potential storage tank sites: Atwood Property and Holy Cross Cemetery. The evaluation was performed using a wireless path simulation software tool.

2.0 COMMUNICATIONS LINK BASIS OF DESIGN

It is not feasible to establish a direct wireless link between the WWTP and the Holy Cross Cemetery due to geographical obstructions between the two sites. Therefore, an alternative method of connecting the two sites (WWTP and Holy Cross Cemetery) is to use the Atwood Property as a 'collector' site for the data transmitted by the Holy Cross Cemetery site. Figures 1 and 2 show the proposed communication link path. The communication link simulation assumed that only SCADA/HMI data handling will be required.

Figure 1 Proposed Communication Link Path

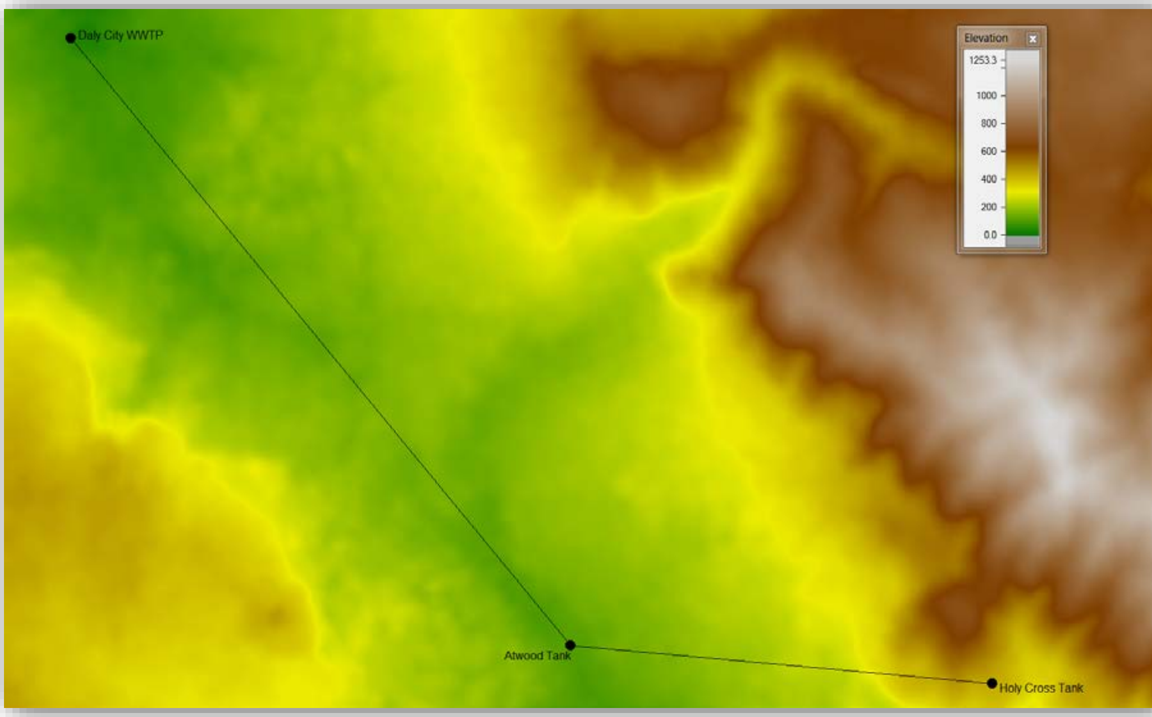
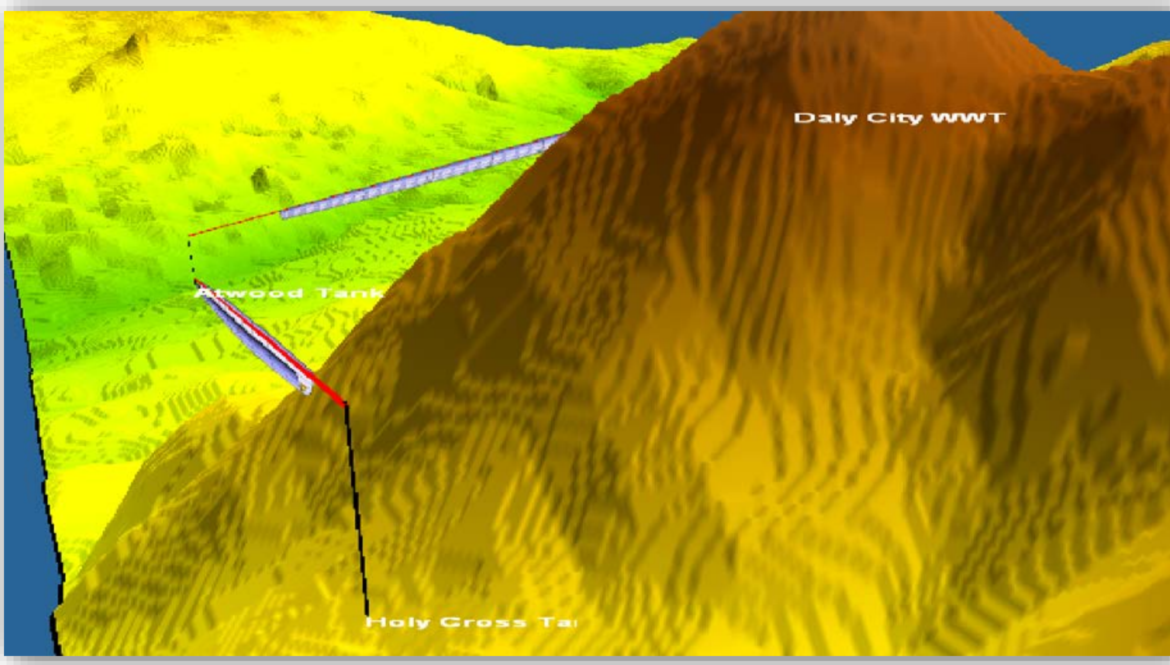


Figure 2 Proposed Communication Link Path Topography



3.0 ANTENNA HEIGHTS

The following section summarizes the antenna heights required to establish a wireless communication link between the three sites.

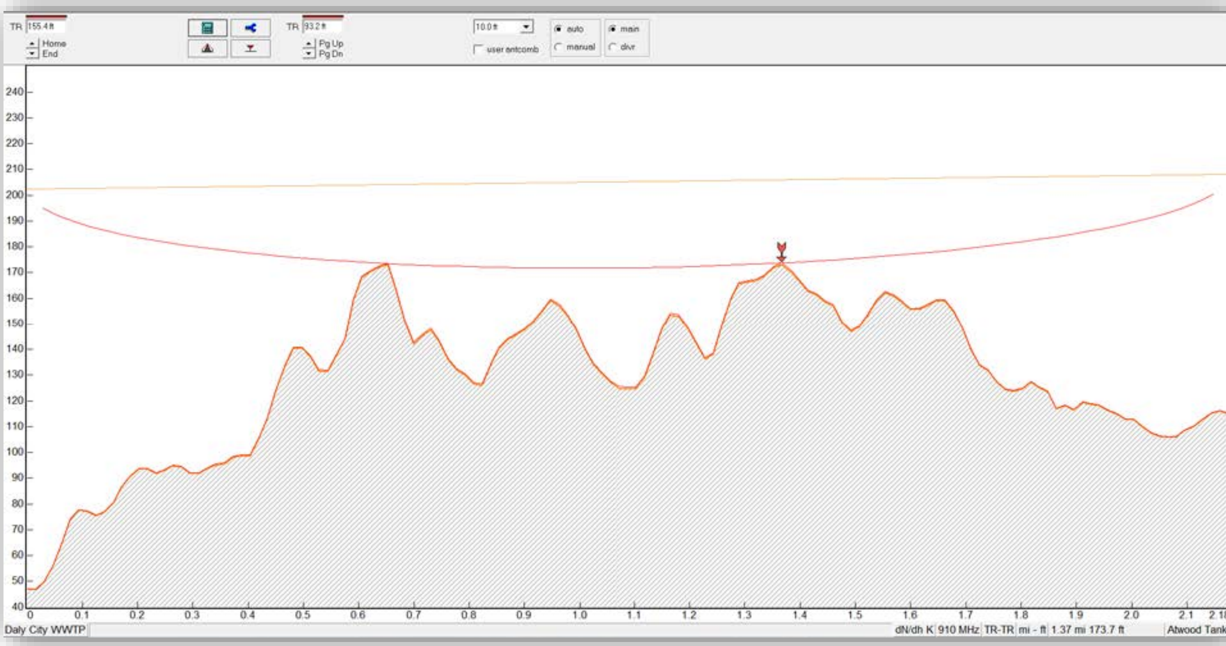
3.1 Link between Daly City WWTP and Atwood Property

Figure 3 shows the geographical profile between the WWTP and Atwood Property. The solid yellow line represents Line of Sight (LoS) and the curved red line below it represents 60% Fresnel zone where it is critical to ensure no obstructions exist.

The tower heights required at each site are as follows:

- Daly City WWTP: **157.4 Feet**
- Atwood Property: **95.2 Feet**

Figure 3 Geographical Profile: WWTP to Atwood Property



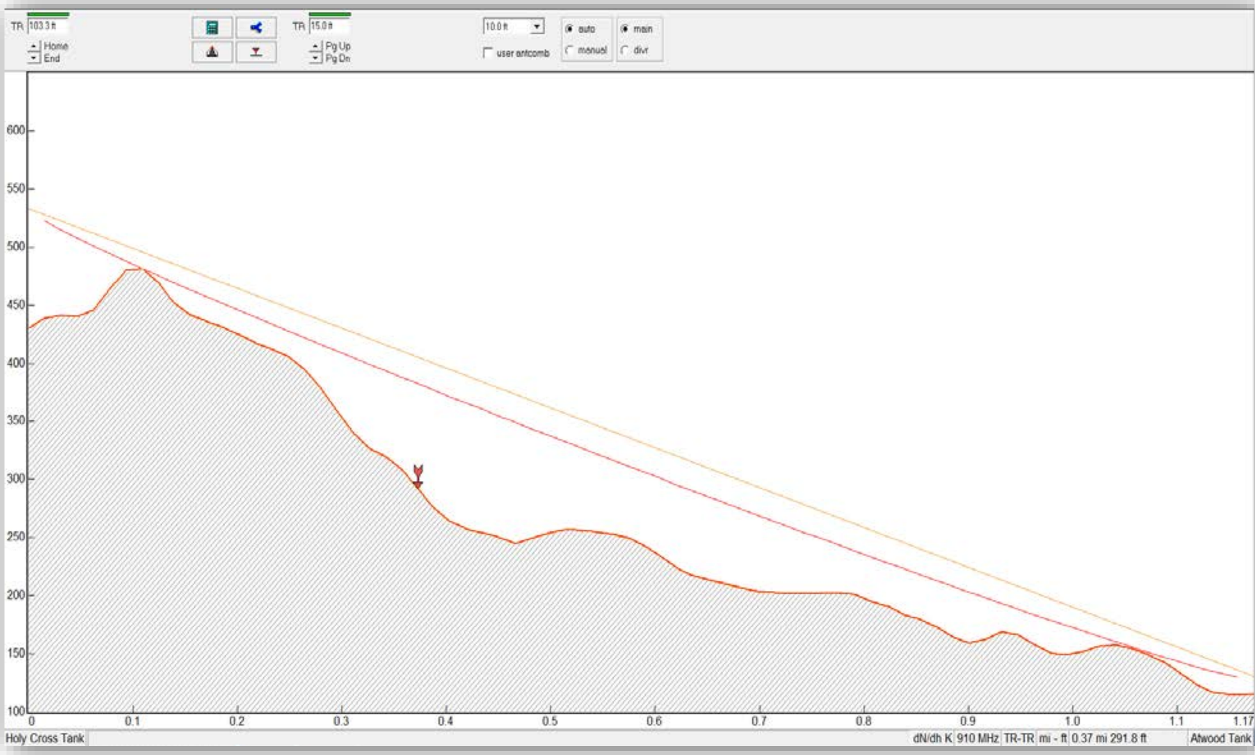
3.2 Link between Atwood Property and Holy Cross Cemetery

Figure 4 shows the geographical profile between the Atwood Property and Holy Cross Cemetery. The solid yellow line represents Line of Sight (LoS) and the curved red line below it represents 60% Fresnel zone where it is critical to ensure no obstructions exist.

The tower heights required at each site are as follows:

- Atwood Property: **17.0 Feet**
- Holy Cross Cemetery: **105.3 Feet**

Figure 4 Geographical Profile: Atwood Property to Holy Cross Cemetery



4.0 CONCLUSION AND RECOMMENDATIONS

Based on the wireless path simulation, the tower heights required are impractical for the type of data link that is under consideration.

Since the data transmission requirements are limited (no video or high bandwidth voice data), Carollo recommends considering cellular radios. Cellular radios are more cost effective for this application and are better suited for the topography. One key advantage of cellular radios is that they do not need a line of sight for operation and can communicate across walls, hills, and other geographical features. Please note that a cellular system does require a monthly recurring cost and has limited troubleshooting access (beyond the radio itself) if a radio link becomes non-functional.

APPENDIX J - PROJECT MEMORANDUM 14 - COLMA BOULEVARD PIPELINE ALIGNMENT

This document is released for the purpose of information exchange review and planning only under the authority of Darren G. Baune, 9/12/2017, California P.E. No. 68899.

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

PROJECT MEMORANDUM NO. 14
COLMA BOULEVARD ALIGNMENT

DRAFT
September 2017

2700 YGNACIO VALLEY ROAD, SUITE 300 • WALNUT CREEK, CALIFORNIA 94598 • P. 925.932.1710 • F. 925.930.0208

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

PROJECT MEMORANDUM
NO. 14
COLMA BOULEVARD ALIGNMENT

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COLMA BOULEVARD ALIGNMENT

1.0 INTRODUCTION

1.1 Purpose

The purpose of this memorandum is to evaluate the Colma Boulevard pipeline alignment to convey recycled water from the Daly City Wastewater Treatment Plant (WWTP) to the cemeteries in Colma.

1.2 Background

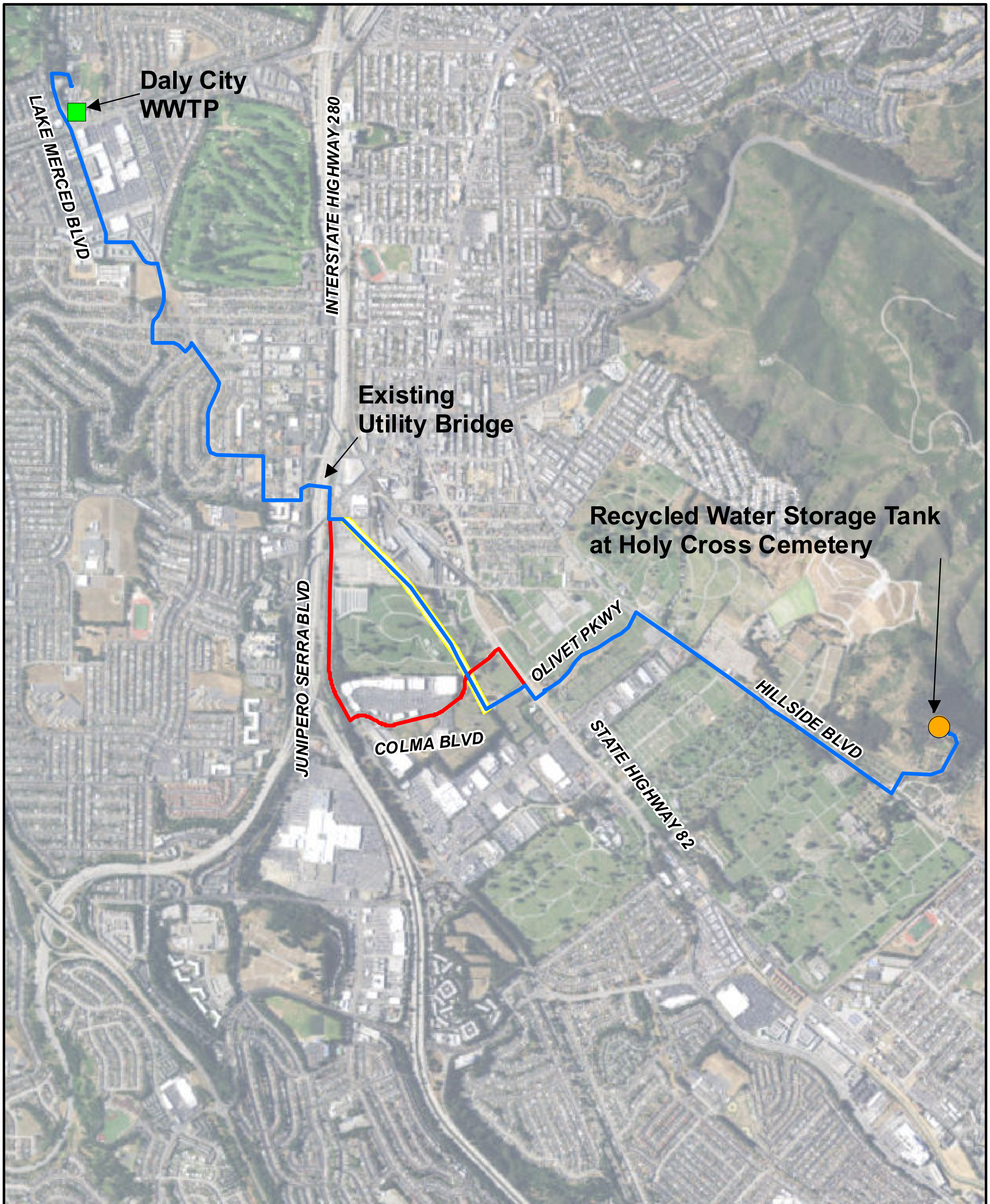
The Recycled Water Treatment and Delivery System Expansion Feasibility Study (Feasibility Study) (Carollo, 2009) recommended the pipeline alignment shown in Figure 1 from the City of Daly City's (Daly City) WWTP to the recycled water storage tank located at the Italian Cemetery. This alignment was selected as the preferred alternative during the Feasibility Study because it was the most favorable route in terms of construction cost as well as non-economic criteria (ease of permitting, community acceptance, constructability, access to easements, utility conflicts, traffic, and, operation and maintenance (O&M)).

The San Francisco Public Utilities Commission (SFPUC) and Daly City expressed concern that the Feasibility Study alignment is routed within an SFPUC easement in the location shown in Figure 1. Within this easement, the SFPUC owns and operates the 54-inch San Andreas Pipeline (SAPL) No. 2, the 66-inch SAPL No. 3, the 60-inch Sunset Supply Pipeline, the 30-inch Baden Merced Pipeline (BMPL), which is abandoned, and an 8-inch raw water pipeline. The Feasibility Study planned for the recycled water pipeline to be installed along the abandoned BMPL alignment adjacent to the existing pipelines.

The SFPUC and Daly City requested Carollo evaluate an alignment outside of the easement. Based on discussions with Daly City, the project team selected the Colma Boulevard alignment as the preferred alternative. The additional evaluation includes topographic surveying, development of 30 percent design drawings, and the California Environmental Quality Act (CEQA) analysis for the Colma Boulevard alignment. The Colma Boulevard alignment will also be included in the Preliminary Design Report for the Project. The geotechnical investigation was not performed at this time. If this alternative is selected the geotechnical investigation would be performed during final design.

2.0 COLMA BOULEVARD ALIGNMENT

The Colma Boulevard alignment is routed along the Feasibility Study alignment west of I-280 and crosses I-280 at the existing utility bridge. East of I-280, the alignment is along Junipero Serra Boulevard and Colma Boulevard as shown in Figure 1. Junipero Serra



Feasibility Study Alignment
Colma Blvd Alignment
SFPUC Easement
Daly City WWTP
Storage Tank

Feet
0 1,150 2,300

COLMA BOULEVARD ALIGNMENT

FIGURE 1

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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Boulevard and Colma Boulevard are both four lane roads located in the Town of Colma. Junipero Serra Boulevard and Colma Boulevard contain several utilities such as water pipelines, sanitary sewer pipelines, storm drains, and electric.

This PM evaluates the Colma Boulevard alignment (hydraulics, cost, and pumping) assuming the recycled water storage tank is located at the Holy Cross or Atwood Property. PM 5 titled, "Recycled Water Storage Tank Site Evaluation" (Carollo, 2017) found that the Holy Cross and Atwood sites are the most feasible alternatives. PM 5 also found that the proposed tank site at the Salem Memorial Park is small and would require a cost prohibitive tank depth of 70 feet. Due to this finding, the Colma Boulevard Alignment was not evaluated for the Salem Memorial Park storage tank site.

The hydraulics, cost and pumping evaluation of the Colma Boulevard alignment depends on the storage tank location. The storage tank location impacts the required horsepower (hp) at the recycled water effluent pump station and the length of the recycled water pipelines. The storage tank size and design, the distribution system pump station, and the transmission pipeline size are not impacted.

2.1 Storage Tank at the Atwood Property

Figure 2 shows the Colma Boulevard pipeline alignment assuming the storage tank is located at the Atwood Property.

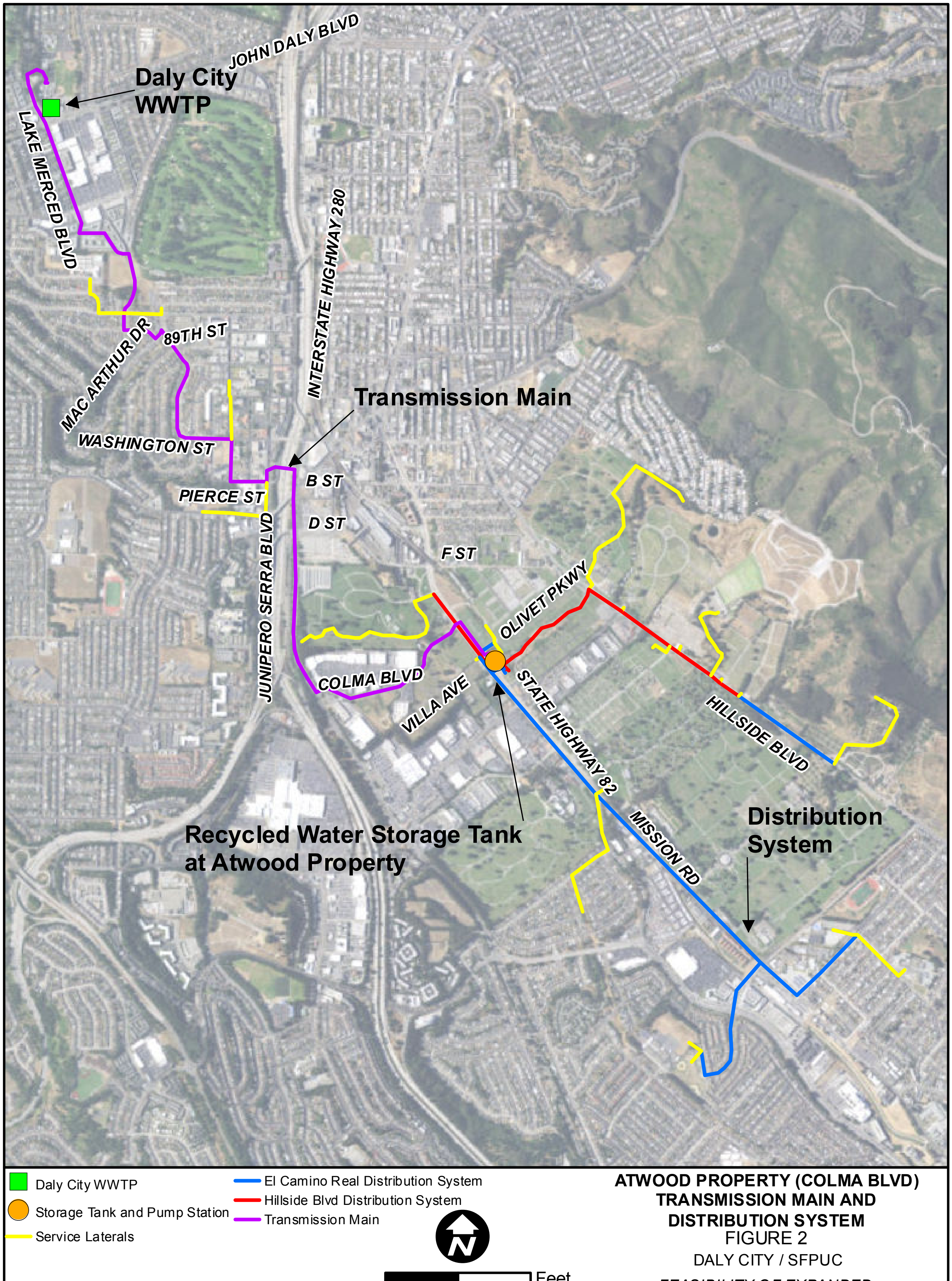
2.1.1 Recycled Water Pump Station

The recycled water pump station located at the Daly City WWTP is a three-pump facility with 2 duty pumps and 1 standby pump. The system curve for the pump station is shown in Appendix A. The pump design criteria are presented in Table 1. Table 1 also compares the Colma Boulevard and Feasibility Study pipeline alignments pump station design criteria.

Table 1 Atwood Property - Recycled Water Pump Station
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Item	Feasibility Study Alignment	Colma Blvd Alignment
Configuration	2 duty + 1 standby	2 duty + 1 standby
Pump Capacity (each pump)	1.78 mgd	1.78 mgd
Total Dynamic Head (feet)	230	310
Assumed Pump Efficiency	85 percent minimum	85 percent minimum
Motor horsepower (HP), each pump	100 HP minimum	130 HP minimum

The motor horsepower is higher for the Colma Boulevard Alignment since there is a hill along Junipero Serra Boulevard that the alignment needs to overcome, which creates a



ATWOOD PROPERTY (COLMA BLVD) TRANSMISSION MAIN AND DISTRIBUTION SYSTEM

FIGURE 2

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

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higher static elevation. The highest elevation of the Feasibility Study Alignment is approximately 193 feet. The highest elevation of the Colma Boulevard Alignment is approximately 270 feet.

Due to the increased operating pressure, only one booster pump system is needed for the Colma Blvd Alignment. The booster system is required for the Margaret Pauline Brown Elementary School. For comparison, the Feasibility Study Alignment requires two booster pump systems.

2.1.2 Recycled Water Pipelines

The Colma Boulevard Alignment requires additional transmission pipe length compared to the Feasibility Study Alignment. Pipe sizes for both alignments are similar. A summary of the pipeline lengths for the Atwood Property storage tank site is presented in Table 2.

Table 2 Atwood Property - Pipeline Lengths
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

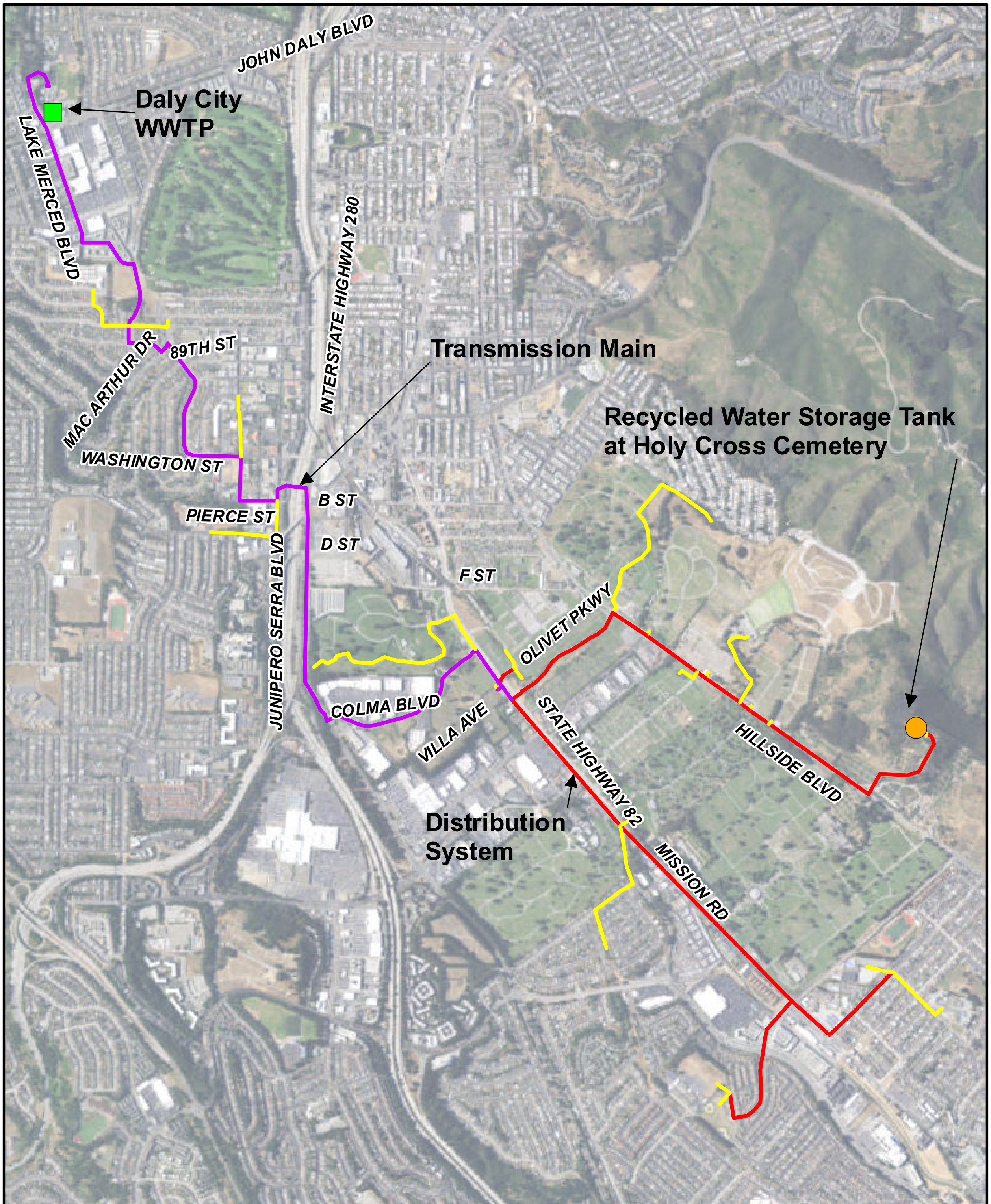
Item	Transmission Main Pipeline Lengths (ft)
Feasibility Study Alignment	16,700
Colma Boulevard Alignment	18,900

2.2 Storage Tank at the Holy Cross Cemetery

Figure 3 shows the Colma Boulevard pipeline alignment assuming the storage tank is located at the Holy Cross Cemetery.

2.2.1 Recycled Water Pump Station

Similar to the Feasibility Study Alignment, the recycled water pump station at the Daly City WWTP is a three-pump facility consisting of 2 duty pumps and 1 standby pump. The system curve for the pump station is shown in Appendix A. The pump design criteria are presented in Table 3. The pumping requirements for the Feasibility Study Alignment and the Colma Boulevard Alignment are fairly similar. Three pressure reducing valves (PRVs) are needed to reduce pressures for three customers along the transmission main that will have minimum pressures greater than 100 pounds per square inch (psi).



Daly City WWTP
Storage Tank
Service Laterals
Gravity Distribution System
Transmission Main

0 1,150 2,300 Feet

HOLY CROSS CEMETERY (COLMA BLVD) TRANSMISSION MAIN AND DISTRIBUTION SYSTEM

FIGURE 3

DALY CITY / SFPUC

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

Table 3 Holy Cross Cemetery - Pump Station at Daly City WWTP Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City		
Item	**Feasibility Study Alignment**	**Colma Blvd Alignment**
Configuration	2 duty + 1 standby	2 duty + 1 standby
Pump Capacity (each pump)	1.78 mgd	1.78 mgd
Total Dynamic Head (feet)	540	545
Assumed Pump Efficiency	85 percent minimum	85 percent minimum
Motor horsepower (HP), each pump	200 HP minimum	200 HP minimum

2.2.2 Recycled Water Pipelines

The Colma Boulevard Alignment requires additional transmission and customer piping when compared to the Feasibility Study Alignment. Pipe sizes for both alignments are similar. A summary of the pipeline lengths for the Holy Cross Cemetery storage tank site is presented in Table 4.

Table 4 Holy Cross Cemetery - Pipeline Lengths Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City			
Item	**Transmission Main Pipeline Length (ft)**	**Customer Service Lines Pipeline Length (ft)**	**Total Pipeline Length (ft)**
Feasibility Study Alignment	16,700	16,500	33,200
Colma Boulevard Alignment	18,800	18,200	37,000

3.0 COST ESTIMATE

3.1 Basis for Estimate

The project is currently at the 30% design phase and the design has not been developed in detail. The construction cost estimates are consistent with the Association for the Advancement of Cost Engineering (AACE) International Class 4 budget estimate with an accuracy range of +50 percent to -30 percent of the actual project cost.

3.1.1 ENR Benchmark

Providing a cost benchmark for construction estimates is useful in documenting the time of estimate preparation and in allowing for projections and escalations to later dates using the equivalent index value.

This preliminary design cost estimate is benchmarked to the Construction Cost Indices (CCI) published by the Engineering News Record (ENR) for August 2017. It should be noted this is the most current ENR to date. Typically, for the Daly City region, the ENR San Francisco CCI is used. The ENR San Francisco CCI for August 2017 was 12037.

3.1.2 Unit Costs

Unit costs have been researched and used for the major pipeline and structure components of the Project. These major components include water piping, pumps, valving, structures, and appurtenances.

Unit costs have been developed using preliminary quotations received from equipment and material manufacturers supplemented with installation costs based on past experience with similar projects, available recent bid data, or cost estimating guidelines derived from estimating guides such as the 2017 RS Means Heavy Construction Data publication, the most current publication to date.

3.1.3 Contingencies

Contingencies are typically applied to a construction estimate at the design development phase to account for construction items not yet identified design unknowns. As the design is refined and finalized, the contingency, typically expressed as a percent of the construction cost, will trend downward. At the completion of the design, the contingency should represent only a reasonable construction change order allowance. Agencies typically retain contingency within their project budgets, even when construction contract award values are known, to cover the cost or deal with unforeseen conditions.

A 30 percent contingency, calculated based on the raw construction cost, has been included in all three alternatives' cost estimates. This is consistent with the recommendations for a project at an AACE Class 4 level of development.

3.2 Construction Cost

The preliminary design construction cost estimates for the Colma Boulevard Alignment are summarized in Tables 5 and 6. Appendix B provides details for each estimate including quantities, unit prices, and estimating assumptions. These estimates exclude property acquisition costs, which will need to be negotiated with the land owners.

3.3 Operations and Maintenance Cost

The operations and maintenance (O&M) cost was estimated for the Colma Boulevard alignments. O&M costs for pump station and pipeline include the electricity costs of pumping and annual maintenance of the facilities.

Table 7 compares the O&M costs for the Colma Boulevard Alignment (for each tank site alternative) to the Feasibility Study Alignment. The table shows the O&M cost for the Colma

Boulevard Alignment is higher than the Feasibility Study Alignment for each tank site alternative.

Table 5 Cost Estimate: Storage Tank at Atwood Property
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Item		Feasibility Study Alignment Cost	Colma Blvd Alignment Cost
01	Transmission Pipeline		$3,606,000	$4,090,000
02	Pump Station at WWTP		$490,000	$524,000
03	Storage Tank		$4,069,000	$4,069,000
04	Distribution System		$7,616,000	$7,560,000
05	Distribution System Pump Station		$725,000	$725,000
	TOTAL DIRECT COST		**$16,506,000**	**$16,968,000**
	Contingency	30%	$4,952,000	$5,090,000
	Subtotal		$21,458,000	$22,058,000
	General Contractor Overhead, Profit & Risk	12%	$2,575,000	$2,647,000
	Subtotal		$24,033,000	$24,705,000
	Escalation to Mid-Point(1)	12.6%	$3,033,000	$3,118,000
	Subtotal		$27,066,000	$27,823,000
	Sales Tax (Applied to 50% of Total Direct Cost)	9.0%	$743,000	$764,000
	Subtotal		$27,809,000	$28,587,000
	General Conditions	12.0%	$3,337,000	$3,430,000
	TOTAL ESTIMATED CONSTRUCTION COST		**$31,146,000**	**$32,017,000**
	Cost Range		***$21,802,000 - $46,719,000***	***$22,411,000 - $48,024,000***
	Engineering, Legal & Administration Fees	20%	$6,229,000	$6,403,000
	Owner's Reserve for Change Orders	5%	$1,557,000	$1,601,000
	TOTAL ESTIMATED PROJECT COST		**$38,932,000**	**$40,021,000**

Notes:

(1) Based on a compound annual escalation rate of 4%, a project design duration of 18 months starting in January 2018, and a construction duration of 24 months starting in June 2019.

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Table 6 Cost Estimate: Storage Tank at Holy Cross Cemetery
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Item		Feasibility Study Alignment Cost	Colma Blvd Alignment Cost
01	Transmission Pipeline		$3,599,000	$4,074,000
02	Pump Station at WWTP		$562,000	$562,000
03	Storage Tank		$2,431,000	$2,431,000
04	Distribution System		$6,748,000	$7,039,000
05	Distribution System Pump Station		$0	$0
		TOTAL DIRECT COST	**$13,340,000**	**$14,106,000**
	Contingency	30%	$4,002,000	$4,232,000
	Subtotal		$17,342,000	$18,338,000
	General Contractor Overhead, Profit & Risk	12%	$2,081,000	$2,201,000
	Subtotal		$19,425,000	$20,539,000
	Escalation to Mid-Point(1)	12.6%	$2,451,000	$2,592,000
	Subtotal		$21,874,000	$23,131,000
	Sales Tax (Applied to 50% of Total Direct Cost)	9.0%	$600,000	$635,000
	Subtotal		$22,474,000	$23,766,000
	General Conditions	12.0%	$2,697,000	$2,852,000
		TOTAL ESTIMATED CONSTRUCTION COST	**$25,171,000**	**$26,618,000**
	Cost Range		***$17,620,000 - $37,757,000***	***$18,633,000 - $39,927,000***
	Engineering, Legal & Administration Fees	20%	$5,034,000	$5,324,000
	Owner's Reserve for Change Orders	5%	$1,259,000	$1,331,000
		TOTAL ESTIMATED PROJECT COST	**$31,464,000**	**$33,273,000**

Notes:

(1) Based on a compound annual escalation rate of 4%, a project design duration of 18 months starting in January 2018, and a construction duration of 24 months starting in June 2019.

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Table 7 O&M Cost Summary Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City				
	Atwood Property - Feasibility Study Alignment	**Atwood Property - Colma Blvd Alignment**	**Holy Cross Cemetery - Feasibility Study Alignment**	**Holy Cross Cemetery - Colma Blvd Alignment**
Annual Pumping Cost	$262,000	$315,000	$152,000	$152,000
Annual Maintenance Cost	$389,000	$400,000	$315,000	$333,000
Total Annual O&M Cost	**$651,000**	**$715,000**	**$467,000**	**$485,000**

3.4 Amortized Cost

The project team has developed estimates for the total annualized cost based on the estimated construction cost and annual O&M costs presented in Tables 5, 6, and 7. This total annualized cost was estimated over the 20 year project lifetime based on the constructions costs presented in Section 3.2 and annual operating and maintenance costs presented in Section 3.3. Annualized costs are presented in Table 8.

Table 8 Annualized Cost Summary Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City				
	Atwood Property - Feasibility Study Alignment	**Atwood Property - Colma Blvd Alignment**	**Holy Cross Cemetery - Feasibility Study Alignment**	**Holy Cross Cemetery - Colma Blvd Alignment**
Annualized Capital Cost	$3,124,000	$3,211,000	$2,525,000	$2,670,000
Annual O&M Cost	$651,000	$715,000	$467,000	$485,000
Total Annual Cost	**$3,775,000**	**$3,926,000**	**$2,992,000**	**$3,155,000**

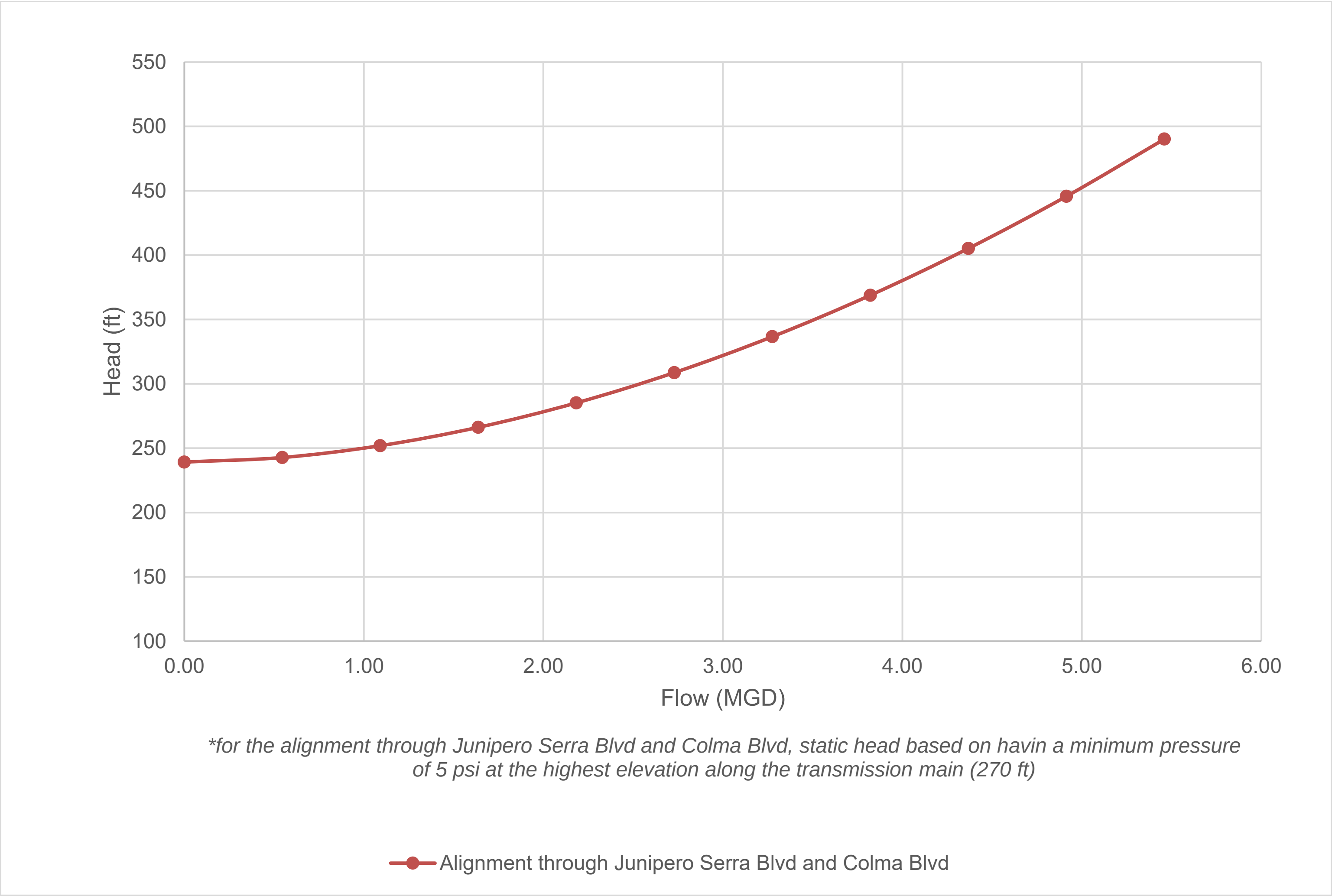
Notes:
(1) Capital Cost was annualized assuming a 20 year project life and a 5% interest rate.

4.0 SUMMARY

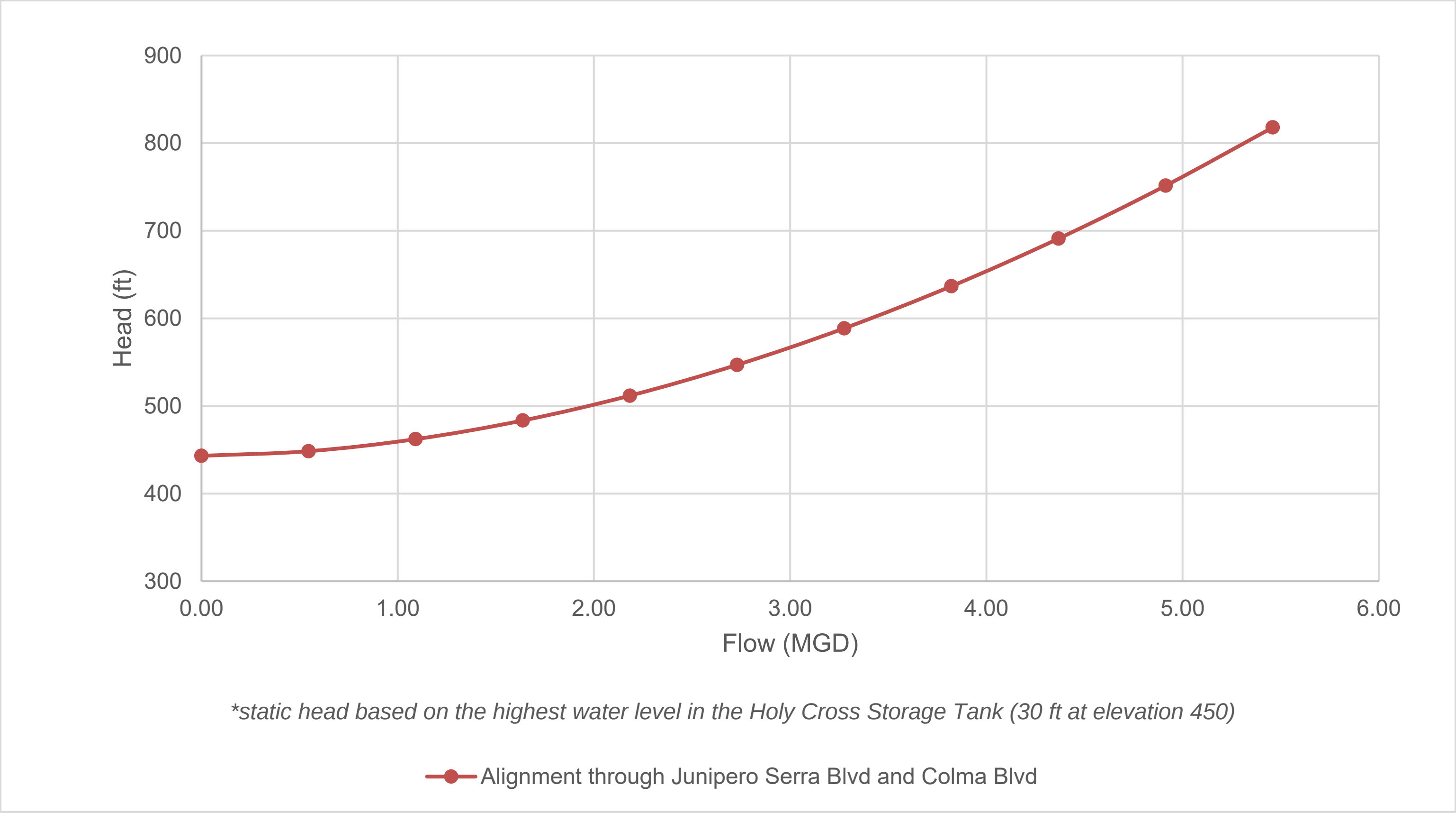
Tables 5, 6, 7, and 8 show the Colma Boulevard Alignment is more costly than the Feasibility Study Alignment in terms of construction cost, O&M cost and annualized capital cost. However, the Colma Boulevard Alignment is preferred because it does not route the pipeline through SFPUC's easement (Figure 1), which allows the SFPUC to use the easement for another purpose.

APPENDIX A – SYSTEM CURVES

ATWOOD PROPERTY STORAGE TANK - RECYCLED WATER PUMP STATION SYSTEM CURVE



HOLY CROSS CEMETERY STORAGE TANK - RECYCLED WATER PUMP STATION SYSTEM CURVE



APPENDIX B – DETAILED COST ESTIMATES

PROJECT SUMMARY

Estimate Class: 4

Project:	**Daly City RW Pre-Design: Atwood Configuration - Colma Blvd Alignment**	**PIC:**	**MJB**
Client:	**Daly City and SFPUC**	**PM:**	**DGB**
Location:	**Daly City, CA**	**Date:**	**July 21, 2017**
Zip Code:	**94014**	**By:**	**RP**
Carollo Job #	**10076A.10**	**Reviewed:**	**DGB**

NO.	DESCRIPTION		TOTAL
01	Transmission Pipeline		$4,089,817
02	Pump Station at WWTP		$523,846
03	Storage Tank		$4,068,569
04	Distribution System		$7,559,621
05	Distribution System Pump Station		$725,465
	TOTAL DIRECT COST		**$16,967,319**
	Contingency	30.0%	$5,090,000
	Subtotal		**$22,057,319**
	General Contractor Overhead, Profit & Risk	12.0%	$2,647,000
	Subtotal		**$24,704,319**
	Escalation to Mid-Point	12.6%	$3,118,000
	Subtotal		**$27,822,319**
	Sales Tax (Applied to 50% Total Direct Cost)	9.0%	$764,000
	Subtotal		**$28,586,319**
	General Conditions	12.0%	$3,430,000
	TOTAL ESTIMATED CONSTRUCTION COST		**$32,016,319**
	Engineering, Legal & Administration Fees	20.0%	$6,403,000
	Owner's Reserve for Change Orders	5.0%	$1,601,000
	TOTAL ESTIMATED PROJECT COST		**$40,020,319**

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration - Colma Blvd Alignment
Client: Daly City and SFPUC
Location: Daly City, CA
Element: 01 Transmission Pipeline

Date : July 21, 2017
By : RP
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 15 - Mechanical					
15000	14" DI Pipe Finished	18586	LF	$215.85	$4,011,880	
15000	16" DI Pipe Finished	319	LF	$244.24	$77,937	
15000	12" DI Pile Finished	0	LF	$194.36	$	
	Total					**$4,089,817**
	Grand Total					**$4,089,817**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration - Colma Blvd Alignment
Client: Daly City and SFPUC
Location: Daly City, CA
Element: 02 Pump Station at WWTP

Date : July 21, 2017
By : RP
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02260	Sheet Piling, 27#/Sf To 20' Deep, Driven, Pulled & Salvaged (Pits Only)	1,881.00	SF	$47.13	$88,646	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	492.56	CY	$2.08	$1,024	
02300	20 Cy Dump Truck, 30 Miles/Round Trip	492.56	CY	$14.02	$6,905	
02300	Imported Pipe Bed & Zone/Confined Structure Backfill, Class B Material	129.56	CY	$88.36	$11,448	
	Total					**$108,023**
	Division 03 - Concrete					
03300	18" Structural Flat Mat On Grade	33.00	CY	$549.30	$18,127	
03300	18" Edge Forms, Slab On Grade, Add	98.00	LF	$26.19	$2,567	
03300	12" Straight Wall >8' High	52.22	CY	$1,172.98	$61,253	
03300	8" Straight Wall, To 8' High	2.47	CY	$1,649.14	$4,073	
03300	12" Elevated Slab To 20'	33.00	CY	$553.50	$18,265	
	Total					**$104,285**
	Division 15 - Mechanical					
15000	Pump at Tratment Plant	3	EA	$54,100.00	$162,300	
15112	12" 150# Fxf Awwa Butterfly Valve, No Op	3.00	EA	$3,669.84	$11,010	
15114	12"- 200 Psi Ci Fxf Swing Check Valve	3.00	EA	$8,565.04	$25,695	
15119	Air/Vac Valve, 150# Flange, 12"	3.00	EA	$8,457.66	$25,373	
15121	12" Flex Cplg, Above Ground	3.00	EA	$1,635.24	$4,906	
15121	14" Flex Cplg, Above Ground	1.00	EA	$1,880.05	$1,880	
15251	14"X12" Cldi Flg Rdcg Tee In Place	3.00	EA	$5,884.41	$17,653	
15251	14" 90° 125# Cldi Fxf Ell	2.00	EA	$4,689.68	$9,379	
15251	14" Flg Cldi Pipe In Bldg	20.00	LF	$208.75	$4,175	
15251	12" Flg Cldi Pipe In Bldg	9.00	LF	$171.61	$1,544	
	Total					**$263,916**
	Division 17 - Instrumentation and Controls					
17000	I&C Adder	1.00	LS	$47,622.38	$47,622	
	Total					**$47,622**
	Grand Total					**$523,846**

DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration - Colma Blvd Alignment
Client: Daly City and SFPUC
Location: Daly City, CA
Element: 03 Storage Tank

Date : July 21, 2017
By : RP
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02000	Shoring System with tiebacks	1	LS	$690,000.00	$690,000	
02300	Topsoil Strip & Stockpile On Site, To 1000 Cy	1,557.41	CY	$8.99	$14,003	
02300	Replace Topsoil To 1000 Cy (From Stockpile)	1,557.41	CY	$18.89	$29,424	
02300	Stripping & Stockpiling Equip. Move-On Cost	1.00	LS	$3,060.68	$3,061	
02300	Remove Grass & Shrubs Medium Density, 2" Depth To 1 Acre	42,050.00	SF	$.04	$1,493	
02300	Clearing & Grubbing Equipment Move-On Cost	1.00	LS	$1,761.82	$1,762	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	26,066.67	CY	$2.08	$54,205	
02300	Native Trench Backfill/Unconfined Struct. Bf, Class B Material	10,242.81	CY	$20.83	$213,365	
02300	10 Cy Dump Truck, 20 Miles/Round Trip	15,823.85	CY	$17.87	$282,825	
	Total					**$1,290,137**
	Division 03 - Concrete					
03300	18" X 18" Square Column/Pier	81	CY	$1,873.73	$151,772	
03300	20" W X 36" D Conc Beam	122.22	CY	$1,422.40	$173,846	
03300	12" Elevated Slab, 27'-32' High	465.41	CY	$661.48	$307,860	
03300	36" Structural Flat Mat On Grade	1516.67	CY	$619.64	$939,786	
03300	30" Straight Wall >8' High	1333.33	CY	$686.44	$915,246	
03300	30" Straight Wall >8' High	406.67	CY	$686.44	$279,153	
	Total					**$2,767,663**
	Division 05 - Metals					
05500	Fixed Aluminum Ladder - No Safety Cage	60.00	VLF	$119.85	$7,191	
	Total					**$7,191**
	Division 07 - Thermal and Moisture					
07700	2'-6" X 4'-6" Roof Hatch & Curb, All Aluminum	1.00	EA	$2,129.26	$2,129	
07700	3'-0" X 2'-6" Roof Hatch & Curb, All Aluminum	1.00	EA	$1,449.08	$1,449	
	Total					**$3,578**
	Grand Total					**$4,068,569**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration - Colma Blvd Alignment
Client: Daly City and SFPUC
Location: Daly City, CA
Element: 04 Distribution System

Date : July 21, 2017
By : RP
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02260	Sheet Piling, 22#/Sf To 15' Deep, Driven, Pulled & Salvaged (Pits Only)	168	SF	$40.74	$6,844	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	9	CY	$2.08	$19	
02300	20 Cy Dump Truck, 30 Miles/Round Trip	9	CY	$14.02	$131	
	Total					**$6,994**
	Division 03 - Concrete					
03300	12" Edge Forms, Slab On Grade, Add	24	LF	$13.50	$324	
03300	12" Flat Non-Formed S.O.G.	1	CY	$489.40	$651	
03300	12" Straight Wall, To 8' High	3	CY	$1,325.17	$4,121	
03300	12" Straight Wall, To 8' High	2	CY	$1,325.17	$2,743	
	Total					**$7,839**
	Division 05 - Metals					
05500	Fixed Galv. Steel Ladder - No Safety Cage	14	VLF	$101.85	$1,426	
05500	Galvanized Steel Pit Frame & Cover	32	SF	$35.09	$1,123	
	Total					**$2,549**
	Division 11 - Equipment					
11000	Booster Pump	1	EA	$30,600.00	$30,600	
11000	Hydro-pneumatic tank	1	EA	$6,600.00	$6,600	
	Total					**$37,200**
	Division 15 - Mechanical					
15000	12" DI Pile Finished	3061	LF	$194.36	$594,843	
15000	2" PVC Pipe Finished	1743	LF	$163.38	$284,706	
15000	3" PVC Pipe Finished	219	LF	$165.41	$36,215	
15000	4" DI Pipe Finished	9599	LF	$169.01	$1,622,353	
15000	6" DI Pipe Finished	4520	LF	$174.85	$790,388	
15000	8" DI Pipe Finished	8769	LF	$181.50	$1,591,570	
15000	10" DI Pipe Finished	203	LF	$188.15	$38,283	
15000	14" DI Pipe Finished	6063	LF	$215.85	$1,308,675	
15000	16" DI Pipe Finished	2617	LF	$244.24	$639,183	
15000	18" DI Pipe Finished	282	LF	$265.59	$74,895	
15000	1.5" PVC Pipe Finished	3125	LF	$162.38	$507,478	
15000	1" PVC Pipe Finished	102	LF	$161.39	$16,451	
	Total					**$7,505,039**
	Grand Total					**$7,559,621**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Atwood Configuration - Colma Blvd Alignment
Client: Daly City and SFPUC
Location: Daly City, CA
Element: 05 Distribution System Pump Station

Date : July 21, 2017
By : RP
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02742	4" Ac Paving On 8" Abc	111.11	SY	$72.66	$8,073	
	Total					**$8,073**
	Division 04 - Masonry					
04220	Standard Concrete Block, 8"	680	SF	$21.88	$14,876	
04220	Standard Concrete Block, 8"	1320	SF	$21.88	$28,877	
04220	Integral Cmu Color Adder	2000	SF	$1.85	$3,704	
04220	Full Grout (All Cells)	2000	SF	$1.62	$3,241	
04220	Seismic Reinforcement Adder	2000	SF	$1.82	$3,642	
	Total					**$54,339**
	Division 07 - Thermal and Moisture					
07200	2" Composite Roof Insulation	2000	SF	$3.69	$7,382	
07400	Standing Seam 0.032" Aluminum Enameled On Mansard Or Vertical Surface	2000	SF	$24.05	$48,096	
	Total					**$55,478**
	Division 08 - Doors and Windows					
08110	6/0 X 6/8 X 1.75" "B" Label Double Hollow Metal Door W/Frame & Hdwre	1	PR	$2,459.68	$2,460	
	Total					**$2,460**
	Division 15 - Mechanical					
15000	In field pumps El Camino	2.00	EA	$62,200.00	$124,400	
15000	In field pumps Hillside	2.00	EA	$156,650.00	$313,300	
	Total					**$437,700**
	Division 16 - Electrical					
16000	Electrical Adder for In Field Pump Station	1	LS	$167,415.00	$167,415	
	Total					**$167,415**
	Grand Total					**$725,465**

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PROJECT SUMMARY

Project:	**Daly City RW Pre-Design: Holy Cross Configuration - Colma Blvd Alignment**	**Estimate Class:**	**4**
		PIC:	**MJB**
Client:	**Daly City and SFPUC**	**PM:**	**DGB**
Location:	**Daly City, CA**	**Date:**	**July 21, 2017**
Zip Code:	**94014**	**By:**	**RP**
Carollo Job #	**10076A.10**	**Reviewed:**	**DGB**

NO.	DESCRIPTION		TOTAL
01	Transmission Pipeline		$4,073,844
02	Pump Station at WWTP		$562,238
03	Storage Tank		$2,430,779
04	Distribution System		$7,039,050
05	Distribution System Pump Station		$0
	TOTAL DIRECT COST		**$14,105,910**
	Contingency	30.0%	$4,232,000
	Subtotal		**$18,337,910**
	General Contractor Overhead, Profit & Risk	12.0%	$2,201,000
	Subtotal		**$20,538,910**
	Escalation to Mid-Point	12.6%	$2,592,000
	Subtotal		**$23,130,910**
	Sales Tax (Applied to 50% Total Direct Cost)	9.0%	$635,000
	Subtotal		**$23,765,910**
	General Conditions	12.0%	$2,852,000
	TOTAL ESTIMATED CONSTRUCTION COST		**$26,617,910**
	Engineering, Legal & Administration Fees	20.0%	$5,324,000
	Owner's Reserve for Change Orders	5.0%	$1,331,000
	TOTAL ESTIMATED PROJECT COST		**$33,272,910**

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Holy Cross Configuration - Colma Blvd Alignment
Client: Daly City and SFPUC
Location: Daly City, CA
Element: 01 Transmission Pipeline

Date : July 21, 2017
By : RP
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 15 - Mechanical					
15000	14" DI Pipe Finished	18512	LF	$215.85	$3,995,907	
15000	16" DI Pipe Finished	319	LF	$244.24	$77,937	
	Total					**$4,073,844**
	Grand Total					**$4,073,844**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Holy Cross Configuration - Colma Blvd Alignment
Client: Daly City and SFPUC
Location: Daly City, CA
Element: 02 Pump Station at WWTP

Date : July 21, 2017
By : RP
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02260	Sheet Piling, 27#/Sf To 20' Deep, Driven, Pulled & Salvaged (Pits Only)	1,881.00	SF	$47.13	$88,646	
02300	Structure/Pit Excavation, 4Cy Wheel Loader, Class B & C Material	492.56	CY	$2.08	$1,024	
02300	20 Cy Dump Truck, 30 Miles/Round Trip	492.56	CY	$14.02	$6,905	
02300	Imported Pipe Bed & Zone/Confined Structure Backfill, Class B Material	129.56	CY	$88.36	$11,448	
	Total					**$108,023**
	Division 03 - Concrete					
03300	18" Edge Forms, Slab On Grade, Add	98.00	LF	$26.19	$2,567	
03300	18" Structural Flat Mat On Grade	33.00	CY	$549.30	$18,127	
03300	12" Straight Wall >8' High	52.22	CY	$1,172.98	$61,253	
03300	8" Straight Wall, To 8' High	2.47	CY	$1,649.14	$4,073	
03300	12" Elevated Slab To 20'	33.00	CY	$553.50	$18,265	
	Total					**$104,285**
	Division 15 - Mechanical					
15000	Pumps at Treatment Plant	3	EA	$65,734.00	$197,202	
15112	12" 150# Fxf Awwa Butterfly Valve, No Op	3.00	EA	$3,669.84	$11,010	
15114	12"- 200 Psi Ci Fxf Swing Check Valve	3.00	EA	$8,565.04	$25,695	
15119	Air/Vac Valve, 150# Flange, 12"	3.00	EA	$8,457.66	$25,373	
15121	14" Flex Cplg, Above Ground	1.00	EA	$1,880.05	$1,880	
15121	12" Flex Cplg, Above Ground	3.00	EA	$1,635.24	$4,906	
15251	12" Flg Cldi Pipe In Bldg	9.00	LF	$171.61	$1,544	
15251	14" Flg Cldi Pipe In Bldg	20.00	LF	$208.75	$4,175	
15251	14"X12" Cldi Flg Rdcg Tee In Place	3.00	EA	$5,884.41	$17,653	
15251	14" 90° 125# Cldi Fxf Ell	2.00	EA	$4,689.68	$9,379	
	Total					**$298,818**
	Division 17 - Instrumentation and Controls					
17000	I&C Adder	1	LS	$51,112.58	$51,113	
	Total					**$51,113**
	Grand Total					**$562,238**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Holy Cross Configuration - Colma Blvd Alignment
Client: Daly City and SFPUC
Location: Daly City, CA
Element: 03 Storage Tank

Date : July 21, 2017
By : RP
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02300	Topsoil Strip & Stockpile On Site, To 1000 Cy	279.89	CY	$8.99	$2,516	
02300	Replace Topsoil To 1000 Cy (From Stockpile)	279.89	CY	$18.89	$5,288	
02300	Stripping & Stockpiling Equip. Move-On Cost	1.00	LS	$3,060.68	$3,061	
02300	Remove Grass & Shrubs Medium Density, 2" Depth To 1 Acre	19,731.02	SF	$.04	$700	
02300	Clearing & Grubbing Equipment Move-On Cost	1.00	LS	$1,761.82	$1,762	
02300	10 Cy Dump Truck, 20 Miles/Round Trip	450.89	CY	$17.87	$8,059	
02300	Native Trench Backfill/Unconfined Struct. Bf, Class B Material	450.89	CY	$20.83	$9,392	
	Total					**$30,779**
	Division 03 - Concrete					
03000	Prestressed Concrete Tank	1.00	LS	$2,400,000.00	$2,400,000	
	Total					**$2,400,000**
	Grand Total					**$2,430,779**

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DETAILED COST ESTIMATE

Project: Daly City RW Pre-Design: Holy Cross
Client: Daly City and SFPUC
Location: Daly City, CA
Element: 04 Distribution System

Date : July 21, 2017
By : RP
Reviewed: DGB

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 15 - Mechanical					
15000	14" DI Pipe Finished	8709	LF	$215.85	$1,879,881	
15000	10" DI Pipe Finished	203	LF	$188.15	$38,283	
15000	4" DI Pipe Finished	9617	LF	$169.01	$1,625,434	
15000	12" DI Pipe Finished	2534	LF	$194.36	$492,424	
15000	18" DI Pipe Finished	0	LF	$265.59	$	
15000	1.5" PVC Pipe Finished	3125	LF	$162.38	$507,478	
15000	1" PVC Pipe Finished	102	LF	$161.39	$16,451	
15000	8" DI Pipe Finished	7460	LF	$181.50	$1,353,956	
15000	6" DI Pipe Finished	4503	LF	$174.85	$787,361	
15000	3" PVC Pipe Finished	219	LF	$165.41	$36,215	
15000	2" PVC Pipe Finished	1743	LF	$163.38	$284,706	
15118	3" Rdc Pressure Bf Preventer Assy W/Relief Valve	3	EA	$5,620.21	$16,861	
	Total					**$7,039,050**
	Grand Total					**$7,039,050**

This document is released for the purpose of information exchange review and planning only under the authority of Darren G. Baune, 9/22/2017, California P.E. No. 68899.

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

TECHNICAL MEMORANDUM NO. 3
CONCEPTUAL PLANNING FOR
INDIRECT POTABLE REUSE

DRAFT
September 2017

2700 YGNACIO VALLEY ROAD, SUITE 300 • WALNUT CREEK, CALIFORNIA 94598 • P. 925.932.1710 • F. 925.930.0208

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

TECHNICAL MEMORANDUM
NO. 3
CONCEPTUAL PLANNING FOR INDIRECT POTABLE REUSE

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CONCEPTUAL PLANNING FOR INDIRECT POTABLE REUSE

1.0 EXECUTIVE SUMMARY

The purpose of this technical memorandum (TM) is to present the results from the Conceptual Indirect Potable Reuse (IPR) Treatment and Concentrate Disposal Feasibility Analysis. The IPR facility would treat secondary effluent from the Daly City Wastewater Treatment Plant (WWTP) for groundwater replenishment. The analysis focused on:

- IPR treatment alternatives (Refer to PM 11 in Appendix A).
- Concentrate disposal alternatives (Refer to PM 12 in Appendix B).
- IPR regulatory requirements (Refer to PM 13 in Appendix C).

If this project moves forward, additional studies would be required to determine the groundwater injection location, conveyance infrastructure, environmental impacts, and other aspects of the project.

The secondary effluent at Daly City's WWTP is challenging to treat and has the potential to rapidly foul the ultrafiltration (UF) and reverse osmosis (RO) membranes. Based on our understanding of the water quality from the membrane pilot, and a case study of an IPR facility that treats a similar water quality, Carollo recommends including a pretreatment process to reduce the potential fouling of the membranes. The project team performed a desktop study to evaluate the feasibility of several pretreatment and process modifications. Considering footprint, risk, regulatory status, and costs, ozone biologically active filtration (BAF) is the most feasible pretreatment alternative. Therefore, the recommended IPR treatment train would consist of ozone BAF, UF, RO, and ultraviolet (UV) advanced oxidation processes (AOP), as shown in Figure ES.1. Carollo recommends pilot testing this treatment train to demonstrate process performance prior to designing the full scale facility.

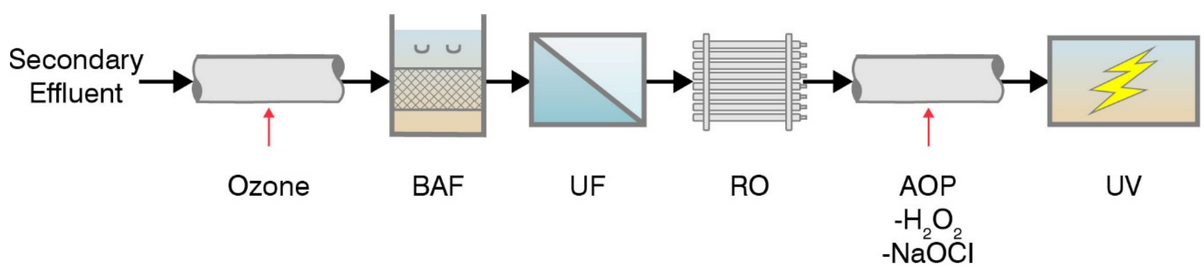

Figure 3.1 Recommended IPR Treatment Train

The project team estimates that the size of the recommended IPR facility is 100 feet by 200 feet in plan view area. Two feasible locations near the Daly City WWTP were identified for the new facility:

- Above grade in the parking lot.
- Below grade in the baseball field.

The above grade facility would allow continued use of the baseball field, however parking and access to the baseball field would be eliminated. The estimated construction cost for the above grade facility is $49,026,000. The below grade facility would have minimal impacts to the parking lot, however operations and maintenance (O&M) access and equipment removal will be challenging. Additionally, there will be some permanent impact to the baseball fields. The estimated construction cost for the below grade facility is $58,005,000.

One additional challenge with the IPR facility is disposal of the RO concentrate. An analysis was performed to determine whether or not disposal of the RO concentrate would result in discharge permit violations. Two disposal locations were considered:

- Daly City WWTP outfall.
- Oceanside Treatment Plant influent.

Disposal in Daly City WWTP's outfall would result in compliance issues with carbonaceous biochemical oxygen demand (CBOD), ammonia, and possibly toxicity. In order to stay in compliance, the capacity of the facility would need to be limited to 1 million gallons per day (mgd) or the RO concentrate would need to be treated prior to disposal. The Oceanside Treatment Plant already has potential compliance issues with biochemical oxygen demand (BOD), ammonia, and possible toxicity due to planned plant upgrades. If Daly City's RO concentrate is added to the Oceanside Treatment Plant, the severity of the compliance issues with CBOD, ammonia, and toxicity increases. The CBOD compliance issue could be resolved by relocating the point of compliance. Ammonia and toxicity are dependent on dilution. A dilution factor of 291:1 to 313:1 would be required to maintain compliance. The current dilution factor is 150:1, however the permit has expired. The new dilution factor is being negotiated between the San Francisco Public Utilities Commission (SFPUC) and the regulatory agencies at this time.

APPENDIX A – PROJECT MEMORANDUM 11 - IPR TREATMENT ALTERNATIVES ANALYSIS

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CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

PROJECT MEMORANDUM NO. 11
IPR TREATMENT ALTERNATIVES ANALYSIS

DRAFT
September 2017

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CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

PROJECT MEMORANDUM
NO. 11
IPR TREATMENT ALTERNATIVES ANALYSIS

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IPR TREATMENT ALTERNATIVES ANALYSIS

1.0 INTRODUCTION

1.1 Purpose

The purpose of this project memorandum (PM) is to summarize the conceptual level study to add an indirect potable reuse (IPR) facility at the Daly City Wastewater Treatment Plant (WWTP). This PM discusses the following:

- The secondary effluent water quality (i.e., source water) and treatment requirements for indirect potable reuse.
- Indirect potable reuse treatment process alternatives, preliminary process selection, and recommended future piloting for full-scale implementation of the project.
- Conceptual site design and budgetary cost estimates for two potential alternatives for the indirect potable reuse treatment facility.

1.2 Background

The City of Daly City (City) operates an existing recycled water treatment facility at their WWTP. The existing facility is permitted to produce a maximum of 2.77 million gallons per day (mgd) of recycled water for irrigation of nearby golf courses, parks, and medians. The average dry weather flow at the WWTP is approximately 5.9 mgd. The unused secondary effluent is disinfected and discharged to the Pacific Ocean through the City's outfall.

Carollo Engineers (Carollo) is currently conducting the Feasibility of Expanded Tertiary Recycled Water Facilities Project for the San Francisco Public Utilities Commission (SFPUC) and the City of Daly City. The purpose of the project is to perform a preliminary design (i.e. 30%) to increase the capacity of the existing recycled water treatment facilities. The expanded system would provide the treatment and infrastructure needed to deliver approximately 3 million gallons per day (mgd) of irrigation supply to schools in Daly City, cemeteries in the Town of Colma (Colma), and some sites in South San Francisco (SSF).

In addition to the preliminary design described above, the SFPUC and Daly City requested that Carollo perform a conceptual level study to consider adding an indirect potable reuse (IPR) facility for groundwater replenishment. If the SFPUC and Daly City decide to move forward with implementing IPR, additional studies would be required to determine the groundwater injection location, conveyance infrastructure, environmental impacts, and other aspects of the project.

2.0 WATER QUALITY

2.1 Source Water Quality

The treatment process selection was driven by the source water quality, the finished water quality goals, treatment regulations, and site constraints. The source water for the IPR facility is secondary effluent from Daly City's WWTP. The secondary treatment utilizes a high purity oxygen (HPO) activated sludge process. HPO facilities operate with short solids retention times (SRT) resulting in water qualities that have high concentrations of total organic carbon and ammonia.

Daly City's secondary effluent water quality has the potential to rapidly foul the ultrafiltration (UF) and reverse osmosis (RO) membranes impacting cost, efficiency, and reliability. Table 1 compares "typical" secondary effluent water quality to Daly City's secondary effluent. The typical water quality shown is based on Carollo's experience at other wastewater treatment plants that have biological nutrient removal. As shown, Daly City's secondary effluent has twice the concentrations of total organic carbon (TOC) and ammonia and a significant concentration of iron. The high concentration of total organic carbon can foul the membranes and may be difficult to remove down to the required concentration (<0.5 mg/L). The iron concentrations are concerning because they can form complexes with the organics that foul the membranes and are difficult to remove.

Table 1 Secondary Effluent Water Quality Comparison
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Parameter	Unit	Typical Secondary Effluent(1)	Daly City Secondary Effluent(2)
Total Organic Carbon (TOC)	(mg/L)	10	21
Total Suspended Solids (TSS)	(mg/L)	5 - 10	8.4
Ammonia (as N)	(mg/L)	1 - 25(3)	53
Turbidity	(NTU)	2 - 6	6.5
Total Iron	(mg/L)	-	0.95

Notes:
(1) Assumed secondary treatment with biological nutrient removal.
(2) Average value based on pilot data grab samples collected during UF membrane pilot testing March 1, 2016 through March 17, 2017.
(3) Concentration of ammonia depends on whether or not the facility includes nitrification.

2.2 Finished Water Quality

Title 22 of the California Code of Regulations (CCR) requires IPR treatment processes to meet the standards of drinking water treatment plants. The regulations also require that IPR facilities provide the additional pathogen, TOC, nitrogen, and 1,4 dioxane removal listed in

Table 2. PM 13, titled "Indirect Potable Reuse Regulatory Requirements" (Carollo, 2017) provides a detailed discussion of the IPR regulatory requirements.

Table 2 IPR Finished Water Quality Requirements
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

Parameter	Unit	IPR Finished Water Quality Requirement
Pathogen Microorganism Control		
Virus	(LRV[1])	12
Giardia	(LRV[1])	10
Cryptosporidium	(LRV[1])	10
Total Organic Carbon (TOC)	(mg/L)	<0.25/0.50[2]
Total Nitrogen	(mg/L)	<10
1,4 Dioxane	(LRV[1])	0.5
NDMA	(ng/L)	<10

Notes:
(1) LRV = log removal value
(2) Per Title 22 during the first 20 weeks of full-scale operation 95% of TOC samples should be <0.25 mg/L. After 20 weeks, TOC samples should be <0.5 mg/L.

3.0 IPR TREATMENT PROCESS

3.1 Regulatory Requirements

Title 22 of the California Code of Regulations defines two types of groundwater replenishment reuse projects: surface application and subsurface injection. Surface application recharges groundwater by allowing percolation of treated water from a spreading area, which is typically an unlined pond or basin. The water infiltrates into the unsaturated zone and reaches the water table. The percolation basins typically require a large footprint but this depends on the percolation rate and the replenishment rate. Subsurface injection is any other addition of water to the groundwater. It typically involves a direct connection to the water table and injection via a well. Due to the limited availability and high cost of land in the area, this analysis assumes the water would be injected with subsurface wells.

The regulations for subsurface injection require an advanced treatment train that includes reverse osmosis (RO), advanced oxidation (AOP), and at least three separate treatment processes credited with no less than 1.0 log removal of each pathogen (virus, Giardia, Cryptosporidium). PM 13, titled "Indirect Potable Reuse Regulatory Requirements," provides a detailed discussion of the regulatory requirements (Carollo, 2017).Currently, there is one approved process train that meets theses regulatory requirements. The approved process train consists of microfiltration (MF) or ultrafiltration (UF), reverse osmosis (RO), and ultraviolet (UV) advanced oxidation process (AOP), as shown in Figure 1. It should be noted that if surface application is selected for the groundwater replenishment method the treatment process may change.

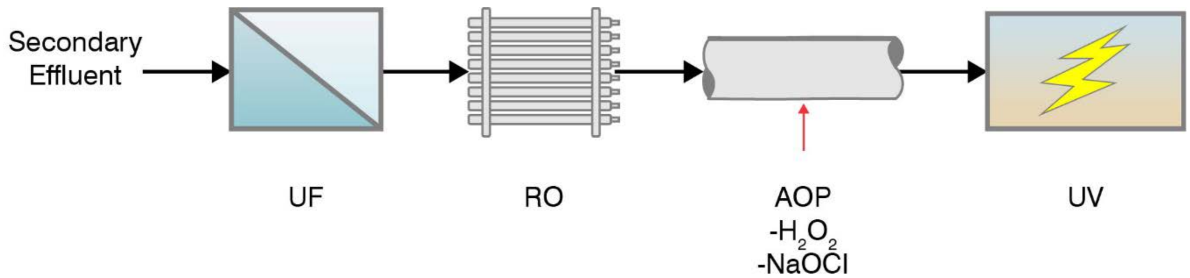


Figure 1 Approved IPR Process Train

3.2 Daly City IPR Process Selection

As discussed above, the Title 22 regulations define the minimum treatment required for IPR based on the groundwater replenishment method (i.e. percolation ponds, subsurface injection, other). Depending on the raw water quality, some facilities may require additional treatment processes to obtain reasonable performance and/or reduce operations and maintenance requirements.

The Expanded Tertiary Recycled Water Facilities Project included a 7-month long pilot study of an UF membrane system at Daly City WWTP. The pilot study focused on developing pretreatment and cleaning strategies to minimize fouling. The pilot study concluded that successful operation of the full-scale recycled water facility would require properly managing pretreatment chemicals and chemical cleans.

Based on our understanding of the secondary effluent water quality from the pilot project, Carollo recommends investigating treatment processes to "pre-treat" the secondary effluent before the membrane process. Pretreatment is recommended to minimize fouling of the UF and RO membranes from the high concentrations of organics and iron found in the Daly City secondary effluent.

3.2.1 Case Study: West Basin Municipal Water District

Carollo is aware of one IPR facility that treats secondary effluent from a HPO activated sludge process in the United States. The West Basin Municipal Water District's (West Basin) IPR facility treats secondary effluent from the City of Los Angeles' Hyperion Wastewater Treatment Plant. As shown in Table 3, Daly City's secondary effluent is similar to the West Basin Secondary effluent but Daly City's secondary effluent is more challenging to treat because it has higher concentrations of TOC and ammonia.

The West Basin IPR facility has operated since 1995. The original process treatment train consisted of microfiltration membranes (MF), reverse osmosis membranes (RO), and ultraviolet advanced oxidation process (UV AOP), as shown in Figure 2. The facility has experienced operational challenges due to the quality of the secondary effluent since it was commissioned. There has been biological growth and iron fouling on both the MF and RO membranes, which requires more frequent chemical cleans and may result in reduced membrane life.

Table 3 Daly City's vs. West Basin's Secondary Effluent Water Quality Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City

Parameter	Unit	Daly City Secondary Effluent(1)	West Basin Secondary Effluent(2)
Total Organic Carbon (TOC)	(mg/L)	21	12
Total Suspended Solids (TSS)	(mg/L)	8.4	10 - 25
Ammonia (as N)	(mg/L)	53	48
Turbidity	(NTU)	6.5	7 - 10
Total Iron	(mg/L)	0.95	0.3 - 1.5

Notes:
(1) Average value based on pilot data grab samples collected during UF membrane pilot testing March 1, 2016 through March 17, 2017.
(2) Based on 2007 data from WBMWD's Master Plan and data presented at 2017 AMTA conference.

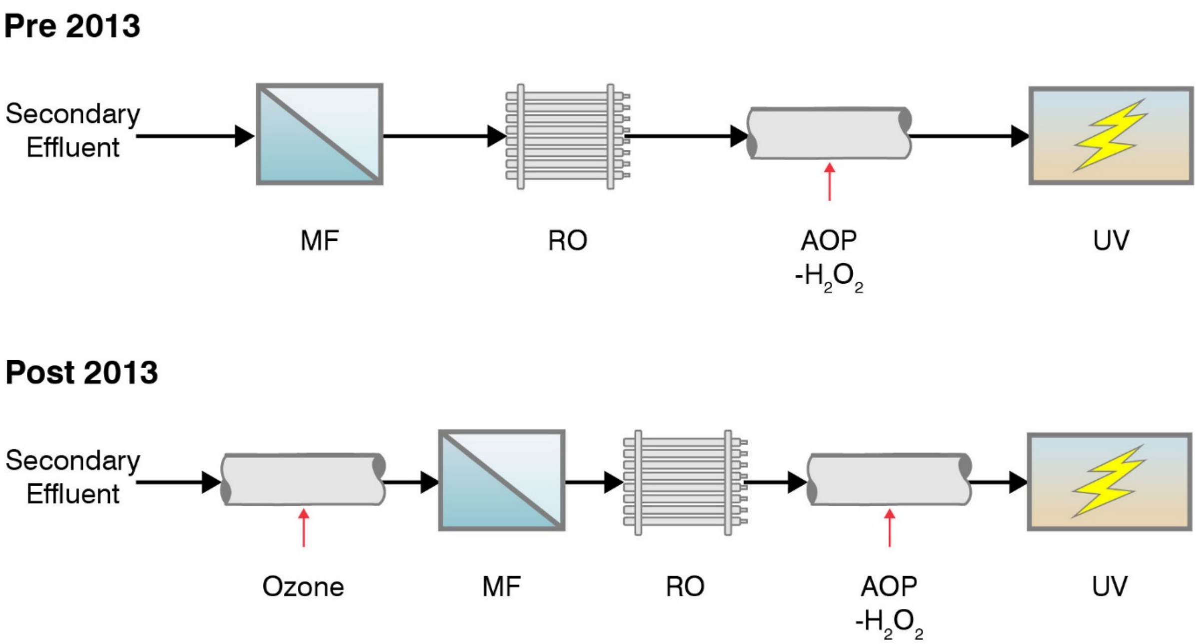


Figure 2 West Basin MWD's IPR Treatment Train

In 2013, ozone was added as pretreatment with the intent to reduce fouling of the MF membranes. However, oxidation of the organics in this water generated assimilable organic carbon (AOC), and resulted in biological fouling of the downstream RO membranes. The example demonstrates the need for pretreatment alternatives to be carefully evaluated. Alternatives to this approach are presented in the following section.

3.2.2 Pretreatment Alternatives

The project team performed a desktop study to evaluate feasible IPR pretreatment processes at the Daly City WWTP. This study is based on our experience at similar facilities and knowledge of the secondary effluent water quality. However, process testing and/or piloting was not performed. The following sections discuss three alternatives for pretreatment and two process modifications.

3.2.2.1 Chemical Pretreatment - Aluminum Based Coagulant

As demonstrated in the membrane pilot study at Daly City, an aluminum based coagulant could be used as pretreatment to improve UF membrane performance. For this alternative, the coagulant would be dosed upstream of the UF membranes as shown in Figure 3.

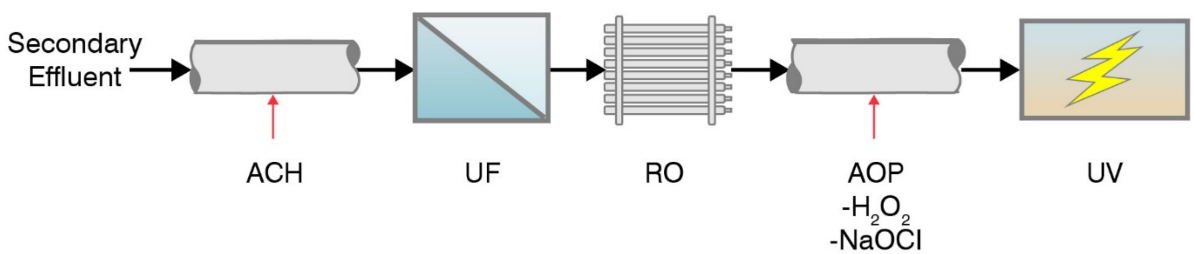


Figure 3 IPR Treatment Train - Aluminum Based Coagulant Pretreatment

Daly City currently uses an aluminum based coagulant, aluminum chloride hydroxide (ACH), as pretreatment for its existing recycled water facility. ACH pretreatment is critical to the operation of the existing Dynasand filters. The ACH dose in this application ranges from 25 - 50 mg/L. During the UF membrane pilot study 5 mg/L of ACH was found to be effective at minimizing fouling.

However, aluminum based coagulants present a risk to the downstream RO membranes. Silica in the secondary effluent can react with dissolved aluminum that passes through the UF membranes and form aluminum silicate. Aluminum silicate causes irreversible scaling on the RO membranes. In line aluminum coagulation is not recommended as pretreatment for the IPR treatment process.

3.2.2.2 Chemical Pretreatment - Iron Based Coagulant

An iron based coagulant could be used as pretreatment. For this alternative, the coagulant would be dosed upstream of the UF membranes as shown in Figure 4. Unlike the aluminum based coagulant, the iron based coagulant requires a longer reaction time and potentially requires flocculation upstream of the UF membranes.

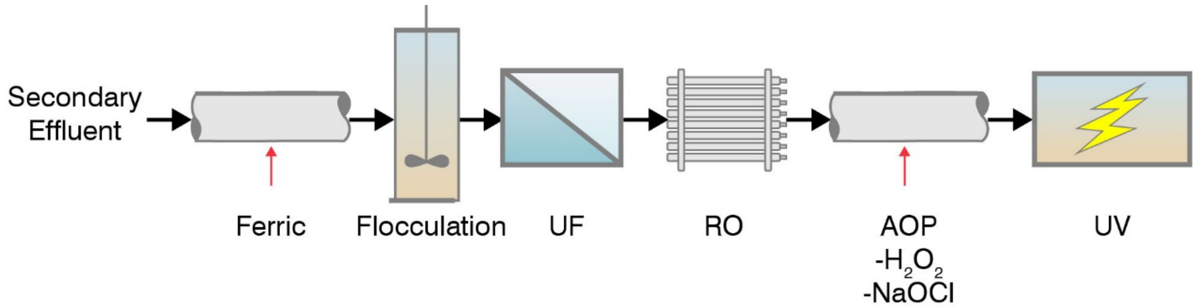


Figure 4 IPR Treatment Train - Iron Based Coagulant Pretreatment

An iron based coagulant presents a couple of risks to the UF and RO membranes. First, residual iron has the potential to react with chloramines, generating amidogen (NH_2) radicals leading to RO membrane damage and elevated salt passage. Also, iron has the potential to foul the UF and RO membranes. During the membrane pilot study, iron was identified as a key membrane foulant. ACH pretreatment and frequent citric acid chemical cleans were required to prevent and recover from iron fouling. As shown in Table 1, the average iron in the secondary effluent was 0.95 mg/L. Daly City confirmed that ferrous chloride is added to the gravity thickeners, however it is unclear whether or not there is a background concentration of iron in the primary influent. The risks associated with an iron based coagulant would likely outweigh the benefits and therefore is not recommended.

3.2.2.3 Ozone BAF

Ozone injection followed by biologically active filtration (ozone BAF) could be used as pretreatment upstream of the UF membranes, as shown in Figure 5.

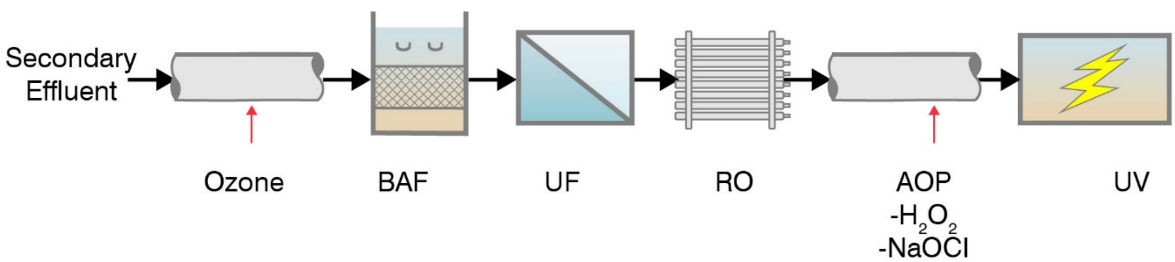


Figure 5 IPR Treatment Train - Ozone BAF Pretreatment

For this alternative, ozone would be dosed based on the concentration of TOC in the secondary effluent (1 mg/L Ozone to 1 mg/L TOC). The ozone will break up the organic matter into AOC and make it more biologically degradable by the BAF. Ozone BAF has the potential to reduce TOC, reduce the impact of extracellular polymeric substances (EPS), reduce iron, and help with the filterability of the membrane feed water.

3.2.2.4 Secondary MBR

Daly City's secondary effluent water quality is challenging due to the high purity oxygen (HPO) activated sludge process. One alternative would be to modify the secondary treatment process to improve the secondary effluent water quality. For this alternative, primary effluent could be treated by a secondary membrane bioreactor (MBR). The MBR effluent would be used as UF feed water, as shown in Figure 6.

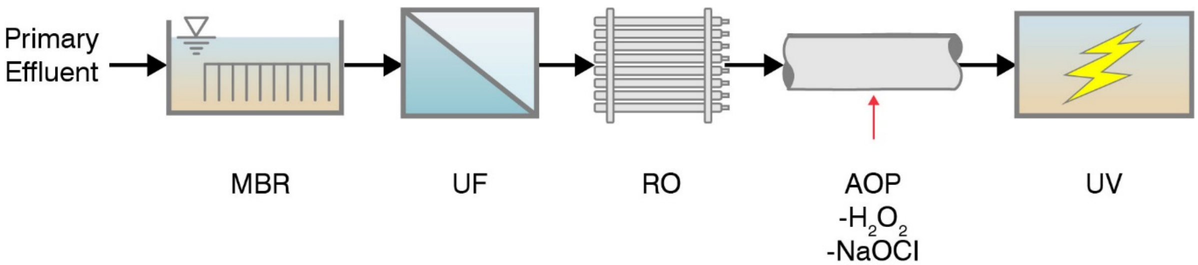


Figure 6 IPR Treatment Train - Secondary MBR

The MBR would require a much longer SRT than the existing secondary treatment process in order to prevent membrane fouling downstream and solve the current water quality issues. The long SRT would require a large footprint, which is not ideal given the site constraints.

3.2.2.5 Tertiary MBR

Another alternative would be to replace the UF membranes with a tertiary membrane bioreactor (MBR). Pretreatment would not be required for this alternative, as shown in Figure 7.

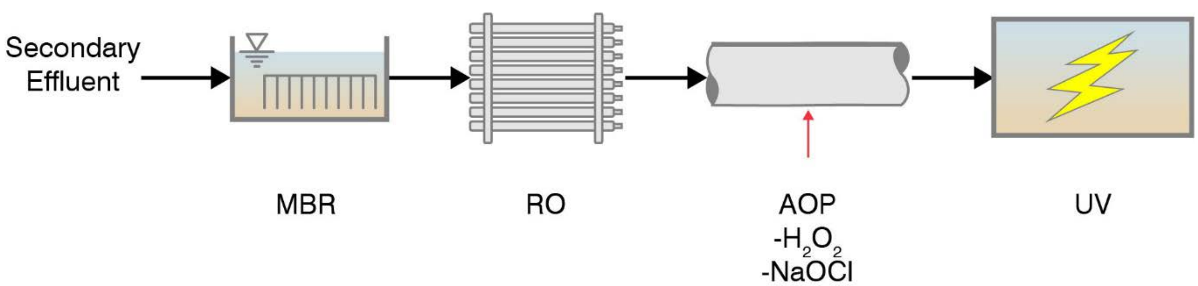


Figure 7 IPR Treatment Train - Tertiary MBR

The concept of replacing the UF system with a MBR system in an IPR treatment train is currently being researched and has not yet been approved in the Title 22 regulations. One challenge with this technology is the inability to perform direct integrity tests. Direct integrity tests are used to confirm the integrity of the membrane fibers and verify pathogen removal. Additionally, the integrity tests protect the downstream RO membranes by confirming that compromised fibers are not allowing the passage of untreated secondary effluent.

Only a few MBR systems have the ability to perform direct integrity test at this time. Research in Australia developed a method to relate turbidity to log removal credits. However, that method has not yet been approved by the State Water Resources Control Board, Division of Drinking Water. Further research on this concept is being conducted at demonstration facilities by Santa Clara Valley Water District and Metropolitan Water District.

3.2.3 Recommendation

Table 4 compares the five alternatives discussed herein as pretreatment alternatives. Considering footprint, risk, regulatory status, and cost, ozone BAF is the most feasible alternative and is recommended at this time. The recommended IPR treatment train would consist of ozone BAF, UF, RO, and UV AOP as shown in Figure 8.

Table 4 Pretreatment Alternative Comparison
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

	Aluminum Based Coagulant	Iron Based Coagulant	Ozone BAF	Secondary MBR	Tertiary MBR
Footprint	Minimal	Minimal	Moderate	Large	Large
Risk to RO	Potentially High	Potentially High	Minimal	Minimal	Moderate
Regulatory Status	Approved	Approved	Approved	Approved	Not approved
Cost	Low	Low	Medium	High	Medium

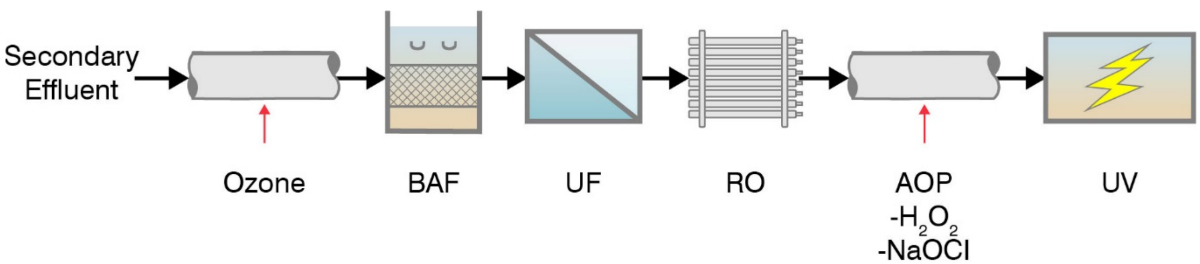


Figure 8 Recommended IPR Treatment Train

Carollo also recommends performing a pilot test of ozone BAF, UF, RO, and UV AOP to demonstrate process performance before designing a full-scale system. The pilot test would require a footprint of 25 feet by 60 feet and last for approximately 6 months.

3.3 Modifying the Recycled Water Treatment to IPR Treatment

One benefit of the recommended treatment train is that the UF and UV system are common processes that could be used for a recycled water facility or an IPR facility. This is beneficial because a recycled water facility could be built now to meet the current project goals and be designed to accommodate a future conversion to IPR.

4.0 IPR FACILITY CONCEPTUAL DESIGN

The project team estimated the size of the full scale IPR facility based on similar facilities. The process equipment could be located outside below a sun shading structure or within a building. The approximate footprint required is 100 feet by 200 feet as shown in Figure 9. Based on discussions with Daly City and SFPUC, there are two feasible locations near the Daly City WWTP, which include:

- Above grade in the parking lot.
- Below grade in the baseball field.

4.1 Above Grade in Parking Lot

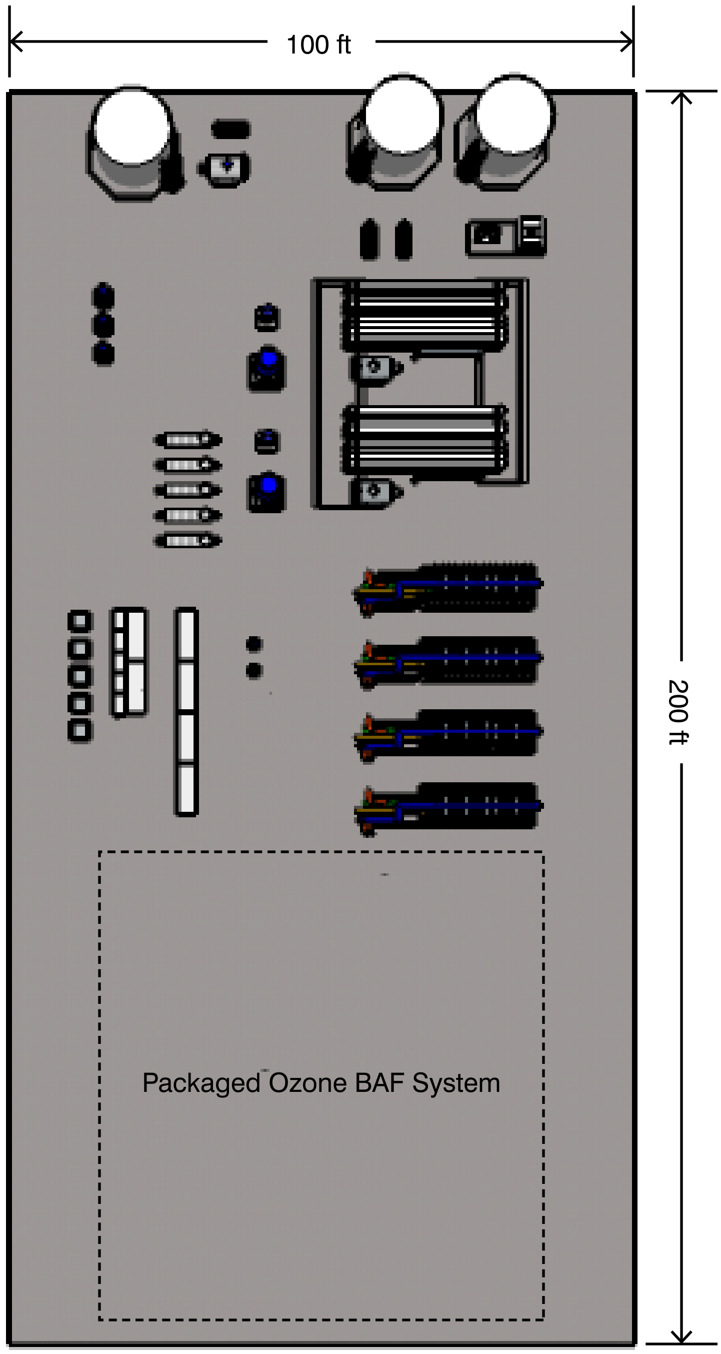
The IPR facility could be located above grade in the parking lot adjacent to the WWTP, as shown in Figure 10. This location would be compatible with the existing WWTP and allow for convenient operations and maintenance (O&M) of the equipment. Also, this location would allow continued use of the baseball fields. The primary challenge of this location is that parking and access to the baseball fields are eliminated and a new parking area would be required. One solution could be to build a multi-story parking structure in the parking lot of the nearby senior center.

4.2 Below Grade in Baseball Field

Alternatively, the IPR facility could be located below grade under the Westlake Park baseball fields. The WWTP already has two primary sedimentation basins and four equalization basins below the baseball fields. This location would have minimal impacts to the parking lot and WWTP.

The primary challenges of this location are O&M access and equipment removal. The design of the facility would need to include either a ramp so that equipment could be removed by a truck or an above-grade building where equipment could be removed through a crane system. With either method, there will be some permanent impact to the above grade baseball field. If a ramp is designed, the ramp entrance will be exposed and will require footprint at grade as shown in Figure 11. If a crane system is implemented for equipment removal, an above grade building will be located along the west side of the baseball fields as shown in Figure 12.

An additional challenge with this location is the temporary shutdown of the baseball fields during construction. During the 1987 plant expansion, new baseball fields were built off-site to mitigate the construction of the facilities below the existing baseball fields. A similar solution would likely be implemented for the construction of an IPR facility.



IPR Facility

FIGURE 9

CITY OF DALY CITY
PM 11 – IPR TREATMENT ALTERNATIVES

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Above Grade IPR Facility in Parking Lot

FIGURE 10

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PM 11 – IPR TREATMENT ALTERNATIVES

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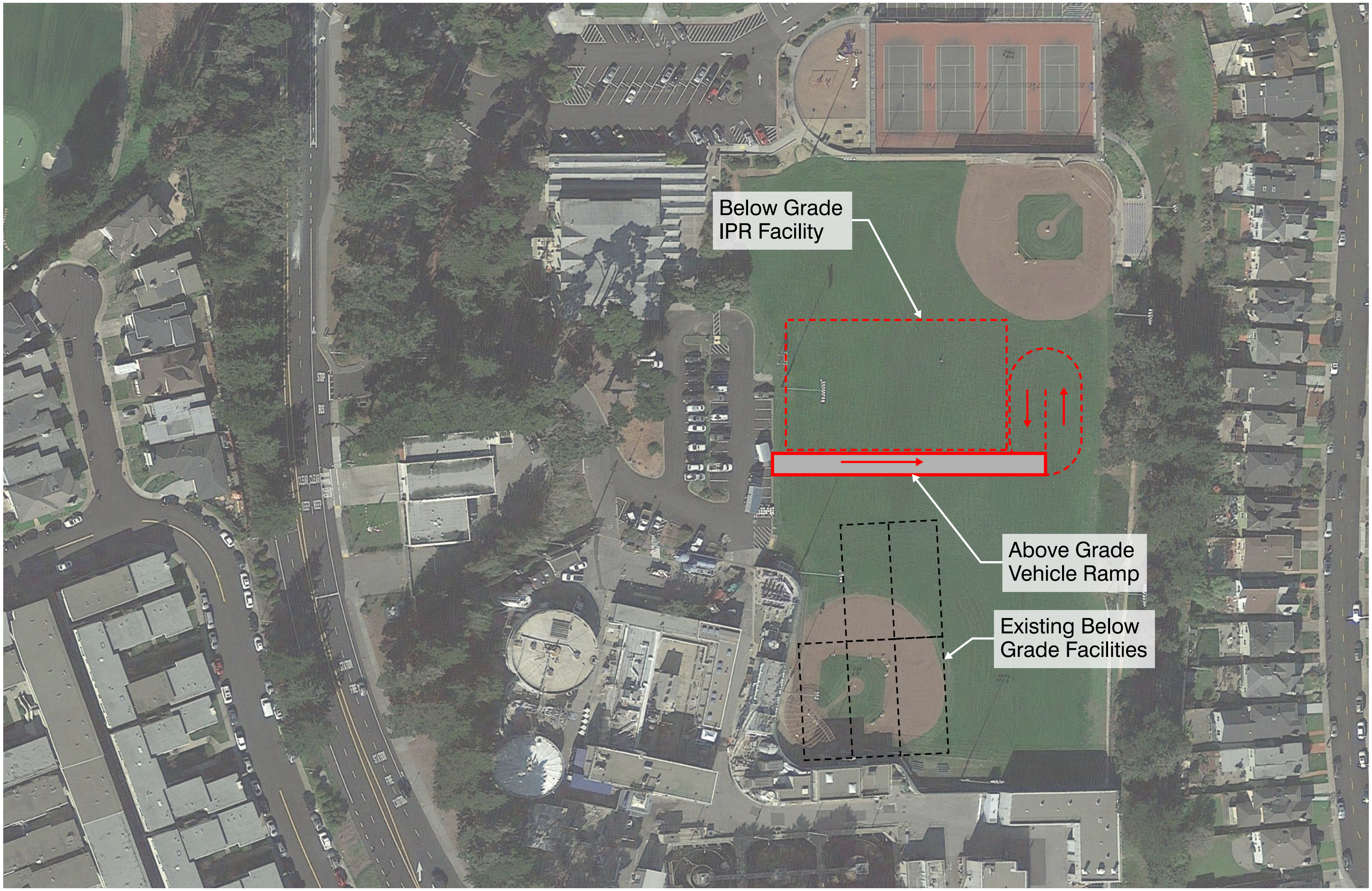

Below Grade IPR Facility in Baseball Field - Ramp Alternative

FIGURE 11

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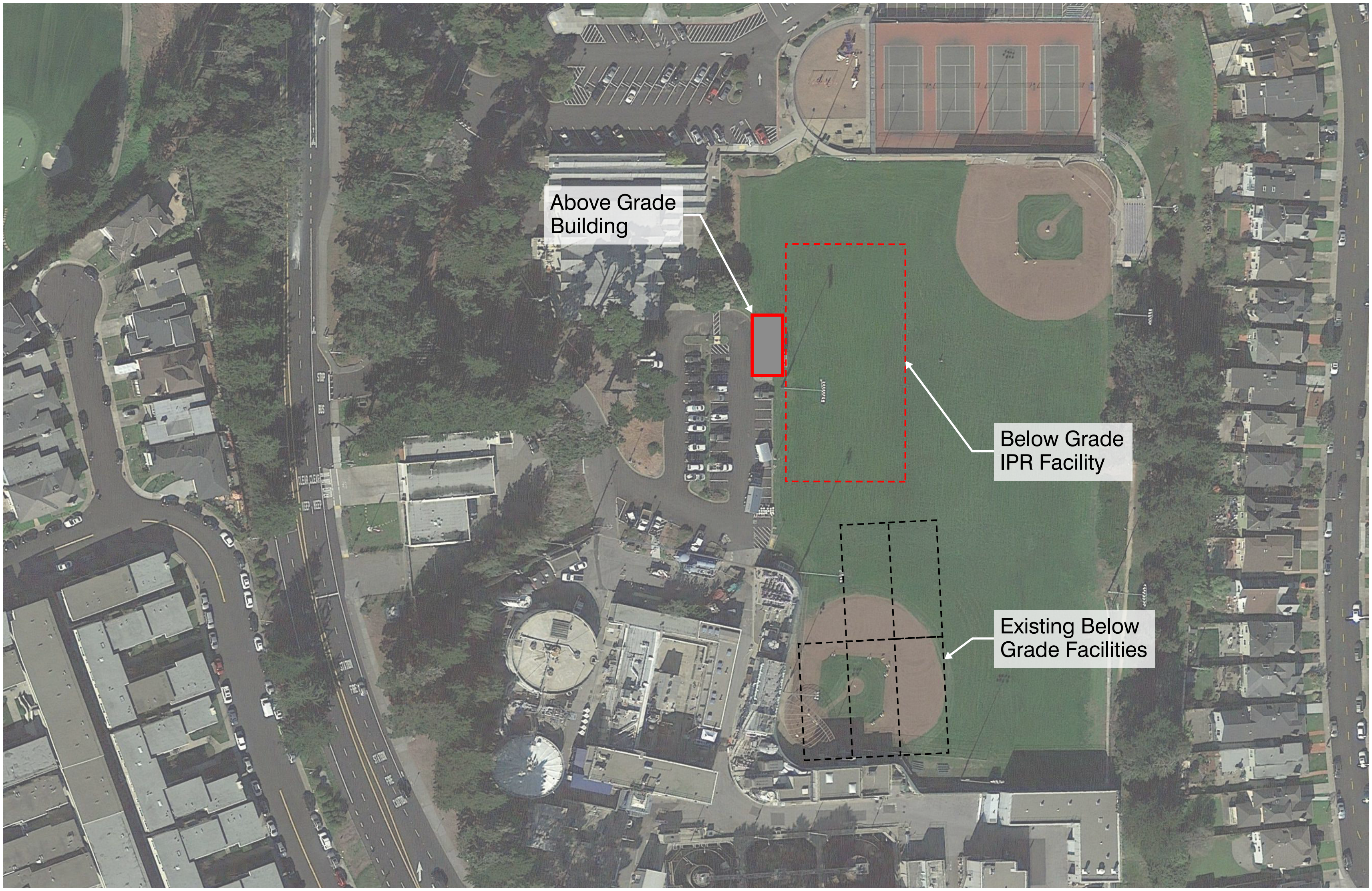

Below Grade IPR Facility in Baseball Field - Crane Alternative

FIGURE 12

CITY OF DALY CITY
PM 11 – IPR TREATMENT ALTERNATIVES

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5.0 RO CONCENTRATE DISPOSAL

The RO system will create a concentrate flow that will need to be discharged. PM 12, titled "Concentrate Disposal Alternatives" (Carollo, 2017) summarizes the RO concentrate disposal analysis performed for the project. The analysis examines whether or not the addition of the RO concentrate would result in discharge permit violations for the following two disposal alternatives:

- Disposing concentrate in the Daly City WWTP outfall.
- Disposing concentrate at the Oceanside Treatment Plant.

The results from the analysis are summarized in the following sections.

5.1 Disposal at Daly City WWTP Outfall

The first alternative considered disposing the RO concentrate at the Daly City WWTP outfall. If the IPR facility operates at its design capacity (up to 2.4 mgd of RO permeate), there would be compliance issues with CBOD, ammonia, and possibly toxicity. The CBOD point of compliance could be relocated to the secondary effluent stream to resolve the CBOD compliance issue. In order to keep ammonia in compliance, the IPR facility would need to reduce its capacity down to approximately 1 mgd or treat the RO concentrate.

5.2 Disposal at Oceanside Treatment Plant

The second alternative considered disposing the RO concentrate at SFPUC's Oceanside Treatment Plant. This analysis was performed in two parts.

First, the analysis considered the impact of the Oceanside Treatment Plant's planned TPAD process addition and new MF/RO recycled water facility. These additions are expected to result in BOD, ammonia, and possibility toxicity compliance issues. SFPUC plans to switch from BOD to CBOD, which should resolve the BOD compliance issue. Ammonia compliance is dependent on dilution. The dilution in the current permit is 150:1, however the permit has expired. If the dilution was to remain the same, it is anticipated that ammonia would not exceed the limits. However, a new dilution study was conducted which resulted in a dilution of 112:1. If the dilution is changed to 112:1, ammonia would be out of compliance.

A second analysis was performed to identify compliance issues after the RO concentrate from Daly City's IPR facility is added to the Oceanside Treatment Plant influent. Similar to the previous analysis, it is anticipated that CBOD, ammonia, and toxicity will have compliance issues. The CBOD point of compliance could be relocated to the secondary effluent stream to resolve the CBOD compliance issue. Ammonia and toxicity compliance are dependent on dilution. A dilution factor of at least 155:1 would be required to keep ammonia in compliance. A dilution factor of 291:1 - 313:1 would be required to keep toxicity in compliance.

The final dilution has not yet been determined and is currently being discussed between SFPUC and the regulatory agencies.

5.2.1 Disposal Location

For this alternative, SFPUC identified two potential connection points to the sewer collection system. Based on a preliminary analysis, it appears that there is capacity in the sewer system at these locations for the additional 0.6 mgd of RO concentrate. The locations were identified through SFPUC's geographic information system (GIS), but have not been field verified at this time. The two connections are manholes near the southern tip of Lake Merced, as shown in Figure 13.

6.0 COST ESTIMATE

6.1 Basis of Cost Estimate

The project is currently in the conceptual design phase and has not been developed in detail. The construction cost estimates are consistent with an AACE International Class 5 budget estimate, which has an accuracy range of +100 percent to -20 percent of the actual project cost.

6.1.1 ENR Benchmark

Providing a cost benchmark for construction estimates is useful in documenting the time of estimate preparation and in allowing for projections and escalations to later dates using the equivalent index value.

This preliminary design cost estimate is benchmarked to the Construction Cost Indices (CCI) published by the Engineering News Record (ENR) for May 2017, which is the most current ENR. We recommend using the ENR San Francisco CCI for the Daly City region, which was 11691 for May 2017.

6.1.2 Unit Costs

The cost estimates for each alternative were developed based on "dollar per gallon" budgetary estimates and industry standards for the RO system. Manufacturer quotes were used for the processes common to the Expanded Tertiary Recycled Water Facilities Project (secondary effluent pump station, membrane filtration, and ultraviolent disinfection) and for the Ozone BAF process.

Potential RO Concentrate Discharge Locations

FIGURE 13

CITY OF DALY CITY

PM 11 - IPR TREATMENT ALTERNATIVES

6.1.3 Contingencies

Contingencies are typically applied to a construction estimate at the design development phase to account for construction items not yet identified, and construction design unknowns. As the design is refined and finalized, the contingency, typically expressed as a percent of the raw construction cost, will trend downward. At the completion of the design, the contingency should represent only a reasonable construction change order allowance. Agencies typically retain contingency within their project budgets, even when construction contract award values are known, to cover the cost or deal with unforeseen conditions.

A 30 percent contingency, calculated based on the raw construction cost, has been included in the cost estimate. This is in alignment with the recommendations for a project at an AACE Class 5 level of development.

6.2 Above Grade in Parking Lot

The estimated construction cost for an above grade IPR facility located in the parking lot is $49,026,000. This cost estimate includes a +100/-20 percent accuracy and the cost ranges from $39,221,000 to $98,052,000. Table 5 presents a summary of the cost estimate. Note that the estimate assumes that the facility is inside of a building for a direct comparison to the Expanded Recycled Water Facility that was designed within a building. This estimate does not include costs for the pipeline to the groundwater basin, the injection well, or relocating the parking lot.

6.3 Below Grade in Baseball Field

The estimated construction cost for an IPR facility located below the baseball field is $58,005,000. This cost estimate includes a +100/-20 percent accuracy and the cost ranges from $46,404,000 to $116,010,000. Table 6 presents a summary of the cost estimate. This estimate does not include costs for the pipeline to the groundwater basin, the injection well, or temporarily relocating the baseball fields.

Table 5	IPR Facility - Above Grade in Parking Lot - Cost Estimate Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City			
No.	**Item**	**Unit Cost**	**Quantity**	**Estimated Cost**
01	Secondary Effluent Pump Station	$ 0.09/gal	3.6 mgd	$338,000
02	Ozone + Biologically Active Filter	$ 0.94/gal	3.6 mgd	$3,375,000
03	Membrane Filtration Process	$ 1.17/gal	3.0 mgd	$3,510,000
04	Reverse Osmosis Process	$ 0.60/gal	3.0 mgd	$1,800,000
05	Ultraviolet/Advanced Oxidation Process System	$ 0.46/gal	3.0 mgd	$1,383,000
06	Chemical Systems	$ 0.19/gal	3.0 mgd	$560,000
07	Effluent Pump Station	$ 0.17/gal	2.4 mgd	$410,000
08	RO Concentrate Disposal Pipeline	$ 850/LF	4,000 LF	$3,400,000
09	IPR Treatment Building	$ 250/sf	20,000 sf	$5,000,000
10	Pipeline to Groundwater Basin	-	-	Not included
11	Injection Well	-	-	Not included
12	Relocated Parking	-	-	Not included
			Subtotal	**$19,776,000**
13	Sitework (Applied to Items #1 - 8)		5%	$989,000
14	Electrical & I/C (Applied to Items #1 - 8)		20%	$2,955,000
15	Mechanical (Applied to Items #1 - 8)		15%	$2,216,000
	TOTAL DIRECT COST			**$25,936,000**
	Contingency		30%	$7,781,000
	Subtotal			$33,717,000
	General Contractor Overhead, Profit & Risk		12%	$4,046,000
	Subtotal			$37,763,000
	Escalation to Mid-Point(1)		12.8%	$4,843,000
	Subtotal			$42,606,000
	Sales Tax (Applied to 50% of Total Direct Cost)		9%	$1,167,000
	Subtotal			$43,773,000
	General Conditions		12%	$5,253,000
	TOTAL ESTIMATED CONSTRUCTION COST			**$49,026,000**
	Cost Range		***$39,221,000 - $98,052,000***	
	Engineering, Legal & Administration Fees		20%	$9,805,000
	Owner's Reserve for Change Orders		5%	$2,451,000
	TOTAL ESTIMATED PROJECT COST			**$61,282,000**

Notes:
(1) Based on a compound annual escalation of 4%, a design duration of 12 months starting in June 2018, and a construction duration of 24 months starting in June 2019.

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Table 6 IPR Facility - Below Grade in Baseball Field - Cost Estimate
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City

No.	Item	Unit Cost	Quantity	Estimated Cost
01	Secondary Effluent Pump Station	$ 0.09/gal	3.6 mgd	$338,000
02	Ozone + Biologically Active Filter	$ 0.94/gal	3.6 mgd	$3,375,000
03	Membrane Filtration Process	$ 1.17/gal	3.0 mgd	$3,510,000
04	Reverse Osmosis Process	$ 0.60/gal	3.0 mgd	$1,800,000
05	Ultraviolet/Advanced Oxidation Process System	$ 0.46/gal	3.0 mgd	$1,383,000
06	Chemical Systems	$ 0.19/gal	3.0 mgd	$560,000
07	Effluent Pump Station	$ 0.17/gal	2.4 mgd	$410,000
08	RO Concentrate Disposal Pipeline	$ 850/LF	4,000 LF	$3,400,000
09	IPR Treatment Building	$ 500/sf	20,000 sf	$10,000,000
10	Pipeline to Groundwater Basin	-	-	Not included
11	Injection Well	-	-	Not included
12	Temporary Relocated Baseball Field	-	-	Not included
			Subtotal	**$24,776,000**
13	Sitework (Applied to Items #1 - 8)		5%	$739,000
14	Electrical & I/C (Applied to Items #1 - 8)		20%	$2,955,000
15	Mechanical (Applied to Items #1 - 8)		15%	$2,216,000
		TOTAL DIRECT COST		**$30,686,000**
	Contingency		30%	$9,206,000
	Subtotal			$39,892,000
	General Contractor Overhead, Profit & Risk		12%	$4,787,000
	Subtotal			$44,679,000
	Escalation to Mid-Point[(1)]		12.8%	$5,730,000
	Subtotal			$50,409,000
	Sales Tax (Applied to 50% of Total Direct Cost)		9%	$1,381,000
	Subtotal			$51,790,000
	General Conditions		12%	$6,215,000
		TOTAL ESTIMATED CONSTRUCTION COST		**$58,005,000**
	Cost Range		***$46,404,000 - $116,010,000***	
	Engineering, Legal & Administration Fees		20%	$11,601,000
	Owner's Reserve for Change Orders		5%	$2,900,000
		TOTAL ESTIMATED PROJECT COST		**$72,506,000**

Notes:
(1) Based on a compound annual escalation of 4%, a design duration of 12 months starting in June 2018, and a construction duration of 24 months starting in June 2019.

The cost estimate herein is based on our perception 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 Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

APPENDIX B – PROJECT MEMORANDUM 12 - CONCENTRATE DISPOSAL ALTERNATIVES

This document is released for the purpose of information exchange review and planning only under the authority of Darren G. Baune, 08/01/2017, California P.E. No. 68899.

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

PROJECT MEMORANDUM NO. 12 CONCENTRATE DISPOSAL ALTERNATIVES

DRAFT

August 2017

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

PROJECT MEMORANDUM
NO. 12
CONCENTRATE DISPOSAL ALTERNATIVES

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CONCENTRATE DISPOSAL ALTERNATIVES

1.0 INTRODUCTION

1.1 Purpose

The purpose of this project memorandum (PM) is to evaluate reverse osmosis (RO) concentrate disposal alternatives for the proposed indirect potable reuse (IPR) facility at the Daly City Wastewater Treatment Plant (WWTP).

1.2 Background

The potential indirect potable reuse (IPR) facility at Daly City WWTP would include reverse osmosis (RO) as part of the treatment process. The RO process would be designed to provide 80 percent recovery, such that 80 percent of the RO feed flow would become treated water for IPR. The remaining 20 percent of the flow is referred to as RO concentrate and would need to be discharged. The RO concentrate would contain all of the constituents removed by the RO process and an evaluation is required to determine the discharge location. This PM considers the following disposal alternatives:

- Disposing concentrate in the Daly City WWTP outfall.
- Disposing concentrate at the Oceanside Treatment Plant.

It should be noted that the Oceanside Treatment Plant is currently in the process of adding temperature phased anaerobic digestion (TPAD) and a 5 million gallons per day (mgd) recycled water facility to their plant. Both of these projects will have an effect on the plant's effluent. The TPAD process will increase the concentration of ammonia and the new recycled water facility will have RO concentrate. The analysis for disposal at the Oceanside Treatment Plant takes these plant upgrades into consideration.

2.0 EVALUATION

2.1 Assumptions

The RO concentrate disposal analysis was performed assuming an average daily influent flow of 3 mgd. The design value of 3 mgd is the same flowrate used for the Feasibility of Expanded Tertiary Facilities Project. Based on 80 percent recovery of the RO system, the RO concentrate flow would be approximately 0.6 mgd.

2.2 Methodology

A mass balance of the system was created to develop concentration factors. The concentration factors were then applied to historical data to estimate the future effluent concentration after Daly City's RO concentrate is added.

A Reasonable Potential Analysis (RPA) was conducted to identify toxic pollutants that have the potential to exceed water quality objectives. This analysis focused on pollutants listed in Table 1 of the 2015 California Ocean Plan. Compliance was also estimated for conventional pollutants, such as Carbonaceous Biochemical Oxygen Demand (CBOD) and Total Suspended Solids (TSS) that have technology based effluents per the Clean Water Act.

The details of this analysis are provided in Appendix A.

3.0 RESULTS

3.1 Discharge to Daly City WWTP Outfall

The first alternative considered disposing the RO concentrate at the Daly City WWTP outfall. If the IPR facility operates at its design capacity (up to 2.4 mgd), compliance issues are anticipated for CBOD and ammonia, as shown in Table 1.

Table 1 Disposal at Daly City WWTP Outfall - Anticipated Non-Compliance Feasibility of Expanded Tertiary Recycled Water Facilities City of Daly City

Pollutant	Permit Limit	% Estimated Non-Compliance
Water Based Effluent Limits		
Ammonia - 6 month median	69.6 mg/L(1)	100%
Ammonia - Daily maximum	278.4 mg/L(1)	5%
Technology Based Effluent Limits		
CBOD - Weekly Median	40 mg/L	5.3%
CBOD - Monthly Median	25 mg/L	0.4%

Notes:
(1) Calculated based on current dilution

The CBOD limit is set as a measure of the effectiveness of secondary treatment. Therefore, the CBOD point of compliance could be relocated to the secondary effluent stream to resolve the compliance issue.

Ammonia is anticipated to be out of compliance 100 percent of the time. In order to keep ammonia in compliance, the capacity of the IPR facility would need to be reduced to approximately 1 mgd. Or, an additional side-stream treatment process could be installed to remove ammonia.

Daly City's discharge has not had high levels of toxicity in the past. However, the data is insufficient to estimate the toxicity at the estimated concentrations after the RO concentrate is discharged in the Daly City WWTP outfall. Additional testing would be required to determine if the concentrations are toxic.

3.2 Oceanside Treatment Plant

The second alternative considered disposing the RO concentrate at SFPUC's Oceanside Treatment Plant. This analysis was performed in two parts.

First, the analysis considered the impact of the Oceanside Treatment Plant's planned TPAD process addition and new MF/RO recycled water facility. These additions are expected to result in BOD, ammonia, and possibility toxicity compliance issues as shown in Table 2. SFPUC plans to switch from BOD to CBOD, which should resolve the BOD compliance issue. Ammonia compliance is dependent on dilution. The dilution in the current permit is 150:1, however the permit has expired. If the dilution was to remain the same, it is anticipated that ammonia would not exceed the limits. However, a new dilution study was conducted which resulted in a dilution of 112:1. If the dilution is changed to 112:1, ammonia would be out of compliance.

**Table 2 Oceanside Treatment Plant - Anticipated Non-Compliance
Feasibility of Expanded Tertiary Recycled Water Facilities
City of Daly City**

Pollutant	Permit Limit	% Estimated Non-Compliance
Water Based Effluent Limits		
Ammonia - 6 month median	67.8 mg/L[(1)]	22%
Chronic Toxicity - Max Day	150 TUc[(1)]	12%
Technology Based Effluent Limits		
BOD - Weekly Median	45 mg/L	3%
BOD - Monthly Median	30 mg/L	11%

Notes:
(1) Calculated based on current dilution of 150:1

A second analysis was performed to identify compliance issues after the RO concentrate from Daly City's IPR facility is added to the Oceanside Treatment Plant influent. Similar to the previous analysis, it is anticipated that CBOD, ammonia, and toxicity will have compliance issues. The CBOD point of compliance could be relocated to the secondary effluent stream to resolve the CBOD compliance issue. Ammonia and toxicity compliance are dependent on dilution. A dilution factor of at least 155:1 would be required to keep ammonia in compliance. A dilution factor of 291:1 - 313:1 would be required to keep toxicity in compliance.

The final dilution has not yet been determined and is currently being discussed between SFPUC and the regulatory agencies.

4.0 SUMMARY

The proposed IPR project will include an RO system. The RO system will produce approximately 0.6 mgd of RO concentrate that will need to be discharged. This analysis considered two disposal alternatives:

- Disposal in the Daly City WWTP outfall.
- Disposal at the Oceanside Treatment Plant.

For both scenarios BOD or CBOD, ammonia, and toxicity are anticipated to have compliance issues. In order to dispose the RO concentrate at the Daly City WWTP outfall and remain in compliance, the facility would need to reduce its capacity to 1 mgd or would need to treat the RO concentrate stream prior to disposal. In order to dispose the RO concentrate at the Oceanside Treatment Plant and remain in compliance, the current dilution factor of 150:1 would need to be renegotiated up to 313:1.

APPENDIX A – INDIRECT POTABLE REUSE DISPOSAL ANALYSIS

CITY OF DALY CITY

INDIRECT POTABLE REUSE DISPOSAL ANALYSIS

Prepared by McGovern McDonald Engineers
for Carollo Engineers

June 26, 2017

City of Daly City
Indirect Potable Reuse Disposal Analysis
- Regulatory Considerations -

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EXECUTIVE SUMMARY

The North San Mateo County Sanitation District Wastewater Plant (WWTP) serves an area just south of San Francisco and is located on the west side of Daly City. Daly City is considering the addition of an indirect potable reuse (IPR) treatment facility at the WWTP. The IPR treatment process would include ultrafiltration (UF), reverse osmosis (RO), and ultraviolet advanced oxidation process (UV AOP).

The purpose of this study is to examine whether addition of the proposed IPR treatment process at Daly City would result in discharge permit violations. Implementing the new treatment train will increase effluent concentrations by removing clean water and leaving the mass of constituents in the RO concentrate to be discharged. Two scenarios were evaluated for disposal of Daly City's RO concentrate: 1) disposal via the Daly City WWTP outfall, and 2) disposal to the San Francisco Public Utility Commission's Oceanside Treatment Plant via a nearby manhole.

The analysis reviews Daly City and Oceanside Treatment Plant flow regimes, dilution factors, historical effluent concentrations, and operational limitations of each system. The analysis reviews current discharge permit limits as well as the 2015 California Ocean Plan, which governs limitations of effluent flows to the Pacific Ocean.

To identify parameters that may have discharge permit compliance issues as the IPR treatment is added, this memorandum addresses the following:

1) Development of concentration factors - The concentration factor is the value that the historical data can be multiplied by to estimate future effluent concentrations when the IPR system is added.

2) Identification of toxic pollutants that exceed water quality objectives through a Reasonable Potential Analysis (RPA). An RPA is a statistical analysis that identifies pollutants that have a potential to exceed water quality objectives. An RPA is conducted every permit renewal cycle. If a pollutant does trigger reasonable potential, then an effluent limit is calculated and included in the permit.

3) Estimated compliance with potential receiving water-quality based effluent limits for toxic pollutants that trigger 'Reasonable Potential', and estimated compliance with technology-based effluent limit for conventional pollutants (e.g. Carbonaceous Biochemical Oxygen Demand and Total Suspended Solids).

4) Estimation of the maximum IPR flow for each parameter that will not cause a compliance issue.

Disposal of Concentrate in the Daly City Wastewater Treatment Plant Outfall

The first scenario looks at the traditional option of disposing the RO concentrate at the Daly City effluent outfall.

The worst-case concentration factor in this scenario is 5.25, which includes a 5% safety factor. This concentration occurs when flows through the treatment plant are insufficient to meet the IPR facility demand. During this scenario, only RO concentrate is sent to the ocean outfall. Within the last five years, the average daily effluent flow has not dropped to this flow rate. However, there are instantaneous times where the effluent flow falls below this flow rate. In these instances, the concentration of pollutants in the effluent when the IPR facility is operating is anticipated to be 5.25 times greater than what their concentration would have been if the IPR were not operating.

A reasonable potential analysis was conducted on Ocean Plan Table 1 pollutants. Historical effluent data from April 2012 through December 2016 was multiplied by the calculated concentration factors. The reasonable potential analysis found that a new permit limit is anticipated to be required for ammonia (Table ES 1).

TABLE ES 1. Anticipated Non-compliance with Water Quality Based Effluent Limits

Pollutant – Averaging Period	Calculated Permit Limit	% Estimated Non-compliance
Ammonia – 6-month median	69.6 mg/L	100% (156 of 156 samples)
Ammonia – Daily maximum	278.4 mg/L	5% (8 of 167 samples)

Conventional pollutants, such as CBOD and TSS, were also reviewed to determine whether, once concentrated, the effluent would meet permit limits. While most of the pollutants are anticipated to meet limits, CBOD is anticipated to exceed weekly permit limits approximately 5.3 percent of the time, and monthly permit limits 0.4 percent of the time (Table ES 2).

TABLE ES 2. Estimated Non-Compliance with Technology-Based Effluent Limits

Pollutant/Standard	Weekly	Monthly
CBOD Concentration	5.3%	0.4%

The maximum IPR permeate flow that would result in compliance with the water quality based effluent limits and technology-based effluent limits was estimated. The most restrictive of the compliance issues is the requirement for maximum 6-month limit for ammonia, which confines IPR flows to approximately 1 mgd.

The Daly City effluent is generally not toxic, yet insufficient data exists to estimate toxicity at concentrations greater than approximately 4 times historical effluent data.

Disposal of Concentrate to the SFPUC Oceanside Treatment Plant

The second scenario assesses the regulatory impacts if the RO concentrate were to be added to the SFPUC Oceanside Treatment Plant influent. The SFPUC is moving forward with their own 5 mgd MF/RO recycled water facility at the Oceanside Plant. In addition, the SFPUC plans to add a Temperature Phased Anaerobic Digestion (TPAD) process to the Oceanside Plant. In 2014, an analysis was conducted to determine the regulatory implications of the addition of these two processes. The analysis was conducted assuming a 4 mgd recycled water facility, and used effluent data from October 1, 2009 through September 30, 2013. The TPAD process was assumed to concentrate ammonia and toxicity by 12%.

The pollutants anticipated to be in non-compliance at the Oceanside Plant once the recycled water and the TPAD processes are in operation, are presented in Table ES3.

Table ES3. Anticipated Non-compliance at the SFPUC's Oceanside Treatment Plant Before Combination with Daly City RO Concentrate

Pollutant – Averaging Period	Required Dilution for Compliance	Anticipated New Permit Limit	% Non-compliance
Ammonia - 6-month median	112	67.8 mg/L	22%
Chronic Toxicity - Max day	112	112 TUc	12%
	150	150 TUc	12%
	185	185 TUc	12%
	234	234 TUc	6%
Biochemical Oxygen Demand (mg/L) – weekly median	Not applicable	45 mg/L	3%
Biochemical Oxygen Demand (mg/L) – monthly median	Not applicable	30 mg/L	11%

Notes: Assumes a 5% safety factor on Oceanside Treatment Plant concentration factors.

These results were used as the basis of an analysis to determine compliance of the SFPUC effluent when the Daly City RO concentrate is added to the influent. The analysis considered only those constituents with compliance issues at either Daly City or the Oceanside Treatment Plant. It was assumed that the Daly City RO concentrate does not get further treatment through the Oceanside Plant, except through RO treatment where the entirety of the constituent concentration goes out to the effluent as concentrate.

Using these assumptions, the following results are anticipated:

- ***Ammonia*** - 6-month median limit for ammonia would be out of compliance approximately six percent of the time. This is assuming the current permitted dilution of 150:1, which is being negotiated for the next permit cycle. To be 100% compliant (based on historical data), the dilution factor for the SFPUC would need to be approximately 155:1.
- ***Toxicity*** - Toxicity is an issue for San Francisco, so further addition of a high-ammonia load would exacerbate this issue.
- ***CBOD -*** Non-compliance for CBOD would also increase, although CBOD would likely not be an issue if the point of compliance is moved after the secondary treatment facilities, before the MF/RO units.

It is important to note the following:

1) The planned capacity of the MF/RO system at Oceanside is 5 mgd, an increase from the 4 mgd used as the basis of this analysis. Therefore, the results underestimate concentrations, and subsequently underestimate compliance issues.
2) It was assumed that the Daly City RO concentrate does not get treatment through the secondary treatment facilities, although the flow would go through the entire treatment process. This overestimates the concentrations in the Oceanside effluent, as additional treatment is expected to occur through the treatment plant.
3) The allowable dilution ratio granted in a discharge permit impacts the compliance for the Ocean Plan Table 1 constituents, including ammonia and toxicity. Dilution for the Oceanside Treatment Plant is currently permitted at 150:1, although the permit is expired, and a new dilution of 112:1 has been identified as plausible. This lower dilution would result in non-compliance for ammonia and toxicity, and possibly other constituents that have not yet been identified.

OVERVIEW

The North San Mateo County Sanitation District Wastewater Plant (WWTP), operating in Daly City, serves several communities south of San Francisco. The WWTP includes a recycled water facility that treats up to 2.77 mgd. The remaining secondary effluent is disinfected and discharged to the Pacific Ocean via a deep-water ocean outfall. Daly City is considering the addition of an indirect potable reuse (IPR) facility that will treat secondary effluent. The IPR treatment process would include ultrafiltration (UF) and reverse osmosis (RO), and ultraviolet advanced oxidation process.

Implementing this IPR treatment train would effectively concentrate the effluent constituents due to removing clean water, while leaving the mass of the constituents in the effluent. This report presents the results of an analysis that was conducted to determine if the concentrated effluent would still meet discharge permit requirements. The analysis considers Daly City flow regimes, dilution factors, historical effluent concentrations, and operational limitations of the system. The analysis reviews current NPDES permit limits as well as the 2015 California Ocean Plan, which governs limitations of effluent flows to the Pacific Ocean.

In addition, this report reviews a second scenario in which the Daly City RO concentrate is discharged to a manhole prior to the San Francisco Public Utilities Commission's (SFPUC) Oceanside Treatment Plant, which is just north of the Daly City WWTP. The Oceanside Treatment Plant discharges to federal waters through the Southwest Ocean Outfall (SWOO).

The SFPUC is also planning its own recycled water project at the Oceanside Treatment Plant. This recycled water treatment plant would include microfiltration (MF) followed by reverse osmosis (RO), and would be online prior to any contributions from Daly City. Additionally, the SFPUC is adding a Temperature Phased Anaerobic Digestion (TPAD) process to their treatment plant that will increase ammonia and toxicity. A 2014 analysis reviewing the regulatory impacts of implementing the MF/RO and TPAD processes at Oceanside was used as a basis for estimating effluent discharge concentrations. A mass balance was completed to estimate the concentrations in the Oceanside effluent when Daly City RO concentrate would be added to the system and the MF/RO system and TPAD would be operational at the Oceanside Plant.

The first step to identify constituents that may exceed regulations is to develop a mass balance of the system to identify concentration factors. Concentration factors were then applied to historical data and the concentrated data was run through a Reasonable Potential Analysis for Ocean Plan Table 1 pollutants. Concentrated, historical data was also compared to permit requirements for conventional pollutants. The following sections provide the results of these analyses.

CONCENTRATION FACTOR

Concentration factors have been calculated to estimate future effluent concentrations when the IPR plant would be operational. For example, a concentration factor of 1.5 would mean that the new effluent concentration is roughly 1.5 times the existing effluent concentration for each pollutant. The calculations conservatively assume that, for each pollutant, 100% of the pollutant is removed during the RO treatment and left in the RO concentrate. Additionally, no removal is assumed through the ultrafiltration process. In summary, these assumptions result in all pollutants leaving the plant through the effluent. For CBOD and TSS, removal data was used to refine the assumptions.

A concentration factor has been calculated for each averaging period (e.g. daily maximum, monthly average, etc.) that corresponds to the averaging period of an effluent limitation for each parameter. For example, the effluent limit for benzene is a 30-day average; therefore, the 30-day concentration factor is used when calculating reasonable potential.

Daily final effluent flow data from April 1, 2012 through December 31, 2016 was used, to determine concentration factors. In addition, hourly wastewater final effluent flows from January 1, 2012 through December 31, 2012 and January 1, 2015 and December 31, 2015 were used to identify instantaneous concentration factors.

The following sections provide an overview of the current and anticipated flow regimes at the WWTP, and identify the concentration factor for each averaging period.

Flow Regimes

The IPR facility is planned to continually produce 2.4 to 2.56 MGD. The flow rate required to operate at this capacity is 3.6 MGD. This flow results in 0.40 mgd of waste backwash water of UF concentrate that returns to the headworks as a recycle stream. The remaining 3.20 mgd continues to the RO process. Up to 0.64 mgd is continuously discharged as RO concentrate and must be disposed. This flow though the RO results in an instantaneous flow of 2.56 MGD as RO permeate (IPR flow) and 0.64 mgd as RO concentrate which composes part of the final effluent flow. Considering the additional UF backwash flow, which recycles back to the headworks, the system demand from the WWTP effluent is 3.2 mgd.[1]

Concentration Factors for Table 1 Ocean Plan Constituents

Table 1 of the 2015 Ocean Plan presents water quality objectives to protect marine life and human health, including both carcinogens and noncarcinogens. The objectives to protect marine life provide instantaneous limits, daily average limits and 6-month rolling median limits for constituents such as copper and arsenic. The objectives to protect human health – both carcinogens, such as benzene, and non-carcinogens, such as toluene – provide limitations for a 30-day rolling average.

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[1] Start-up demand is 3.6 mgd, until steady-state is achieved.

For Table 1 Ocean Plan constituents, the permit requires that a sample is taken once per year, except for total chlorine residual and ammonia, which are sampled more frequently. The concentration factors associated with these limits are described below.

Instantaneous Limits

An analysis of hourly wastewater flows for the period of January 1, 2015 through December 31, 2015 and January 1, 2012 and December 31, 2012 shows that the instantaneous flows are occasionally less than the effluent flow required to supply the IPR demand, usually during the early mornings.

There will be instantaneous times when influent flows are not sufficient to supply the full demand for indirect potable reuse flow. During this time, the effluent flow will be 100% RO concentrate, and the IPR facility may operate below its capacity. This occurred roughly 5% of the time in 2015, and 0.4% of the time in 2012. The significant increase in lower flows likely correlates to conservation efforts in response to the drought. At low flow times, the instantaneous concentration factor will reach its maximum of 5.00, or 5.25 with a 5% safety factor.[2]

Daily Limits

The maximum daily effluent limit is the highest allowable daily discharge based on analyzing the composite of 24 hourly samples taken over a representative calendar day (e.g. midnight through 11:59 pm). As a conservative measure, the minimum average daily wastewater flow is used to determine the concentration factor for daily compliance, as this day has occurred at least once in the last 5 years, and has the potential to occur again. A 5% safety factor is then applied to this lowest flow because it may be the case that an even lower flow day may occur in the future. The lowest daily average over the five years analyzed was 3.44 mgd. The resulting concentration factor for the maximum daily limit is 4.64.

6-Month Median Limits

The 6-month median effluent limit is the highest allowable median of all daily averages for any 180-day period. A 6-month rolling median of flow was calculated using daily flow data from April 1, 2012 through December 31, 2015. The lowest median throughout this period was 4.78 mgd, which, when adding a 5% safety factor, results in a concentration factor of 2.30.

30-Day Average Limits

The 30-day average limit is the highest allowable average of all daily averages for any 30-day period. A 30-day rolling average of flow was calculated using daily flow data from April 1, 2012 through December 31, 2015. The lowest average throughout this period was 4.36 mgd, which, when adding a 5% safety factor, results in a concentration factor of 2.63.

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[2] In the case of instantaneous maximum, a 5% safety factor is added to the concentration factor,

Concentration Factors for Conventional Pollutants

In addition to the Ocean Plan Table 1 pollutants, there are conventional pollutants such as carbonaceous biological oxygen demand (CBOD), which must also meet permit requirements. These parameters are sampled according to the North San Mateo County Sanitation District's NPDES permit requirements and range from once per hour (for total chlorine residual) to once per quarter (for oil & grease).

Average Weekly and Average Monthly Limits

Effluent limits for Carbonaceous Biological Oxygen Demand (CBOD), Total Suspended Solids (TSS), Oils and Grease (O&G), and turbidity all have an average weekly and an average monthly effluent limitation. The average weekly effluent limit is calculated as the average of all daily discharges measured during a calendar week. Similarly, the average monthly effluent limit is calculated as the average of all daily discharges during a calendar month. A daily discharge is based on analyzing the composite of 24 hourly samples taken over a calendar day.

The lowest average calendar monthly flow in the five-year period of flow data reviewed was 4.50 mgd. The lowest average calendar weekly flow in the five-year period was 4.22 mgd. Considering a 5% safety factor, the resulting concentration factor is 2.50 for a calendar month and 2.77 for a calendar week.

30-Day Geometric Mean Limit

Effluent limits for enterococcus bacteria have both an instantaneous limitation as well as a 30-day geometric mean limitation. A 30-day rolling geometric mean of flow was calculated using daily flow data from April 1, 2012 through December 31, 2015. The lowest average throughout this period was 4.34 mgd, which, when adding a 5% safety factor, results in a concentration factor of 2.65.

Concentration Factors in Summary

A summary of the concentration factors for each water quality objective averaging period is provided in Table 1. Each of the minimum flows reported are reduced by 5% as an additional safety factor. This allows for the possibility of even lower flows in the future.

Table 1. Summary of Concentration Factors After IPR Treatment

Water Quality Objective Averaging Period	Minimum Flow (mgd)	Concentration Factor (1)
Maximum Daily	3.44	4.64
Instantaneous Maximum	3.20	5.25
6-month Rolling Median	4.78	2.30
30-day Rolling Average	4.36	2.63
30-day Geometric Mean	4.34	2.65
Calendar Monthly Mean	4.50	2.50
Calendar Weekly Mean	4.22	2.78

Notes: Concentration Factors have been rounded up.

BOD and TSS Concentration Factors

The concentration factors for CBOD and TSS have been refined to reflect available data. The assumption of zero percent removal through UF is conservative. Greater than 95% removal of TSS is expected through the UF process, based on information provided by Carollo Engineers. Therefore, a removal of 90% (to be conservative) through the UF was used in the analysis for TSS. The UF backwash is returned to the headworks for further removal through primary and secondary treatment.

Based on sampling at the Oxnard WWTP in Southern California MF removes particulate BOD, while soluble BOD passes through the MF system. At Oxnard, roughly 40% of the secondary BOD is in the particulate form and was assumed to be removed through the MF. Therefore, at Daly City, lacking any particulate vs. soluble CBOD data, a 40% removal of CBOD is assumed through the UF process, to be returned to the headworks.

Using these assumptions, the concentration factors for CBOD and TSS may be updated to 1.85 and 1 for average weekly, respectively, and 1.72 and 1 for average monthly, respectively.

REASONABLE POTENTIAL ANALYSIS

A Reasonable Potential Analysis (RPA) is an estimate of the potential for an effluent discharge to meet or exceed water quality standards. An RPA is a statistical analysis conducted every five years during the NPDES permit renewal process on toxic pollutants in order to determine which pollutants shall have limits included in the permit.

The Daly City Wastewater Treatment Plant discharges into state waters of the Pacific Ocean. Therefore, Appendix IV of the Water Quality Control Plan for Waters of California ("Ocean Plan") outlines the methodology for calculating reasonable potential. The key factors in this calculation method include the historical effluent data and the effluent dilution ratio.

When considering the historical effluent data, the concentration factors discussed previously were multiplied by each available data point from Ap 1, 2012 through December 31, 2016 for each toxic pollutant in Table 1 of the Ocean Plan (Appendix A) to obtain a 'concentrated' data set. These data points were concentrated regardless of whether the data point was a censored point (i.e. non-detect, ND, or detected not quantified, DNQ).

The dilution for Daly City is 115:1, as prescribed in the NPDES discharge permit. When considering dilution, the decreased flows due to the IPR facility demand will change the effluent flow regime, and consequently the modeled dilution ratio. Without a dynamic modeling effort, it is difficult to predict how a decreased effluent flow will influence the dilution because of the complex and competing factors involved. Daly City may want to consider conducting a modeling effort to assess the impacts of a decreased flow regime to the dilution ratio. As the dilution ratio increases, permit limits increase making compliance less challenging.

Reasonable Potential Analysis Results

A reasonable potential analysis was conducted on the Table 1 Pollutants (Appendix A) according to the methodology outlined in Appendix VI of the Ocean Plan. With the exception of ammonia, all of the parameters in Table 1 were determined not to cause reasonable potential, or were inconclusive due to detection limits not being low enough to assess attainment. Several parameters considered 'inconclusive' were below the detection limit, yet detection limits were greater than water quality objectives. Therefore, it was difficult to discern if, when concentrated, they would exceed limits. A discussion of these constituents is presented in Appendix B.

Chronic Toxicity

Ocean Plan Table 1 includes a water quality objective for chronic toxicity expressed as a daily maximum (1 Toxicity Unit, chronic or TUc). Chronic toxicity is not amendable to being 'concentrated' through a mass balance approach, as is the approach taken for the Ocean Plan Table 1 constituents. The best approach to estimate toxicity is to conduct bench-top or pilot-scale tests. In lieu of this data, an in-depth analysis of existing, available information has been conducted.

In summary, Daly City data is not toxic. The nature of the current testing methods allows us to assess toxicity based on historical data up to a concentration factor of 4. Up to this point, there would have been no compliance issues with toxicity for a concentrated effluent using current statistical methods, the No Observed Effects Concentration (NOEC). The toxicity testing landscape in California is rapidly changing, and by the next permit cycle, if not sooner, toxicity will be determined using a different statistical method called the Test of Significant Toxicity (TST).

Under the current statistical methodology, organisms are exposed at several effluent concentrations (0.25%, 0.5%, 1%, 2%, and 4%) to generate a dose/response curve. These concentrations equate to dilutions, and in turn, concentration factors. The TST methodology runs the test at one dilution and requires that it Pass or Fail. None of the samples at any of the tested dilutions were deemed toxic. The effluent flows tested at the highest concentration of 3.5% equate to a concentration factor of 4 and were not toxic.

The average daily concentration factor (4.64) and the instantaneous maximum concentration factor (5.25) are both greater than 4. Additional testing at higher effluent concentrations would be needed to determine if the effluent is toxic at these concentrations.

COMPLIANCE WITH ANTICIPATED PERMIT LIMITS

Compliance with Ocean Plan Table 1 Pollutants

For Ocean Plan Table 1 pollutants, Water Quality Based Effluent Limits (WQBELs) are calculated for parameters that have triggered reasonable potential. The calculated permit limit and the percent of time it is anticipated to be out of compliance based on historical data are presented in Table 2.

Table 2. Calculated Permit Limit and Anticipated Non-compliance

Pollutant – Averaging Period	Calculated Permit Limit	% Estimated Non-compliance
Ammonia – 6-month median	69.6 mg/L	100% (156 of 156 samples)
Ammonia – Daily maximum	278.4 mg/L	5% (8 of 167 samples)

An estimate of the maximum IPR flow that would result in compliance with WQBELS is provided in Table 3. These calculations are based on historical data, plus a 5% safety factor. Although these flows are conservative, there will be times when the flows could be lower than historical flows.

Table 3. Estimated Maximum IPR Flows Allowable to Maintain Compliance with Water Quality Based Effluent Limits

Parameter	Max IPR Flow
Ammonia - 6-month median	1.02 MGD
Ammonia – Daily maximum	2.42 MGD

It is important to note that this assumes 0% removal through the UF system and 100% removal through the RO system. This assumption could be better adjusted with more information from bench scale testing, which may lead to greater allowable flows.

Compliance with Conventional Pollutants

The Clean Water Act (CWA) requires all treatment plants to meet technology-based effluent limits, as outlined in Table 4. These limits are included in the North San Mateo County Sanitation District NPDES permit.

Table 4. Technology Based Effluent Limits for Secondary Treatment Facilities

Parameter	Weekly (mg/L)	Monthly (mg/L)	Removal (%)
CBOD	40	25	85%
TSS	45	30	85%

The historical record of CBOD and TSS data between April 1, 2012 and December 31, 2016 was concentrated using the concentration factors for CBOD and TSS compared to the limits shown in Table 4. The estimated percent non-compliance for CBOD is approximately 5.3% for the weekly CBOD limit and less than 1 percent for the monthly CBOD limit. TSS is not anticipated to cause an compliance issue.

An estimate of the maximum IPR effluent flow that would result in 100% compliance with the CWA technology based effluent limits is provided in Table 5. These calculations are based on historical data. Although these flows are conservative, there will be times when the flows could be lower than historical flows. Therefore, a 5% safety factor is applied.

Table 5. Estimated Maximum IPR Flows Allowable to Maintain Compliance with CBOD Limits

Parameter	Weekly	Monthly
CBOD	2.47 MGD	2.50 MGD

According to the Ocean Plan, Publicly Owned Treatment Works (POTWs) must meet additional effluent limits for oils and grease (O&G), enterococcus bacteria, chlorine, and turbidity, as presented in Table 6. Effluent data for O&G and turbidity from April 2012 through December 2016 were assessed for average calendar monthly and average calendar weekly compliance, using the applicable concentration factors. Total chlorine is compared against a 6-month median, daily average and instantaneous limits; enterococcus bacteria is compared against a 30-day geometric mean as well as an instantaneous limitation.

Table 6. Effluent Limits for POTWs Based on the Ocean Plan

Parameter	Monthly	Weekly	6-month median	Daily Average	Instant	30-day geometric mean
Oil & Grease (mg/L)	25	40	-	50	-	-
Turbidity (NTU)	75	100	-	-	-	-
Total Chlorine Residual (mg/L)	-	-	0.14	0.57	4.3	-
Enterococcus Bacteria (NTU/100 mL)	-	-	-	-	7400	2500

Oils and Grease (O&G), turbidity, enterococcus bacteria and total chlorine would not have compliance issues.

COMBINING DALY CITY CONCENTRATE WITH THE SFPUC OCEANSIDE TREATMENT PLANT INFLUENT

The option of disposing Daly City's RO concentrate to the influent of the SFPUC's Oceanside Plant via a manhole in the system was also analyzed.

SFPUC Oceanside Treatment Plant

SFPUC is moving forward with their own MF/RO recycled water plant. In addition, the SFPUC plans to add a TPAD process to the Oceanside Plant. In 2014 an analysis similar to the one presented in this report was conducted to determine the regulatory implications of the addition of these two processes. The analysis assumed a recycle water flow of 4 mgd, and was based on effluent data from October 1, 2009 through September 30, 2013. The TPAP process was assumed to concentrate ammonia and toxicity by 12%.

The pollutants anticipated to be in non-compliance at the Oceanside Plant once the recycled water and the TPAD processes are in operation are presented in Table 7.

Table 7. Anticipated Non-compliance at the SFPUC's Oceanside Treatment Plant Before Combination with Daly City UF Concentrate, Based on the 2014 Analysis

Pollutant – Averaging Period	Dilution	Permit Limit	% Non-compliance
Ammonia - 6-month median	112	67.8 mg/L	22%
Chronic Toxicity - Max day	112	112 TUc	12%
	150	150 TUc	12%
	185	185 TUc	12%
	234	234 TUc	6%
Biochemical Oxygen Demand (mg/L) – weekly median	Not applicable	45 mg/L	3%
Biochemical Oxygen Demand (mg/L) – monthly median	Not applicable	30 mg/L	11%

Notes: Assumes a 5% safety factor on RWTP concentration factors.

Similar to the Daly City WWTP, the Oceanside Treatment Plant would have compliance issues with ammonia and BOD. SFPUC plans to change from BOD to CBOD as a measure of meeting the technology standard. In doing so, they would generally be in compliance. Additionally, the point of compliance for CBOD may be moved to after the secondary process, prior to concentration in the MF/UF processes.

Ammonia compliance is highly dependent on dilution. Dilution is an important factor when determining compliance with discharge requirements. The dilution in the current Oceanside permit is 150:1. However, the permit has expired and the SFPUC is undergoing a permit renewal. Per the request of the regulatory agencies, a new dilution study was conducted under various averaging periods and conditions (e.g. currents vs. no currents). The most conservative dilution that resulted from the study, which the RWQCB typically selects as the overall dilution, was 112:1. A final dilution to be included in the new permit still needs to be determined. If the dilution were to remain at 150:1, it is anticipated that ammonia will not exceed limits. Yet, if the permitted dilution is changed to 112:1, then it is anticipated that ammonia could be out of compliance 22% of the time.

Toxicity is also an issue at the Oceanside Treatment Plant. Using the current testing method, toxicity would likely have exceeded limits when concentrated. When switching over to the TST method for determining compliance with toxicity, SFPUC may be in compliance, although toxicity does not exhibit a typical dose-response curve so it is difficult to predict. A review conducted by SFPUC of unionized ammonia concentrations, similar to those that would be in the Oceanside effluent once concentrated, showed that the levels would result in toxicity.[3] Therefore, toxicity is anticipated to be an issue in concentrated effluent.

SFPUC Oceanside Treatment Plant with Daly City RO Concentrate

An analysis was conducted to identify compliance issues when the Daly City RO concentrate is added to the SFPUC Oceanside Treatment Plant influent. The constituents that were identified as issues at both Daly City and the Oceanside Treatment Plant –CBOD, ammonia, and toxicity - were reviewed. The analysis was based on a recycled water flow at the Oceanside Treatment Plant of 4 mgd rather than 5 mgd. Also, the analysis assumed that no further treatment of the Daly City RO concentrate would occur at the Oceanside Treatment Plant, except through the RO treatment, when it would end up in the RO concentrate and out the effluent outfall. Although conservative, ammonia removal will mostly occur through RO treatment.

- CBOD – It is anticipated that CBOD will exceed the monthly limit approximately 3% of the time, and is very close to exceeding the weekly limit. The limit for CBOD is a secondary technology standard, and therefore the point of compliance may be moved to after the secondary process rather than after the RO process. This would avoid the concentration effect, effectively negating compliance issues.
- Ammonia – Ammonia may already be an issue for SFPUC, depending on the final dilution granted in the next permit. With the addition of the RO concentrate from Daly City, ammonia concentrations increase. The dilution factor needed to stay in compliance at Oceanside recycled water flow of 4 MGD would be approximately 155:1. When the recycled water flow at the Oceanside Treatment Plant reaches its full capacity of 5 MGD, the dilution factor required to stay in compliance would be even greater.
- Toxicity – Toxicity is already a concern for the SFPUC when they begin operation of their new recycled water system. A dilution factor of 291 to 313 would be needed at a recycled water flow of 5 mgd, based on the SFPUC analysis. The addition of a highly concentrated ammonia stream to their system will only exacerbate the situation.

Additional analysis is required to determine if, once combined, additional constituents may exceed Oceanside Plant effluent limits. Also, it is important to consider that this initial study considers a recycled flow at the Oceanside Treatment Plant of 4 mgd, rather than the final capacity of 5 mgd.

[3] Correspondence from Amy Chastain, SFPUC 5/15/17

SUMMARY OF RESULTS

Disposal at Daly City Wastewater Treatment Plant Outfall

If the RO concentrate were disposed of at the Daly City WWTP outfall there would be compliance issues with CBOD, ammonia, and possibly toxicity.

Clean Water Act secondary treatment standards (i.e. for CBOD and TSS) apply to all POTWs and are a measure of the effectiveness of secondary treatment. These limits only apply to the secondary treated flows rather than the combined secondary and concentrate flows. Therefore, the point of compliance for CBOD should be moved to the secondary effluent. This would result in no further concentration and thus, compliance with the CBOD standards. This would require specific language in the permit to identify different compliance points for different permit limits.

Ammonia is anticipated to be out of compliance 100% of the time. To remain in compliance the maximum flow to the IPR facility would be approximately1 mgd. In order to reach the full recycled water capacity, the option to discharge RO concentrate through the Daly City outfall would require additional treatment (e.g. sidestream treatment) of the RO concentrate to remove ammonia.

Historically, the Daly City effluent has not been toxic. It is hard to predict, when concentrated, whether the toxicity limits will be exceeded. Bench scale or pilot scale tests are recommended in order to understand whether the concentrated effluent would exceed toxicity limits.

Daly City could try to take a similar approach as the SFPUC by negotiating a greater dilution with the Regional Water Quality Control Board. Their initial toxicity analyses do not show toxicity in the current effluent, a good sign with their relatively higher ammonia concentrations. This path is unclear, as the SFPUC is still navigating this path with no clear outcome. Additionally, SFPUC discharges to federal waters and therefore EPA, rather than the RWQCB, is their main regulatory agency and so they may take a different approach.

Disposal at Oceanside Treatment Plant Outfall

If the Daly City RO concentrate were to be discharged to the SFPUC's Oceanside Treatment Plant, CBOD, ammonia, and toxicity would all be out of compliance. A more encompassing analysis would need to be conducted to determine if additional pollutants would also be out of compliance.

For CBOD, the point of compliance could be moved to the secondary effluent, If it were moves it would no longer be an issue.

For ammonia, compliance is a matter of the dilution granted in the permit by the regulatory agencies. At the potential dilution of 112:1, the Oceanside Treatment Plant effluent would be out of compliance with or without the addition of the Daly City RO concentrate. At the current dilution of 150:1, the Oceanside Treatment Plant effluent would be out of compliance with the addition of the Daly City RO concentrate. Therefore, the addition of the Daly City RO concentrate would require either that the SFPUC negotiate a greater dilution from the regulatory agencies or that additional treatment such as sidestream treatment be applied to the RO concentrate.

Finally, toxicity is increasing the dilution required for the Oceanside Treatment Plant to be in compliance. The addition of Daly City's RO concentrate only makes this dilution requirement even greater.

Appendix A

Table 1 Water Quality Objectives from the 2015 California Ocean Plan

TABLE 1 (formerly TABLE B)
WATER QUALITY OBJECTIVES

	Units of Measurement	Limiting Concentrations: 6-Month Median	Daily Maximum	Instantaneous Maximum
OBJECTIVES FOR PROTECTION OF MARINE AQUATIC LIFE				
Arsenic	µg/L	8.	32.	80.
Cadmium	µg/L	1.	4.	10.
Chromium (Hexavalent) (see below, a)	µg/L	2.	8.	20.
Copper	µg/L	3.	12.	30.
Lead	µg/L	2.	8.	20.
Mercury	µg/L	0.04	0.16	0.4
Nickel	µg/L	5.	20.	50.
Selenium	µg/L	15.	60.	150.
Silver	µg/L	0.7	2.8	7.
Zinc	µg/L	20.	80.	200.
Cyanide (see below, b)	µg/L	1.	4.	10.
Total Chlorine Residual (For intermittent chlorine sources see below, c)	µg/L	2.	8.	60.
Ammonia (expressed as nitrogen)	µg/L	600.	2400.	6000.
Acute* Toxicity	TUa	N/A	0.3	N/A
Chronic* Toxicity	TUc	N/A	1.	N/A
Phenolic Compounds (non-chlorinated)	µg/L	30.	120.	300.
Chlorinated Phenolics	µg/L	1.	4.	10.
Endosulfan*	µg/L	0.009	0.018	0.027
Endrin	µg/L	0.002	0.004	0.006
HCH*	µg/L	0.004	0.008	0.012
Radioactivity	Not to exceed limits specified in Title 17, Division 1, Chapter 5, Subchapter 4, Group 3, Article 3, section 30253 of the California Code of Regulations. Reference to section 30253 is prospective, including future changes to any incorporated provisions of federal law, as the changes take effect.			

* See Appendix I for definition of terms.

TABLE 1 (formerly TABLE B) Continued

Chemical	30-day Average (µg/L) Decimal Notation	Scientific Notation
OBJECTIVES FOR PROTECTION OF HUMAN HEALTH – NONCARCINOGENS		
acrolein	220.	2.2×10^{2}
antimony	1,200.	1.2×10^{3}
bis(2-chloroethoxy) methane	4.4	4.4×10^{0}
bis(2-chloroisopropyl) ether	1,200.	1.2×10^{3}
chlorobenzene	570.	5.7×10^{2}
chromium (III)	190,000.	1.9×10^{5}
di-n-butyl phthalate	3,500.	3.5×10^{3}
dichlorobenzenes*	5,100.	5.1×10^{3}
diethyl phthalate	33,000.	3.3×10^{4}
dimethyl phthalate	820,000.	8.2×10^{5}
4,6-dinitro-2-methylphenol	220.	2.2×10^{2}
2,4-dinitrophenol	4.0	4.0×10^{0}
ethylbenzene	4,100.	4.1×10^{3}
fluoranthene	15.	1.5×10^{1}
hexachlorocyclopentadiene	58.	5.8×10^{1}
nitrobenzene	4.9	4.9×10^{0}
thallium	2.	$2. \times 10^{0}$
toluene	85,000.	8.5×10^{4}
tributyltin	0.0014	1.4×10^{-3}
1,1,1-trichloroethane	540,000.	5.4×10^{5}
OBJECTIVES FOR PROTECTION OF HUMAN HEALTH – CARCINOGENS		
acrylonitrile	0.10	1.0×10^{-1}
aldrin	0.000022	2.2×10^{-5}
benzene	5.9	5.9×10^{0}
benzidine	0.000069	6.9×10^{-5}
beryllium	0.033	3.3×10^{-2}
bis(2-chloroethyl) ether	0.045	4.5×10^{-2}
bis(2-ethylhexyl) phthalate	3.5	3.5×10^{0}
carbon tetrachloride	0.90	9.0×10^{-1}
chlordane*	0.000023	2.3×10^{-5}
chlorodibromomethane	8.6	8.6×10^{0}

* See Appendix I for definition of terms.

TABLE 1 (formerly TABLE B) Continued

Chemical	30-day Average (µg/L) Decimal Notation	30-day Average (µg/L) Scientific Notation
OBJECTIVES FOR PROTECTION OF HUMAN HEALTH – CARCINOGENS		
chloroform	130.	1.3×10^{2}
DDT*	0.00017	1.7×10^{-4}
1,4-dichlorobenzene	18.	1.8×10^{1}
3,3'-dichlorobenzidine	0.0081	8.1×10^{-3}
1,2-dichloroethane	28.	2.8×10^{1}
1,1-dichloroethylene	0.9	9×10^{-1}
dichlorobromomethane	6.2	6.2×10^{0}
dichloromethane	450.	4.5×10^{2}
1,3-dichloropropene	8.9	8.9×10^{0}
dieldrin	0.00004	4.0×10^{-5}
2,4-dinitrotoluene	2.6	2.6×10^{0}
1,2-diphenylhydrazine	0.16	1.6×10^{-1}
halomethanes*	130.	1.3×10^{2}
heptachlor	0.00005	5×10^{-5}
heptachlor epoxide	0.00002	2×10^{-5}
hexachlorobenzene	0.00021	2.1×10^{-4}
hexachlorobutadiene	14.	1.4×10^{1}
hexachloroethane	2.5	2.5×10^{0}
isophorone	730.	7.3×10^{2}
N-nitrosodimethylamine	7.3	7.3×10^{0}
N-nitrosodi-N-propylamine	0.38	3.8×10^{-1}
N-nitrosodiphenylamine	2.5	2.5×10^{0}
PAHs*	0.0088	8.8×10^{-3}
PCBs*	0.000019	1.9×10^{-5}
TCDD equivalents*	0.0000000039	3.9×10^{-9}
1,1,2,2-tetrachloroethane	2.3	2.3×10^{0}
tetrachloroethylene	2.0	2.0×10^{0}
toxaphene	0.00021	2.1×10^{-4}
trichloroethylene	27.	2.7×10^{1}
1,1,2-trichloroethane	9.4	9.4×10^{0}
2,4,6-trichlorophenol	0.29	2.9×10^{-1}
vinyl chloride	36.	3.6×10^{1}

* See Appendix I for definition of terms.

Table 1 Notes:

a) Dischargers may at their option meet this objective as a total chromium objective.

b) If a discharger can demonstrate to the satisfaction of the Regional Water Board (subject to EPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations for cyanide may be met by the combined measurement of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanide complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by the approved method in 40 CFR PART 136, as revised May 14, 1999.

c) Water quality objectives for total chlorine residual applying to intermittent discharges not exceeding two hours, shall be determined through the use of the following equation:

$$\log y = -0.43 (\log x) + 1.8$$

where: y = the water quality objective (in µg/L) to apply when chlorine is being discharged;
x = the duration of uninterrupted chlorine discharge in minutes.

E. Biological Characteristics

1. Marine communities, including vertebrate, invertebrate, algae, and plant species, shall not be degraded.*

2. The natural taste, odor, and color of fish, shellfish,* or other marine resources used for human consumption shall not be altered.

3. The concentration of organic materials* in fish, shellfish* or other marine resources used for human consumption shall not bioaccumulate to levels that are harmful to human health.

F. Radioactivity

1. Discharge of radioactive waste* shall not degrade* marine life.

* See Appendix I for definition of terms.

Appendix B

Reasonable Potential Analysis
Inconclusive Results

REASONABLE POTENTIAL ANALYSIS – INCONCLUSIVE RESULTS

There are several constituents that result in an inconclusive endpoint based on the methodology in Appendix VI of the Ocean Plan. This is due to the data reported being below the lab method detection limit (MDL), resulting in "censored" data. The remaining discussion on WQBEL results shows vulnerabilities in the analysis due to inconclusive data, yet does not necessarily identify any problem constituents. It is important to note that if a data point was detected, and not censored, it did not trigger RP for any of the constituents.

Non-detect (ND) data points are samples that fell below the Method Detection Limit (MDL) and are considered censored data points. Using the MDL as a surrogate for the censored effluent concentrations, there were some constituents in which the diluted MDL was greater than the WQBEL. This would lead to a reasonable potential if these were true data points. Therefore, it is more difficult to discern if, when concentrated, they may result in reasonable potential.

These include the following constituents:

- Aldrin
- Benzidine
- Chlordane
- DDT
- 3,3'-Dichlorobenzidine
- Dieldrin
- Heptachlor epoxide
- PAHs
- TCDD equivalents
- Toxaphene

It is important to note that these are the results even before the concentration factor is applied. If the MDL, used as a surrogate, were multiplied by the concentration factor and then diluted, heptaclor would be added to this list.

There were additional times where the diluted MDL was not greater than the WQBEL, but due to statistical probability, the analysis would result in reasonable potential if the ND points were true data points.

Again, this is shown by using the MDL as a surrogate for the censored effluent concentrations when the result was a non-detect. These constituents are the following:

- Acrylonitrile
- Beryllium
- Thallium
- Tributyltin
- Heptaclor

It is important to note that these are the results even before the concentration factor is applied. If the MDL were multiplied by the concentration factor and then diluted, cadmium (6-month median), chronic toxicity (daily max), and carbon tetrachloride would be added to this list.

APPENDIX C – PROJECT MEMORANDUM 13 - IPR REGULATORY REQUIREMENTS

This document is released for the purpose of information exchange review and planning only under the authority of Darren G. Baune, 08/01/2017, California P.E. No. 68899.

CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

PROJECT MEMORANDUM NO. 13
INDIRECT POTABLE REUSE REGULATORY REQUIREMENTS

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August 2017

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CITY OF DALY CITY

FEASIBILITY OF EXPANDED TERTIARY RECYCLED WATER FACILITIES

PROJECT MEMORANDUM
NO. 13
INDIRECT POTABLE REUSE REGULATORY REQUIREMENTS

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IPR REGULATORY REQUIREMENTS

1.0 INTRODUCTION

Water reuse projects must meet the applicable public health criteria for potable water reuse. Additionally, groundwater recharge projects must not degrade the groundwater quality. The purpose of this project memorandum (PM) is to summarize the regulatory requirements for a potential indirect potable reuse (IPR) facility at the Daly City Wastewater Treatment Plant (WWTP).

2.0 REGULATING AUTHORITIES

The primary regulations governing recycled water use in California are the California Water Code (CWC) and the California Code of Regulations (CCR), Title 22. These codes focus on public health protection and are enforced by the State Water Resources Control Board (SWRCB), Division of Drinking Water (DDW). Permits for water reuse applications are provided by one of the nine Regional Water Quality Control Boards (RWQCBs).

The CWC stipulates that each RWQCB formulate and adopt Water Quality Control Plans for all areas governed by the Board. These plans must contain water quality objectives for surface water and groundwater within the regions that provide reasonable protection of the beneficial uses of the waters. During the process of formulating such Basin Plans, the RWQCBs must consult with and consider recommendations of affected state and local agencies.

In collaboration, SWRCB, DDW and RWQCB have regulatory authority over projects using recycled water. The SWRCB establishes general policies governing the permitting of recycled water projects. The SWRCB developed the Recycled Water Policy to provide guidance to the RWQCB on issuing permits for recycled water project. The SWRCB also exercises general oversight on recycled water projects, including review of RWQCB permitting practices. The DDW focuses on the protection of public health and drinking water supplies and develops uniform water recycling criteria appropriate to particular uses of water. The RWQCB focuses on the protection of surface and groundwater resources and issues permits that implement DDW recommendations.

3.0 INDIRECT POTABLE REUSE REGULATIONS

3.1 Groundwater Recharge Reuse Projects

In June 2014, DDW adopted new regulations to include in Title 22 that replaced existing, less definitive guidelines for groundwater replenishment reuse projects (GRRPs). DDW defines two types of GRRPs: surface application and subsurface injection. Surface application recharges groundwater by allowing percolation of treated water from a spreading area, which is typically an unlined pond or basin. The water infiltrates into the unsaturated zone and reaches the water table. These areas typically require a large footprint depending on the percolation rate. Subsurface injection, is any other addition of water to the groundwater other than through the surface application. It typically involves direct connection to the water table and injection via a well. Due to the limited availability and high cost of land, the analysis for this project focuses entirely upon the use of subsurface injection wells.

The treatment process for subsurface application is required to include reverse osmosis (RO), advanced oxidation (AOP), at least three separate barriers earning 1-log of removal credit each, and a minimum of two months of subsurface travel time, from the time of injection to the time of extraction for use.

Any potable water project (conventional or water reuse) must meet regulated drinking water standards (e.g., MCLs). For potable water reuse projects in California, additional standards are imposed as they pertain to pathogens, advanced oxidation requirements (to remove trace CECs), and several other constituents, as shown in Table 1.

Table 1 Title 22 Groundwater Reuse Replenishment Project Criteria
IPR Regulatory Requirements
City of Daly City

Parameter	Criteria
Pathogen Microorganism Control	
Virus	12 - log reduction
Giardia	10 - log reduction
Cryptosporidium	10 - log reduction
Total Organic Carbon (TOC)	Maximum 0.5 mg/L 20-week running average
1,4-dioxane(1)	0.5 - log reduction by an advanced oxidation process
NDMA	10 ng/L Notification Level (NL)
Total Nitrogen (TN)	10 mg/L

Notes:
(1) Other indicator compounds can be substituted for 1,4-dioxane with approval from DDW

3.2 Anti-degradation

The Recycled Water Policy recognizes that groundwater replenishment reuse projects have the potential to negatively impact the existing water quality in the basin. Therefore, as part of GRRP permitting efforts, an anti-degradation study must be conducted to demonstrate that the input of recycled water will not lower the water quality within the basin. This study must be submitted to the Regional Water Board prior to the implementation of the IPR project. The study requirements are as follows:

- If the project utilizes less than 10 percenr (or multiple projects utilize less than 20 percent) of the available assimilative capacity in a basin, the study should only verify the use of the assimilative capacity
- If the project utilizes more than 10 percent (or multiple projects utilize more than 20 percent) of the available assimilative capacity in a basin, the study analysis will be designated by the Regional Water Board.

The potential project utilizes reverse osmosis (RO), which will result in a water with low concentrations of salts, nutrients, and other components. A post-treatment program will add in essential minerals to stabilize the water before injection to protect groundwater and prevent leaching of native metals or other soil constituents. With post-treatment properly engineered, the industry expectation is that the groundwater quality will improve due to the quality of the injected water.

3.3 Water Quality

The DDW regulations (SWRCB, 2015) include limits for chemical constituents: maximum contaminant levels (MCLs), notification levels (NLs), public health goals (PHGs), and other prescribed constituent limits specified by DDW. They may implement monitoring/removal requirements for contaminants of emerging concern (CECs) from the IPR facility effluent.

These chemical constituents, including disinfection byproducts (DBPs), industrial chemicals, pesticides, metals, and other classes known to be detrimental to human health above certain concentrations, are regulated in drinking water by the U.S. EPA under the Safe Drinking Water Act (SDWA) through MCLs. Any wastewater effluent that is proposed for water supply augmentation should, therefore, meet all of these standards. A number of research studies have found that secondary or tertiary effluents meet most, if not all, MCLs without further treatment (Trussell et al., 2013). Advanced treatment, like the kind being proposed in this study, removes or destroys most remaining constituents to levels below detection. Many of the constituents being removed are not yet regulated, but may be in the future. Providing advanced treatment ensures protection against known and unknown contaminants. The National Research Council (NRC) (2012) demonstrated that from a risk standpoint, well-engineered and operated potable water reuse projects create a better water quality and less risk (for pathogens and pollutants) compared to conventional water supplies.

In addition to the chemical and radiological constituents explicitly regulated through MCLs, a number of unregulated trace organic constituents (e.g., hormones, pharmaceuticals, personal care products, coatings (perfluorinated compounds), flame retardants), which are often found in conventional drinking water sources, will also be found in secondary treated wastewater. These trace level chemicals will be removed well below thresholds of concern by advanced technologies.

The monitoring of specific CECs is required by SWRCB for groundwater recharge projects, with the following example list from the City of Oxnard's GRRP permit: 17B-estradiol, caffeine, NDMA, triclosan, DEET, sucralose.

3.4 Monitoring Facilities

Prior to operating a Groundwater Replenishment Reuse Project (GRRP), the proper monitoring facilities must be established. Section 60320.226 of the CCR (SWRCB, 2015) requires construction of at least two monitoring wells downgradient of the project, specifically:

- One monitoring well located no less than two weeks but no more than six months of travel time from the GRRP, and at least 30 days upgradient of the nearest drinking water well.
- One monitoring well located between the GRRP and the nearest downgradient drinking water well.

Every quarter the monitoring wells will need to be sampled and analyzed for the following per Section 60320.220 and 60320.226:

- Priority Toxic Pollutants.
- Total Nitrogen, Nitrate, Nitrite.
- Contaminants in Table 64449-A and B of Section 64449.
- Any additional contaminants or chemicals specified by the SWRCB.

3.5 Permit

Each component of this recycled water project requires a permit: production, distribution, and end users. The permit issuance for this type of IPR project can be conducted in several ways. Daly City can choose to permit each component separately, with each end user having their own permit and accepting liability or Daly City can apply for a Master Permit, where Daly City accepts full liability for enforcement of the proper recycled water usage.