CITY OF PACIFIC GROVE

LOCAL WATER PROJECT
DRAFT FACILITY PLAN REPORT
WRFP No. 3316-010

January 31, 2014

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Prepared by Brezack and Associates Planning

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LIST OF ABBREVIATIONS

AMSL	Above Mean Sea Level
AFY	Acre-Feet per Year
ASBS	Area of Special Biological Significance
ASR	Aquifer Storage and Recovery
AWWA	American Water Works Association
BOD	Biochemical Oxygen Demand
CAW	California American Water Company
CAWD	Carmel Area Wastewater District
CCR	California Code of Regulations
CDO	Cease and Desist Order
CDPH	California Department of Public Health
CECs	Constituents of Emerging Concern
CEQA	California Environmental Quality Act
COP	California Ocean Plan
CPUC	California Public Utilities Commission
CSIP	Castroville Seawater Intrusion Project
CT	Modal Contact Time
CWC	California Water Code
CWSRF	Clean Water State Revolving Fund
DWR	Department of Water Resources
EC	Electrical Conductivity
ET	Evapotranspiration
FPG	Facility Planning Grant
gpm	Gallons per minute
GWR	Groundwater Replenishment
PBC	Pebble Beach Company
PBCSD	Pebble Beach Community Services District
PGLWP	Pacific Grove Local Water Project
PGUSD	Pacific Grove Unified School District
POM	Presidio of Monterey
ppm	Parts per million
psi	Pounds per square inch
MAWA	Maximum Applied Water Allowance
MBR	Membrane Bioreactor
MCWRA	Monterey County Water Resources Agency
MF	Microfiltration
mgd	Million gallons per day
mg/L	Milligrams per liter
MPN	Most Probable Number

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MPWMD	Monterey Peninsula Water Management District
MPWSP	Monterey Peninsula Water Supply Project
MRIWRMP	Monterey Regional Integrated Water Resources Management Plan
MRWPCA	Monterey Regional Water Pollution Control Agency
OSHA	Occupational Safety and Health Administration
RO	Reverse Osmosis
ROW	Right(s)-of-Way
RTP	Regional Treatment Plant
RWQCB	Regional Water Quality Control Board
SAR	Sodium Adsorption Ratio
SGWB	Seaside Groundwater Basin
SBR	Sequencing Batch Reactor
SNMP	Salt and Nutrient Management Plan
SRWTP	Satellite Recycled Water Treatment Plant
SVGWB	Salinas Valley Groundwater Basin
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
USBR	United States Bureau of Reclamation
UV	Ultraviolet
WAS	Waste Activated Sludge
WDR	Waste Discharge Requirements
WRFP	Water Recycling Funding Program
WWTP	Wastewater Treatment Plant

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ES EXECUTIVE SUMMARY

ES-1 Overview

The City of Pacific Grove is pursuing the construction and operation of a Satellite Recycled Water Treatment Plant (SRWTP) to produce recycled water for non-potable water demands in the City of Pacific Grove with future capability to expand to service other local demands outside of the City. This study documents the work conducted in support of this effort as part of the City of Pacific Grove Local Water Project (PGLWP).

ES-1.1 Background

The City Pacific Grove is located on the Monterey Peninsula along the Central California Coastline. The region is totally dependent on local rainfall for replenishment of its water supplies. Rainfall patterns have resulted in severe droughts. Near coastal groundwater pumping has resulted in increasing total dissolved solids (TDS) concentrations, seawater intrusion and overdraft of the local aquifers (MRWPCA, 2012). Diversions and pumping of the under drain of the Carmel River has put critical habitat at risk, as well as federal and state listed endangered and threatened species. The City's water purveyor, California American Water Company (CAW), is now subject to pumping restrictions pursuant to State Water Resources Control Board (SWRCB) Order 95-10, the related issuance of a Cease and Desist Order by the SWRCB (Order WR2009-0060), and their reduced pumping of the Seaside Groundwater Basin (SGWB), mandated by its adjudication.

On August 29, 2012, the City submitted a Public Participants Proposal in response to the California Public Utilities Commission's (CPUC) administrative law judge Gary Weatherford ruling concerning public participation in the CAW Application 12-04-019. The City proposed the PGLWP to provide non-potable recycled water supplies to supplement CAW's planned Monterey Peninsula Water Supply Project (MPWSP). The MPWSP is CAW's proposed project in response to the SWRCB Order 95-10 and Cease and Desist Order.

The City applied for and secured grant funding for the PGLWP planning from SWRCB through the Regional Water Recycling Facilities Planning Grant Program on March 15, 2013. The grant agreement to fund this study is for $125,000, with the City contributing 50% or $62,000. Upon completion of this study, the City may decide to move forward with implementation of the recommended project. This report facilitates an application for a low interest loan from the Clean Water State Revolving Fund (CWSRF).

ES-1.2 Project Goals

The PGLWP would achieve the following project goals:

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- To preserve available potable water supplies for domestic uses and to maximize the recycling and reuse of non-potable recycled municipal wastewater in a cost effective manner.

- To substitute the City's use of CAW potable water with recycled water for non-potable water demands.

- To maximize the use of existing wastewater collection, treatment, recycling and recycled water distribution infrastructure for the development of irrigation water and other non-potable demands.

ES-1.3 Study Objectives and Approach

The objectives of this Facility Plan are to:

- Refine project alternatives and identify a recommended project;

- Develop a financing plan for the recommended project;

- Develop an implementation plan for the recommended project.

Technical activities already performed by the City of Pacific Grove and its consultants include: site investigation, market analysis, alternative development and evaluation, stakeholder outreach, funding investigation, and preparation of an opinion of probable cost. The details and results of these activities are presented and discussed in Chapters 2 through 7 of this report.

ES-2 Recommended Project Description

The recommended project consists of the construction of a sewer diversion structure, a 0.28 million gallons per day (mgd) SRWTP, waste pump station and force main, recycled water pump station, approximately 0.25 miles of 8 inch pipeline to 6 recycled water customer sites, user connections and site retrofits. The recommended proposed project would serve approximately 125 acre-feet per year (AFY) of recycled water mostly to the City of Pacific Grove Municipal Golf Links and El Carmelo Cemetery. The predominant use of recycled water would be landscape irrigation. Irrigation would occur primarily at night to maximize water use efficiency and minimize public contact. The recommended project is the first phase of a multi-phase, long-term PGLWP that could provide up to 600 AFY of recycled water. However, because later phases of the PGLWP will require further development, their inclusion in this report is programmatic in nature and they are analyzed at a lesser level of detail than the recommended project.

Figure ES-1 presents the location of recommended project uses and facilities. Table ES-1 presents the customer names and estimated demand information. Table ES-2 describes the recommended project facilities.

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Figure ES 1 - Recommended Project Customers and Facilities

Table ES 1 – Recommended Project Customer Names and Demands

ID	Customer	Demand Type	3-Year Reported Non-Potable Water Demand (AFY)	Estimated Actual Non-Potable Water Requirement (AFY)	Peak Demand (MGD)
1	Muncipal Golf Links	Landscape Irrigation	75	90	0.179
2	El Carmelo Cemetery	Landscape Irrigation	8	10	0.020
3	Crespi Pond Restroom	Toilet Flushing	0.3	0.4	0.001
4	Truck Fill	Construction, Sewer Flushing, and Street Sweeping	20	24	0.048
5	Golf Maintenance Facility	Toilet Flushing	0.3	0.4	0.001
6	Environmental Research Division	Landscape Irrigation	0.2	0.2	0.000
	Total		104	125	0.25

Table ES 2 - Recommended Project Facilities

Description	Quantity	Units
Number of Customers	6	
Annual Average Demand	125	AFY
Peak Month Demand	0.25	MGD
Peak Hour Demand	0.43	MGD
Peak Hour Demand	136	gpm
Sewer Diversion Capacity	0.6	MGD
SRWTP (1) Average Capacity	0.114	MGD
SRWTP Peak Capacity	0.28	MGD
New Sanitary Sewer Pump Station 15.5	15	hP
New 6" Force Main	1000	LF
New Recycled Water Pump Station	30	hP
Total Recycled Water Distribution Pipeline Length	1600	LF
8" Sewer Diversion Pipeline	1370	LF
Golf Course Easement (Open Cut through Turf)	1100	LF
Asilomar (Open Cut through pavement)	270	LF
(1) SRWTP = Satellite Recycled Water Treatment Plant		

Future phases of the project would require expansion of both the SRWTP and the distribution system to provide recycled water to other non-potable demands throughout Pacific Grove and other locations.

ES-2.1 Estimated Costs

Table ES-3 summarizes the planning level opinion of probable cost for the recommended project.

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Table ES 3 - Recommended Project Planning Level Opinion of Probable Cost

Description of Expense [6]	Cost
Concrete	$ 10,700.00
Excavation and Back fill (10%)	$ 1,100.00
Miscellaneous Metals (4%)	$ 4,300.00
Yard Piping (7%)	$ 800.00
Total Concrete	$ 16,800.00
Equipment [5]	$ 1,460,000.00
Tax and Delivery (11%)	$ 160,600.00
Installation (20%)	$ 292,000.00
Manufacturer Services (4%)	$ 58,400.00
Total Mechanical	$ 1,971,000.00
Protective Coating (7%)	$ 139,100.00
Electricity (10%)	$ 197,200.00
Instrumentation (10%)	$ 198,800.00
Housing	$ 139,000.00
Subtotal	$ 2,661,900.00
Contingency (30%)	$ 798,600.00
Total Construction Cost	$ 3,480,500.00
Engineering Design (10%)	$ 348,100.00
Total Capital Cost	$ 3,828,600.00
Annualized Capital Cost	$170,900.00
Annualized O&M (5% Construction Cost)	$ 191,430.00
Capital Cost per AFY	$ 1,400.00
O&M Cost per AFY	$ 1,500.00
Total Cost per AFY	$ 2,900.00

(1) Assumes retrofit of existing clarifier/administration building per Harper Eng Estimate
(2) Assumes retrofit of existing headworks
(3) Assumes MBR cost provided by equipment supplier and include headworks through disinfection
(4) Assumes retrofit of existing digester per Harper Eng Estimate
(5) Equipment is defined as mechanical equipment or pipeline
(6) Cost Estimating Factors pursuant to Table 4-6 of Watereuse Research Foundation, Decision Support System for Selection of Satellite vs. Regional Treatment for Reuse Systems, 2009.

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ES-3 Implementation Schedule

Figure ES-2 presents the major tasks and associated project implementation schedule for the recommended project.

The following are the major tasks and milestone deliverables anticipated for the recommended project that are presented in Figure ES-2:

- Environmental analysis and documentation;
- Funding and financial planning;

- Stakeholder outreach;
- Permitting and regulatory agency coordination;
- Design and construction by a Design-Build entity.

ES-4 City Commitment

The City of Pacific Grove is enthusiastically committed to the development and operation of the proposed PGLWP. For many years, the City envisioned the development of a recycled water supply for the irrigation of its Municipal Golf Links, El Carmelo Cemetery and other public and private landscaping. In addition, the City is committed to the reuse of existing sanitary sewer, storm water, and dry weather water supplies before seeking to develop new supplies.

This commitment to developing recycled water is formally documented in the City's General Plan, Local Coastal Plan, and in the resolutions of several City Councils. The vision for the proposed project has been supported by the citizens of the City and has been refined in studies and engineering investigations. This commitment demonstrates the City's dedication to the conservation of its valuable potable water resources, the recognition of the regional importance for water conservation and desire to ensure safe and economical municipal operations.

The City's General Plan articulates as policy the goal to *"Endeavor to ensure an adequate water supply for the City's future needs"*. The City's General Plan Conservation Element notes that *"recent studies have concluded that residents of Pacific Grove cannot assume a complacent attitude toward the water resources of the area,"* and recommends that the feasibility of the use of recycled water for various uses (including irrigation of various public properties such as the Municipal Golf Course) be pursued by the City and other appropriate jurisdictions.

The City's Local Coastal Plan instituted policies related to the protection of available water supplies, providing for:

- Reserving a portion of the City's available water supply for Coastal Act priority use development;
- Permitting new development only when its water demand is consistent with available supply;
- Requiring low-water requirement/drought resistant landscaping; and
- Using recycled wastewater and captured runoff for irrigation where feasible.

The City has committed matching funds to study the feasibility of the PGLWP. On January 16, 2013, the City adopted resolution 13-002 to pursue a Facilities Planning Grant from the California SWRCB. This Facility Plan Study is intended to further analyze the feasibility of this plan based on new information and the most recent advances in water recycling

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equipment. The plan presents an initial analysis of the potential environmental effects of the PGLWP. That analysis is now being further developed for public input in a document that will meet the requirements of the California Environmental Quality Act (CEQA) Plus.

The City, in its support of the PGLWP, is consistent with the State of California's Recycled Water Policy to increase the use of recycled water, and recognizes that, pursuant to Water Code sections 13550 et seq., it is a waste and unreasonable to not use recycled water when recycled water of adequate quality is available.

It is the objective of the City of Pacific Grove to develop a local recycled water supply to benefit all of its citizens and the environment.

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CITY OF PACIFIC GROVE LOCAL WATER PROJECT PROPOSED SCHEDULE

#	Info	Title	Expected Start	Expected End	Expected Duration
0		**Pacific Grove Local Water Project**	07/01/2013	11/23/2016	3.7 years
1		Notice to Proceed	07/01/2013	07/01/2013	0 hours
2		Facility Planning Grant Report Completion	07/01/2013	02/07/2014	8 months
3		**Stakeholder Coordination**	07/01/2013	10/20/2016	3.6 years
6		**Design Development**	07/01/2013	04/04/2014	10 months
9		**CEQA Compliance**	11/18/2013	04/03/2015	1.5 years
27		**Regulatory Permitting**	07/01/2013	06/04/2015	2.1 years
32		**Design Bulid Contractor Assistance**	04/07/2014	11/23/2016	2.87 years

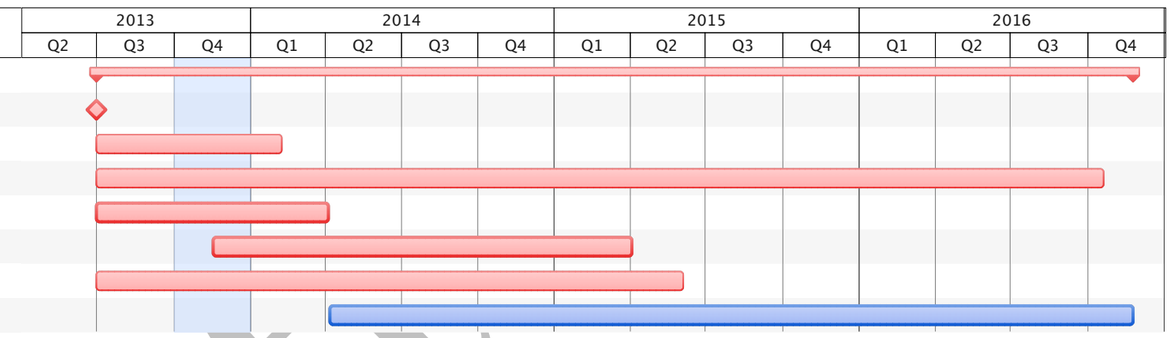

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Figure ES 2 – Implementation Schedule

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1 INTRODUCTION

The City of Pacific Grove (City) is investigating the development potential for a new recycled water supply that would substitute its current use of potable water for irrigation of non-residential landscaping and other potential non-potable uses. The Pacific Grove Local Water Project (PGLWP) could be developed in collaboration with the local water utility, California American Water Company (CAW), the Monterey Peninsula Water Management District (MPWMD) or other local agency partners, or independently by the City of Pacific Grove. The PGLWP includes the construction of a new satellite recycled water treatment plant (SRWTP) to recycle a portion of Pacific Grove's municipal wastewater. Recycled water produced at the SRWTP, located at the retired Point Pinos Wastewater Treatment Plant (WWTP), would be conveyed via a new recycled water distribution system to provide non-potable water for landscape irrigation and other non-potable uses. One future option for the new recycled water distribution system would be the extension of the system to interconnect with the existing Carmel Area Wastewater District/Pebble Beach Community Services District (CAWD/PBCSD) recycled water system, to provide CAWD/PBCSD and the City with diverse water sources, additional operational and seasonal storage, and supply redundancy.

This report has been completed in accordance with the requirements of the State Water Resources Control Board (SWRCB) Facilities Planning Grant Program.

1.1 Background

The City of Pacific Grove is located on the tip of the Monterey Peninsula on the Central California Coast (Figure 1). The City is bound on the north by Monterey Bay, on the east by the City of Monterey, on the south by the unincorporated Pebble Beach Community and the Del Monte Forest, and on the west by the Pacific Ocean. The City is approximately 2.9 square miles in area with a population of approximately 15,300 residents.

The region is totally dependent on local rainfall for replenishment of its water supplies. Rainfall patterns have resulted in severe droughts. Near coastal groundwater pumping has resulted in increasing total dissolved solids (TDS) concentrations, seawater intrusion and overdraft of the local aquifers (MRWPCA, 2012). Diversions and pumping of the under drain of the Carmel River has put critical habitat at risk, as well as federal and state listed endangered and threatened species.

The City's water purveyor, CAW, is now subject to pumping restrictions pursuant SWRCB Order 95-10, the related issuance of a Cease and Desist Order (CDO) by the SWRCB (Order WR2009-0060), and their reduced pumping of the Seaside Groundwater Basin (SGWB), mandated by its adjudication.

On August 29, 2012, the City submitted a Public Participants Proposal in response to the California Public Utilities Commission's (CPUC) administrative law judge Gary Weatherford ruling concerning public participation in the CAW Application 12-04-019.

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The City proposed the PGLWP to provide non-potable recycled water supplies to supplement CAW's planned Monterey Peninsula Water Supply Project (MPWSP).

The PGLWP will replace City irrigation and other demands with non-potable supplies creating a new water supply offset of at least 125 acre-feet per year (AFY) (average annual demand) of potable water. The potable water offset would assist CAW in meeting its obligations to find a replacement to its use of water from the Carmel River and reduce pumping in the SGWB. Once CAW has implemented a replacement water supply to its pumping on the Carmel River and SGWB, and through further negotiations with the SWRCB, CAW, and the MPWMD, a portion or all of the offset may become available for use by the City to meet future potable demands. The PGLWP would reduce the operational production of CAW's proposed seawater desalination plant by at least 125 AFY.

The goals of the PGLWP are:

- To preserve available potable water supplies for domestic uses and to maximize the recycling and reuse of non-potable recycled municipal wastewater in a cost effective manner.

- To substitute the City's use of CAW potable water with recycled water for non-potable water demands.

- To maximize the use of existing wastewater collection, treatment, recycling and recycled water distribution infrastructure for the development of irrigation water and other non-potable demands.

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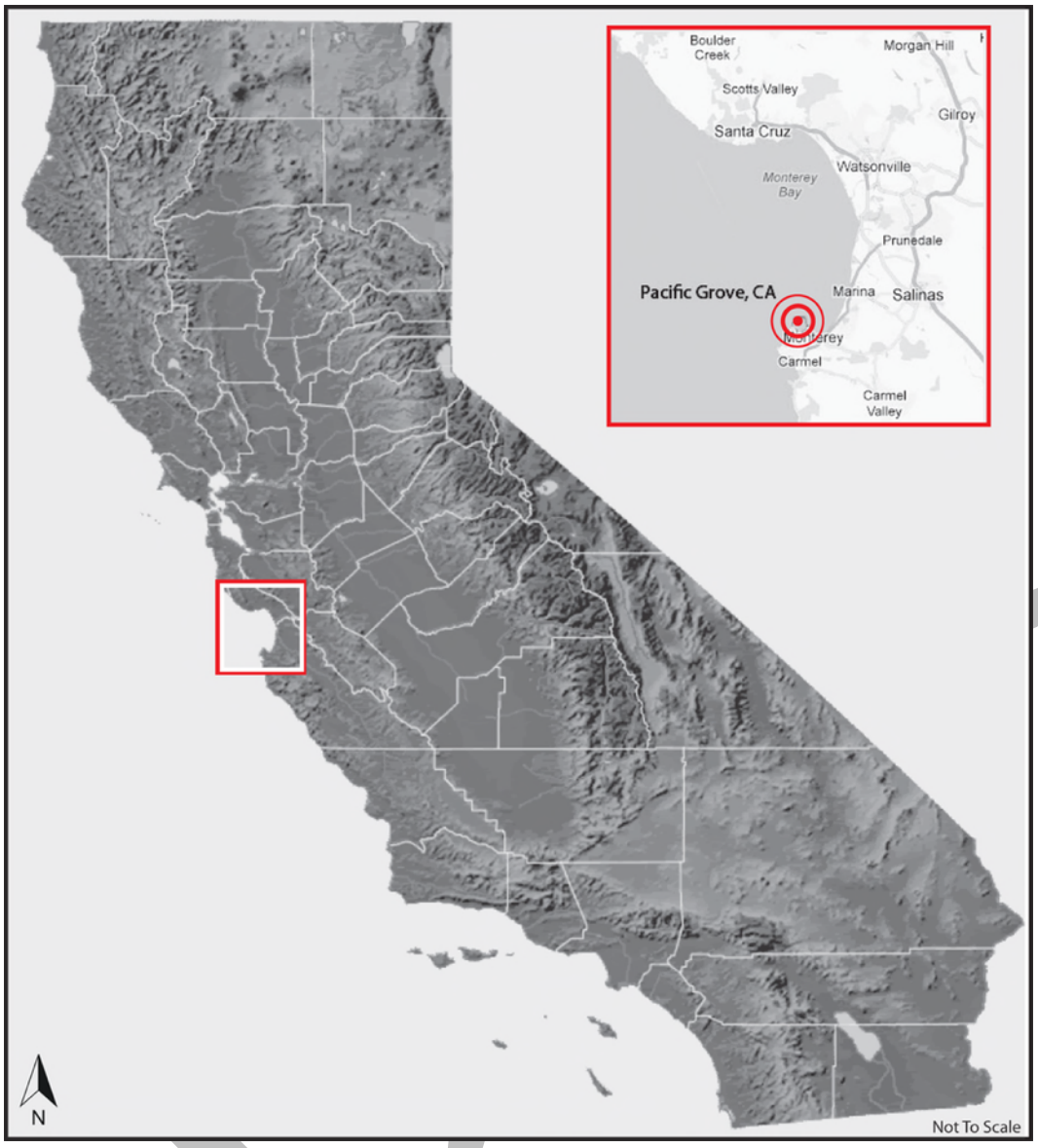

Figure 1 -Project Location

1.2 Facility Plan Objectives and Approach

The objectives of this Facility Plan are to investigate the cost effectiveness of implementing a new SRWTP and distribution system. The key objectives of this Facility Plan are:

- Refine project alternatives and identify a recommended project;
- Develop a financing plan for the recommended project;
- Develop an implementation plan for the recommended project.

This Facility Plan includes results from site investigations, recycled water market assessment, alternative analysis, stakeholder coordination, preliminary environmental and regulatory analysis, economic analysis, and funding plan.

This Facility Plan is based upon initial investigations completed by the City and CAW that produced early definitions of the project components. It also relies upon current investigations of the Monterey and Pacific Grove Area of Special Biological Significance (ASBS) Storm Water Management Project being completed by the Cities of Monterey and Pacific Grove as part of the Southern Monterey Bay/Monterey Peninsula Regional Integrated Water Resources Management Plan (IWRMP). This Facility Plan refines the project components, cost estimates, and project implementation plan for the PGLWP.

1.3 Stakeholder Involvement

The City has actively included project stakeholders in the development of this Facility Plan. The City conducted meetings with project stakeholders to identify support for this project and to address potential concerns and opportunities for collaboration. The following stakeholders have been included within the development of this project:

- California American Water Company (CAW)
- Monterey Peninsula Water Management District (MPWMD)
- Monterey Regional Water Pollution Control Agency (MRWPCA)
- Carmel Area Wastewater District (CAWD)
- Pebble Beach Community Services District (PBCSD)
- Pebble Beach Company (PBC)
- Presidio of Monterey (POM)
- Pacific Grove Unified School District (PGUSD)
- Monterey Peninsula Regional Water Authority (also known as the Mayor's JPA)
- City of Monterey
- California Public Utilities Commission (CPUC).

As part of the development of this Facility Plan, the City met with the above stakeholders on various aspects of the PGLWP to determine opportunities for collaboration and participation in the project. In particular, these meetings investigated opportunities to service additional non-potable water demands and other water supply goals and objectives within the Monterey Peninsula region.

The PGLWP was first developed as part of CAW's proposed MPWSP and approval process by CPUC. The City of Pacific Grove made a public participation proposal to include the PGLWP in the MPWSP. The City and their consultants submitted direct testimony to CPUC providing detailed information regarding the PGLWP. Through a

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settlement agreement process, the City is pursuing the PGLWP independently of the MPWSP, with cooperation from CAW.

City staff is providing regular updates on the status of the PGLWP to its City Council and the public at City Council meetings. The City Council approved a resolution to pursue the SWRCB Facility Planning Grant (FPG) for the completion of this Facility Plan Study on January 16, 2013. Updates to the PGLWP, as well background documents, are posted to the City's website for the public at the following link: http://www.ci.pg.ca.us/index.aspx?page=333.

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2 STUDY AREA CHARACTERISTICS

The City of Pacific Grove's water supplies and wastewater treatment are provided by other regional entities. This chapter presents a summary of the service area settings and provides a discussion of the region's water supplies and wastewater management issues that are pertinent to the City and the PGLWP.

2.1 Service Area Setting

The PGLWP study area is presented in Figure 2. The PGLWP study area includes the City, portions of the service region of CAWD/PBCSD and the PBC, portions of the City of Monterey, and the POM.

The weather of the PGLWP study area is influenced by a marine climate that is pronounced due to the upwelling of cold water from the Monterey submarine canyon. A weather station is located at the National Weather Service's Climate Station in the City of Monterey, elevation 385 feet above mean sea level (AMSL). The warmest month is September, with an average daily high of 71.5°F. The average daily low temperatures are 43°F in January and 53°F in September. Average rainfall is 19.7 inches per year, with 90.3% falling during November through April. During summer, fog drip is a primary source of moisture for plants that would otherwise not be able to persist with such low summer precipitation. (CAW 2010 UWMP Update, 2012)

The PGLWP study area, including but not limited to the City, is comprised of residential, office and commercial land uses, golf courses, recreational parks, schools, military installments, and open space reserves. Within Pacific Grove, the current population is 15,295 (US Census Bureau, 2011).

The prominent water feature is the Monterey Bay and Pacific Ocean coastline adjacent to the City. Along the Monterey Bay side of the City's coast, the near shore waters have been designated by the SWRCB as the Pacific Grove ASBS (Figure 3). The Pacific Grove ASBS lies entirely within the Monterey Bay National Marine Sanctuary, and overlaps with the Pacific Grove State Marine Conservation Area and Hopkins State Marine Reserve. ASBS areas are accorded special protection under the Marine Managed Areas Improvement Act and the California Ocean Plan (COP). The special protections defined in the COP prohibit waste discharges to the ASBS. Storm water discharges into ASBS areas are allowed under a SWRCB adopted General Exception to the COP waste discharge prohibition, with Special Protections that require both structural and non-structural controls to protect "natural water quality" within the ASBS.

The PGLWP study area also includes Crespi Pond (See Figure 2), a brackish to fresh water pond located on the Golf Links between Point Pinos and the north end of Asilomar Avenue. Crespi Pond is habitat to a number of bird species and is managed by the City.

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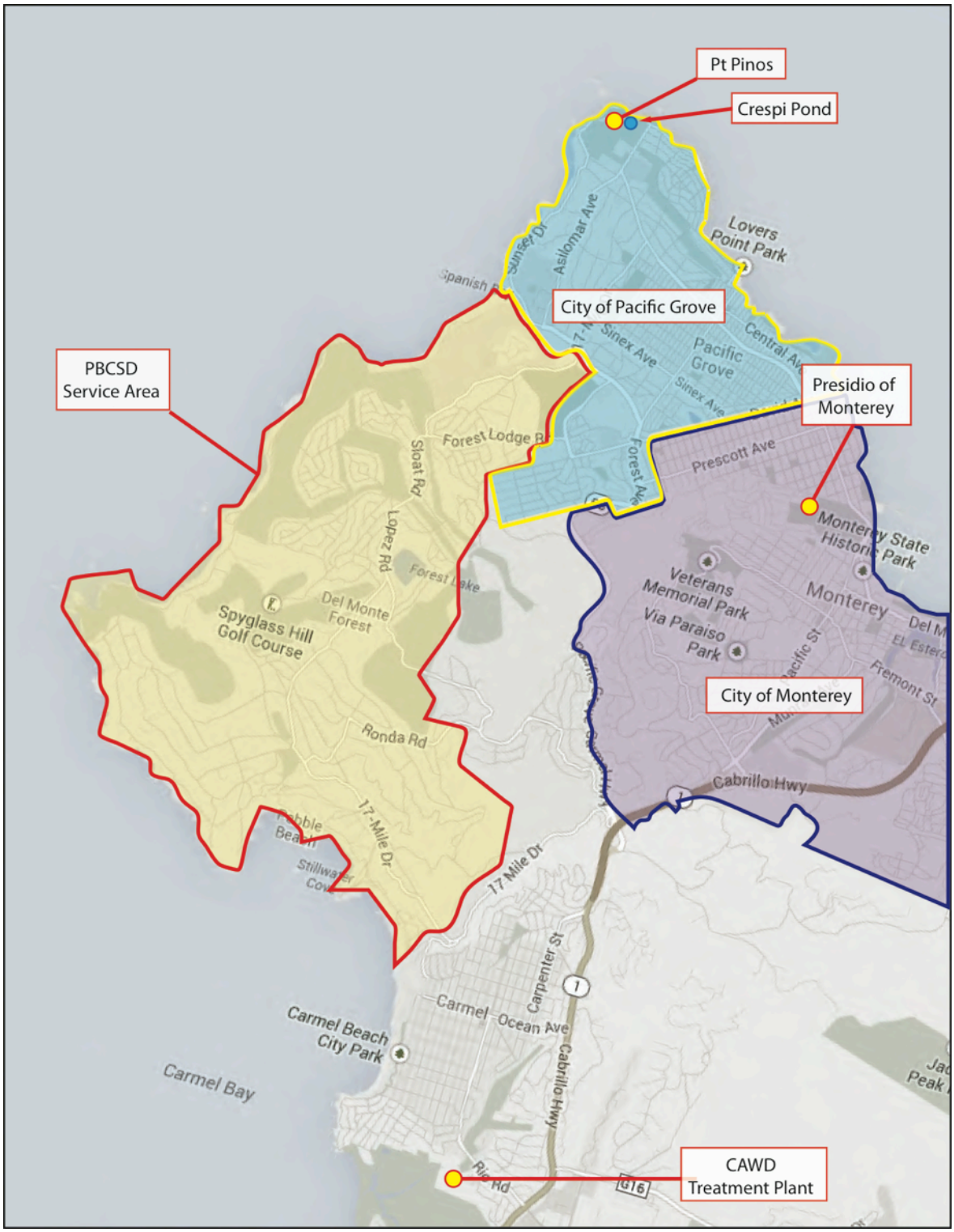

Figure 2 - PGLWP Vicinity Map

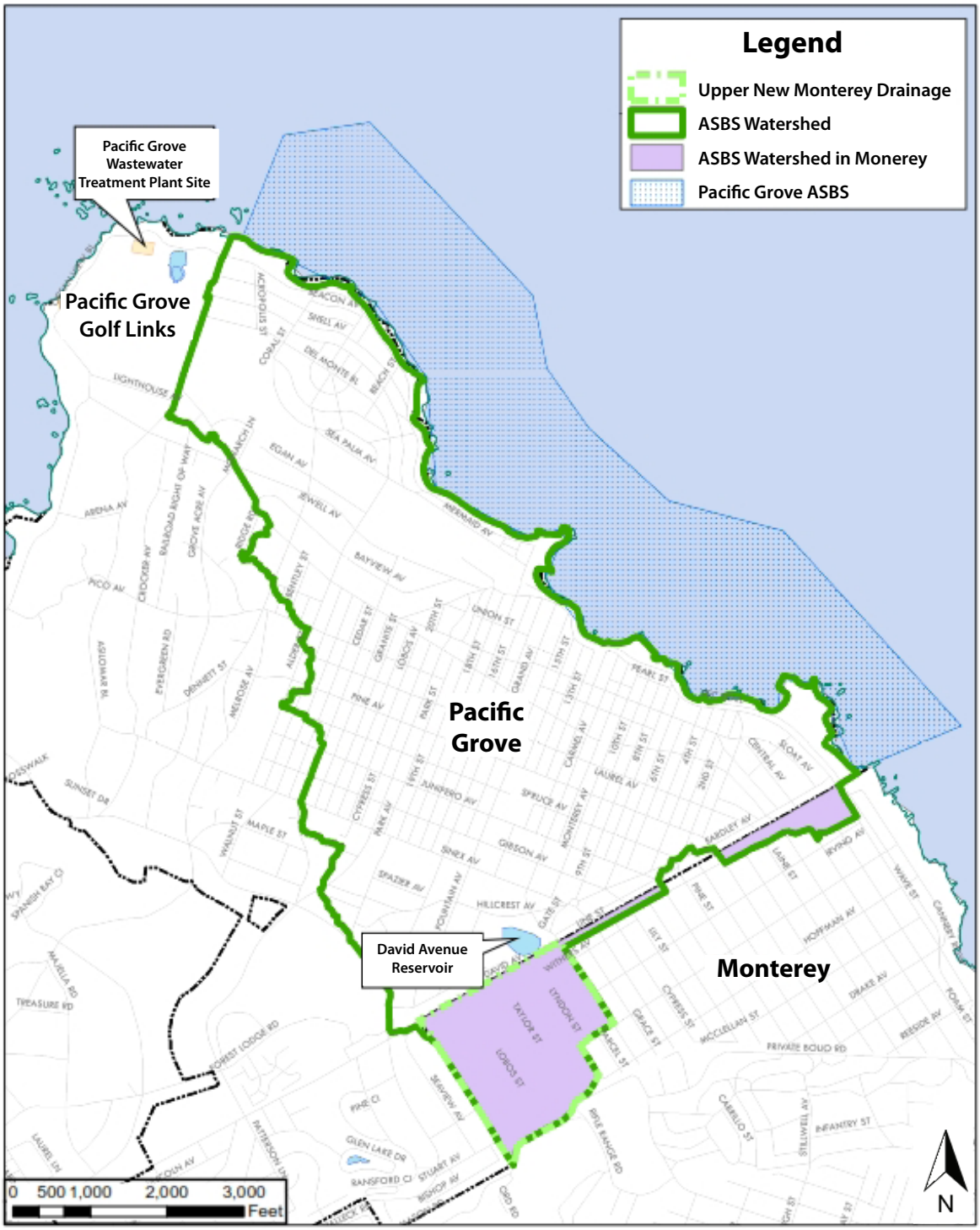

Figure 3 - Pacific Grove ASBS (Source: Fall Creek Engineering, 2013)

2.2 Potable Water Supply Characteristics and Facilities

Potable water is supplied to the City of Pacific Grove by CAW. CAW delivers water to Pacific Grove through a 30-inch steel main in Congress Avenue that transports water to the CAW pumping facility at Sinex and Eardley Avenues. The purpose of the PGLWP is to reduce the City's potable water use and contribute to a regional decrease of potable water use.

CAW collects, treats and distributes water for public and private use and fire suppression within its service area. Through franchise agreements with the jurisdictions in its service area, the CAW Monterey District serves the six cities of Carmel-by-the-Sea, Pacific Grove, Monterey, Seaside, Sand City, Del Rey Oaks, the county areas of the Carmel Valley, Pebble Beach, Carmel Highlands, and the satellite systems of Garrapata, Chualar and the Highway 68 corridor.

The CAW system and the development of water supplies in the Monterey Region dates back to 1882, when the Pacific Improvement Company provided water service to users with its construction of pipelines from the headwaters of the Carmel River to the Del Monte Hotel. The water operation was renamed Monterey County Water Works in 1905. Samuel F. B. Morse headed a group of investors who bought the waterworks along with seven thousand acres of land and the Del Monte Hotel in 1915. In 1930, Chester Loveland acquired the water works company. The District then became the property of California Water and Telephone Company in 1935 and in 1966 was part of a major acquisition by American Water Works Company, Inc. CAW is a subsidiary of American Water Company.

CAW's Central Division's Monterey District is the franchise water purveyor to the entire study area, as well as most of the population on the Monterey Peninsula. CAW is a private utility company that operates under the regulations of the CPUC. The total population served by CAW's Monterey Main system was approximately 94,081 in 2010. The Monterey Main system encompasses 33,950 acres.

Supplies for the Monterey District are developed from surface water from the Carmel River, shallow wells in the Carmel Valley, mid-depth and deep wells in the SGWB.

Water production from these sources is limited by various governmental regulations and annual rainfall amounts. Water supplies have been especially constrained since 1995, when the SWRCB determined that CAW was illegally diverting over 10,000 AFY from the Carmel River Basin in SWRCB Board Order 95-10. Most of the Carmel River withdrawal comes from shallow wells positioned near the Carmel River. This Order determined that withdrawal of water from the Carmel Valley is destructive to the habitat along the river and threatens endangered species. The order also determined that wells in the Carmel Valley are pumping river underflow and not withdrawing from an underground aquifer.

CAW is mandated to develop new water supplies for the Monterey District service area in

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order to decrease its reliance on the Carmel River and the SGWB. [1] Pursuant to Cease and Desist Order 2009-0060 issued on October 20, 2009, by the SWRCB, CAW is required to reduce its unpermitted diversions from the Carmel River and to terminate all diversions in excess of 3,376 AFY from the Carmel River. CAW must therefore find a replacement for approximately 70 percent of its water supply by December 31, 2016. The MPWSP is CAW's proposal for a replacement supply. Failure to meet the 2016 deadline could have harmful consequences for CAW, its customers, and the community. The SWRCB may include civil penalties for such a violation.

While CAW is a public utility regulated by the CPUC, at a local level the MPWMD also provides regulatory oversight of water supplies within the region. The California Legislature created the MPWMD in 1977 for the purposes of "conserving and augmenting the supplies by integrated management of ground and surface water supplies, for control and conservation of storm and wastewater, and for the promotion of the reuse and reclamation of water." [2]

MPWMD governs withdrawals from the surface and groundwater supplies in the Monterey Peninsula region. Figure 4 illustrates the Monterey Peninsula Water Resources System, which is managed by the MPWMD and from which CAW takes about 95% of its water. The other 5% is taken from areas that serve CAW's satellite systems in other areas of Monterey County. The boundaries of MPWMD roughly align with those of CAW's Monterey County District, exclusive of CAW's satellite systems of Toro, Ambler Park, and Chualar.

MPWMD was responsible for the establishment of limits to CAW production from the Carmel River and subsequent allocation of water to jurisdictions in 1990. They provided the leadership in developing certain water supplies including the following:

- Research and development into the expansion of the Peralta Well in the SGWB in the late 1980s,
- A desalination facility rejected by the voters in 1993,
- The Los Padres Dam rejected by the voters in 1995,
- The research, development, and construction of Aquifer Storage and Recovery (ASR) in the 2000s, and,
- Co-funding partnership with MRWPCA in the development of the Groundwater Replenishment (GWR) Project subject to the Memorandum between CAW, MRWPCA, and MPWMD dated April 20, 2012.

[1] the Seaside Basin Adjudication in California American Water v. City of Seaside, et al. (Monterey Superior Court, Case No. M66343).
[2] (Statutes 1977, ch. 527, section2, Deering's Water – Uncod. Acts (2008 Suppl.) Acts 5065, p.98-99 ("District Law").)

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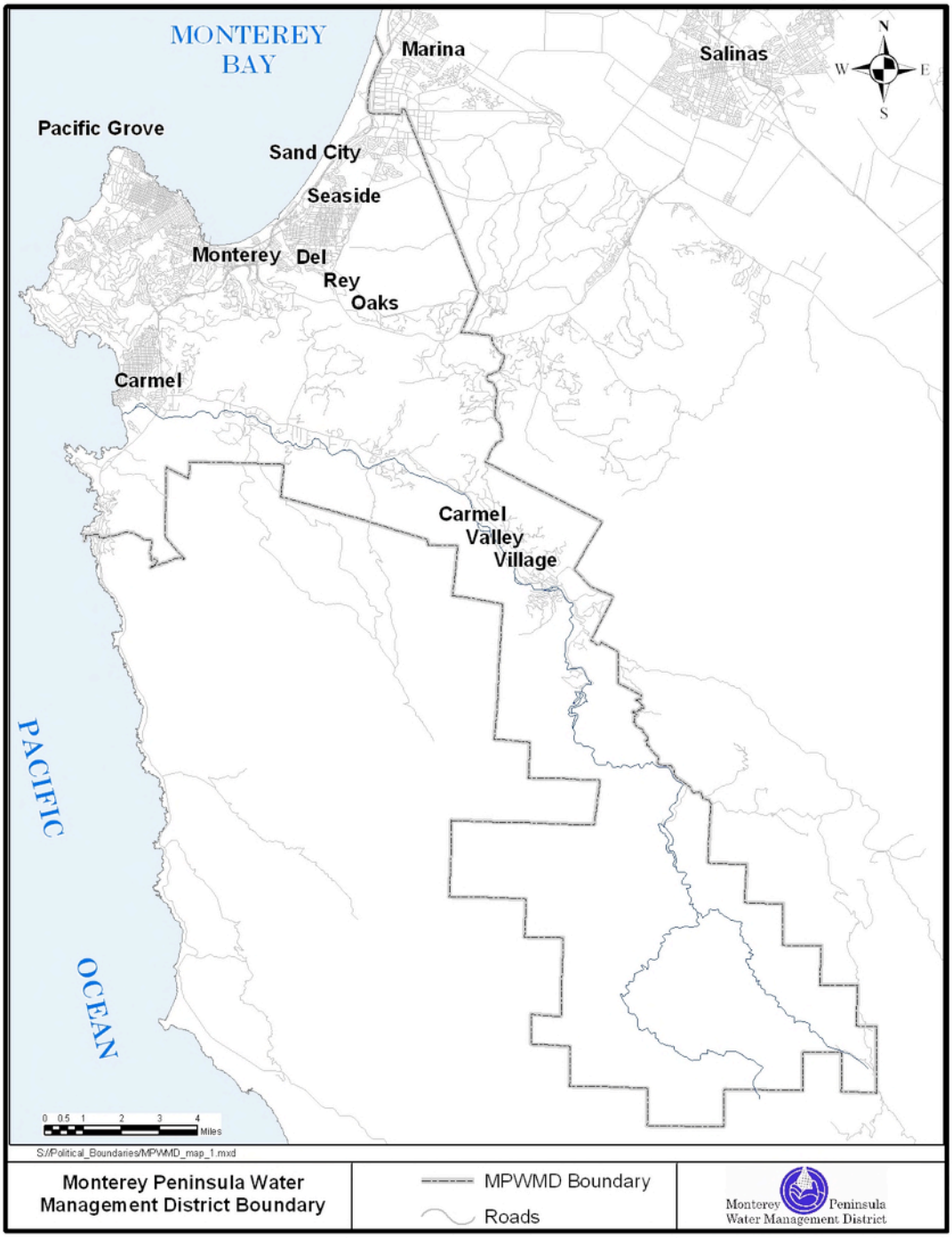

Figure 4 - MPWMD Boundary (Source: MPWMD)

Development of an alternative water supply is necessary for CAW to comply with SWRCB Order No. WR 95-10 and No. 2009-0060 that directed CAW to implement a plan to replace what the SWRCB determined to be unlawful diversions from the Carmel River Basin, as well as with the SGWB 2006 Adjudication. The MPWSP is CAW's proposal for a replacement supply.

The MPWSP will consist of the following two major elements:

(1) A seawater desalination plant and related facilities, consisting of slant intake wells, brackish water pipelines, the desalination treatment plant, product water pipelines, brine disposal, and related appurtenant facilities. The plant will be owned and operated by CAW and will require a 10-mile pipeline to deliver product water to the Monterey Peninsula.

(2) "Distribution and ASR Facilities", consisting of the Transfer, Seaside and the Monterey Pipelines, the Terminal Reservoir, the ASR Pipeline, the ASR Recirculation and Backflush Pipelines, the ASR Pump Station and the Valley Greens Pump Station. These facilities previously approved by the CPUC.

The following regional projects are proposed to complement the MPWSP in meeting CAW's replacement water from the Carmel River:

- An expanded ASR, capturing excess winter flows from the Carmel River for storage in the Seaside Aquifer and withdrawal during the dry summer months. CAW will construct three ASR wells, adding an average annual supply of 900 AFY.

- A MRWPCA GWR Project is expected to yield approximately 3,500 AFY. Source waters will be treated at a new Advanced Water Treatment Plant at the MRWPCA Regional Treatment Plant (RTP). The treated effluent will be conveyed to groundwater injection well sites for storage within the regional groundwater basin.

CAW submitted applications to the CPUC for the following sizing options of the MPWSP's desalination plant:

- 9.0 mgd;
- 5.4 mgd with supplement water supplies purchased from the GWR, if the GWR reaches certain milestones by the time CAW is ready to construct the desalination plant, and the cost of GWR water is reasonable.;
- 9.6 mgd without water from the GWR Project; and
- 6.4 mgd with 3,500 AFY of water from the GWR Project;
- 6.9 mgd plant to be combined with 3,000 AFY of water from the GWR Project.

Table 1 presents CAW's existing and future water supply sources.

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Table 1 – CAW's Existing and Future Regional Water Supply Sources

Water Supply Source	Existing Supply -2010 (AFY)	Anticipated Supply – 2020 (AFY)
Carmel Valley Basin	8,253	3,376
Seaside Groundwater Basin	2,811	2,999
Salinas Groundwater Basin	529	465
Aquifer Storage and Recovery	1,106	1,920
Sand City Desalination	99	94
Ocean Desalination/Groundwater Replenishment	0	9,000
Source: CAW UWMP 2010 Update, July 2012		

2.2.1 Carmel Valley Basin

The Carmel Valley Basin is located along the Carmel River, southeast of the Monterey Peninsula. CAW's Monterey Main system overlies the Carmel Valley Basin. The Carmel Valley Basin is comprised of the alluvial deposits that form the valley floor underlying the Carmel River. The Carmel Valley Basin is presented in Figure 5.

As described previously, CAW is required to reduce diversions from the Carmel Valley Basin to 3,376 AFY by December 31, 2016. To meet the reduction requirement, the CAW's Monterey County District is pursuing the MPWSP, in coordination with MPWMD's ASR project and MRWPCA's GWR Project.

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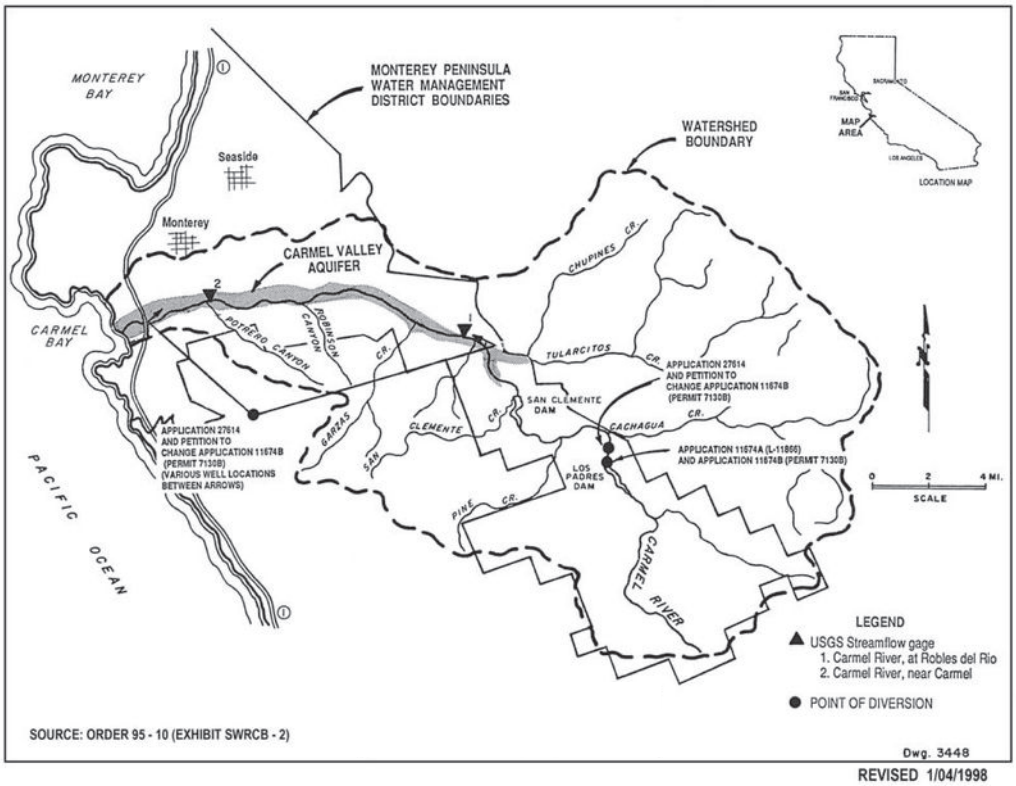

Figure 5 - Carmel Valley Basin (Source: CAW UWMP 2010 Update)

2.2.2 Groundwater

CAW's Monterey County District is supplied in part by the SGWB. The California Department of Water Resources (DWR) issued Bulletin 118 in 2003, which describes the SGWB as being a sub-basin to the Salinas Valley Groundwater Basin (SVGWB). The northern boundary of this sub-basin is the 180/400 Foot Aquifer sub-basin and the southern boundary is the Corral de Tierra sub-basin, both part of the SVGWB. Figure 6 presents each of these groundwater basins. The Monterey Main and Ryan Ranch systems overlie the SGWB as defined by DWR.

The 2006 SGWB Adjudication Order defines the boundaries of the SGWB Aquifer. The SGWB is located at the northwest corner of the Salinas Valley, adjacent to the Monterey Peninsula. The total surface area of the aquifer covers approximately 19 square-miles. The southern boundary of the SGWB follows the Chupines fault, a relatively impermeable formation uplifted to near sea level. The western boundary of the basin extends to the shoreline of the Pacific Ocean. The eastern boundary of the basin is defined by the flow divide in the Paso Robles aquifer, which approximately coincides with surface drainage between the Canyon del Rey and El Toro Creek watersheds. The northern boundary of the basin also follows a groundwater flow divide from the SVGWB. The SGWB is subdivided into several sub-basins including the Laguna Seca, Coastal, and Inland subareas.

In the SGWB adjudication, the Monterey County District's operating yield in 2010 for the Coastal and Laguna Seca sub-basins were reduced to 3,087 and 246 AFY, respectively. Under the terms of the adjudication, the Monterey County District's share of the SGWB operating yield will decrease by 10% every three years to the ultimate safe yield of 1,494 AFY for the Coastal sub-basin and 0 AFY for the Laguna Seca sub-basin.

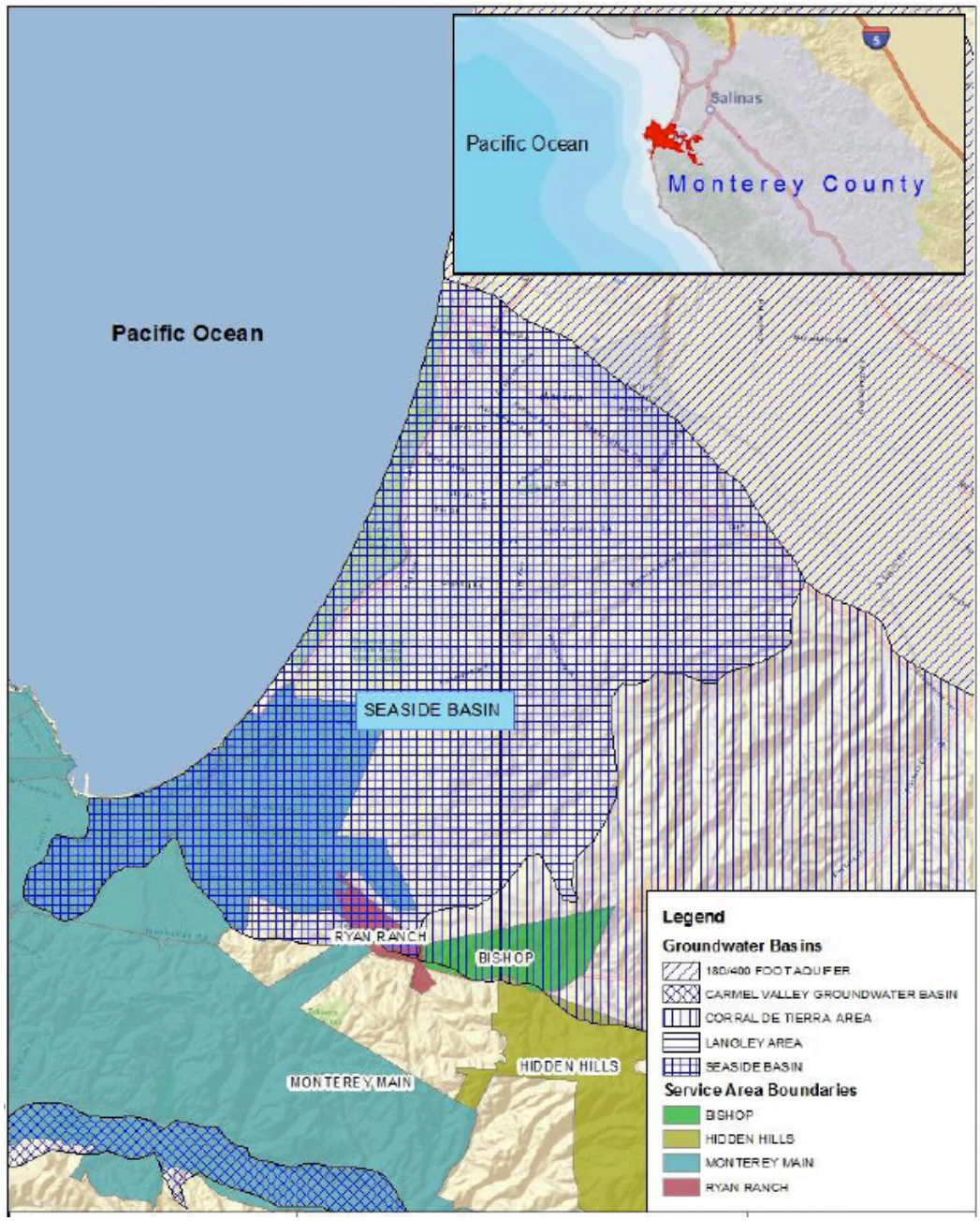

Figure 6 – Groundwater Basins (Source: CAW UWMP 2010 Update)

2.3 Wastewater Characteristics and Facilities

2.3.1 City of Pacific Grove and MRWPCA Facilities

The MRWPCA serves the cities of Del Rey Oaks, Monterey, Pacific Grove, Sand City, Seaside, Salinas and Marina, the former Fort Ord, and parts of Monterey County, such as Boronda, Castroville, and Moss Landing. From 2000 to 2005 influent to the RTP averaged 21.2 mgd, while the plant's maximum treatment capacity is 29.6 mgd. Figure 7 presents the MRWPCA service area.

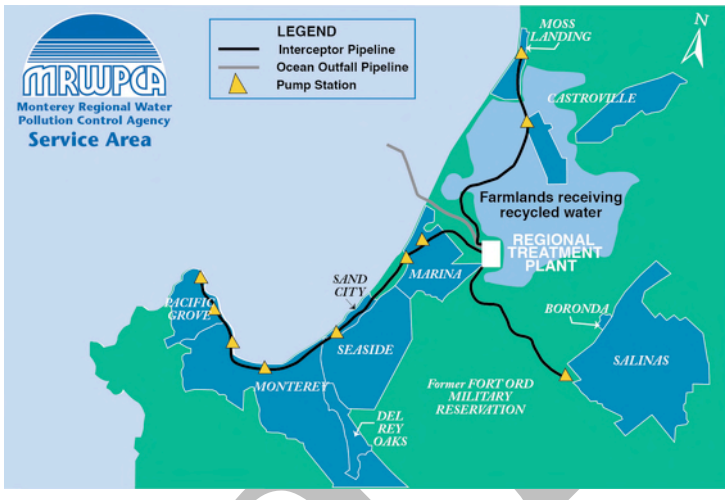

Figure 7 - MRWPCA Service Area

The City of Pacific Grove owns, operates, and maintains the wastewater collection system located within its boundaries. The system consists of approximately 58 miles of pipelines, 900 manholes, and 5 pump stations. Figure 8 presents the City's wastewater collection system. Two additional regional pump stations are owned by the MRWPCA. Wastewater collected throughout the City is conveyed for treatment to the MRWPCA RTP north of the City of Marina. A regional interceptor pipeline is located along the coast of the Cities of Pacific Grove, Monterey, Seaside, and Marina.

Prior to construction of MRWPCA's RTP, City wastewater was treated at the Point Pinos WWTP. The Point Pinos WWTP was built in 1952 with a treatment capacity of 2 mgd. Treatment consisted of the following processes:

- Headworks with bar screen, grit removal and comminutor,
- 210,000 gallon clarifier with disinfection,
- 430,000 gallon sludge digester.

Treated effluent was discharged through an outfall to the Pacific Ocean. The Point Pinos WWTP was retired in 1980 with the City's connection to the RTP. However, the City maintains ownership of the land and facilities. The City uses the site as a maintenance and storage facility for its public works field operations. Figure 9 presents the existing conditions of the Point Pinos WWTP. Figure 10 presents the existing site plan for the Point Pinos WWTP.

Figure 8 – The City of Pacific Grove Sewer and Storm Water Utilities
Source: City of Pacific Grove

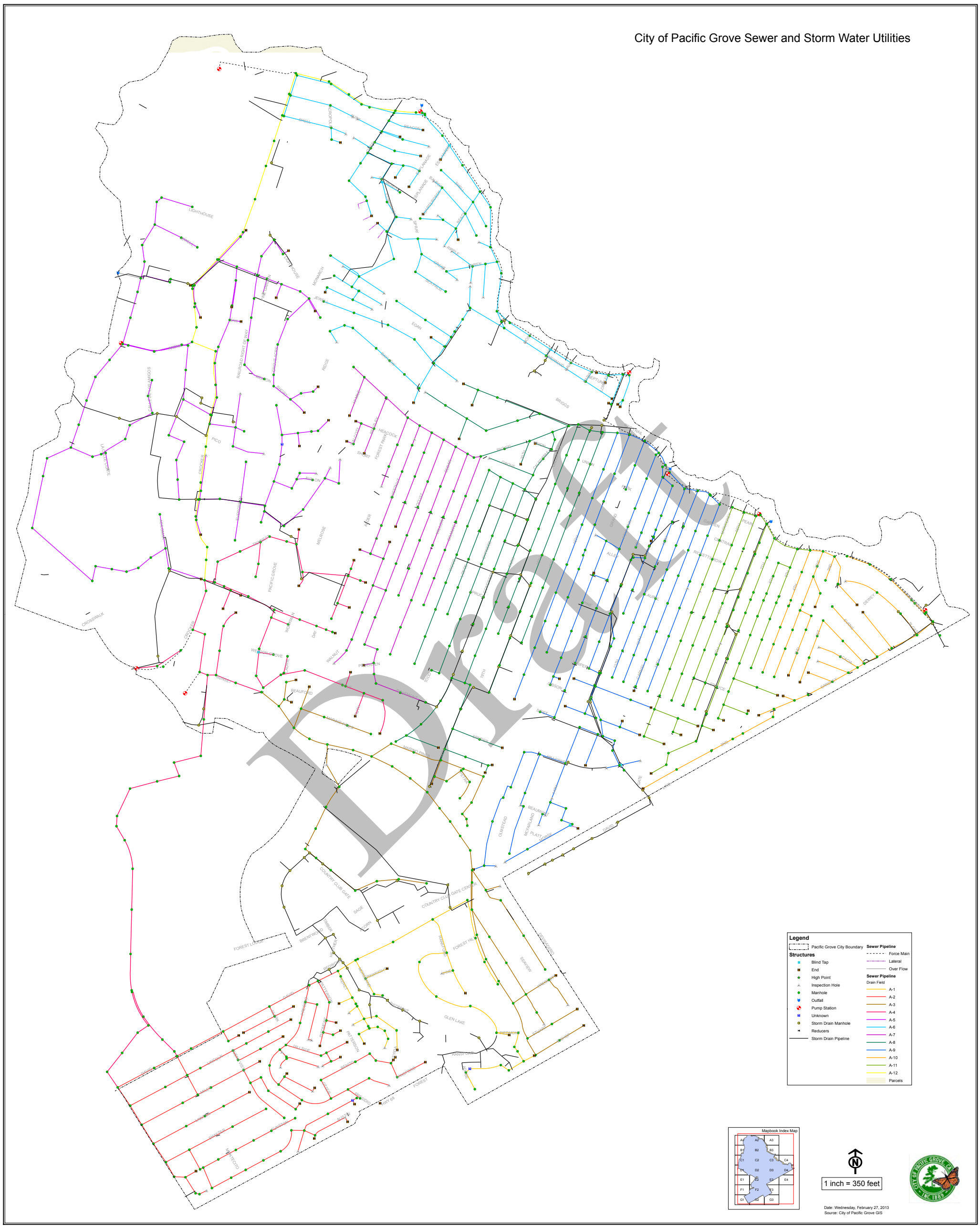

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Figure 9 - Point Pinos WWTP Existing Conditions

Figure 10 - Existing Point Pinos Site Plan

2.3.1.1 Castroville Seawater Intrusion Project (CSIP)

In 1992, MRWPCA and the Monterey County Water Resources Agency (MCWRA) formed a partnership to build two projects: a water recycling facility at the RTP; and a recycled water distribution system including 45 miles of pipeline and 22 supplemental wells. The objective of these projects, known as the Castroville Seawater Intrusion Project (CSIP), was to slow the inland advance of seawater intrusion by supplying irrigation water to nearly 12,000 acres of farmland in the northern Salinas Valley. This project significantly reduced the withdrawal of water from the underground aquifers. The project was completed in 1997 and has been successful at reducing seawater infiltration.

MRWPCA operates a 29.6 mgd recycled water plant, designed for raw food crop irrigation. The overall treatment process consists of gravity separation, secondary treatment, a mixed media filter, and chlorine disinfection. Treated effluent is held in a temporary 80 AF storage pond before being distributed for agricultural irrigation.

2.3.2 CAWD and PBCSD

CAWD provides wastewater collection, treatment and disposal for 11,000 people within its service area. Its service area consists of the City of Carmel-by-the-Sea and outlying County areas of Carmel Woods, Hatton Fields, portions of lower Carmel Valley, Carmel Meadows, Hacienda Carmel, Del Mesa Carmel, Quail Meadows, Pacific Meadows, Highlands Inn, the Tickle Pink Inn and the Highlands Sanitary Association. Additionally, several individual lots in the vicinity are also provided service. CAWD also provides wastewater treatment and disposal by contract agreement with PBCSD for 4,500 people in Del Monte Forest.

PBCSD provides the wastewater collection service for the Pebble Beach Community. PBCSD owns and maintains 74 miles of sewer collection and interceptor pipelines and eight lift stations. As previously mentioned, PBCSD contracts with CAWD for wastewater treatment services. Table 2 presents existing and future wastewater flows for the MRWPCA and CAWD/PBCSD.

Table 2 - Existing and Future MRWPCA and CAWD/PBCSD Wastewater Flows (AFY)

	YEAR					
Service Area	2005	2010	2015	2020	2025	2030
CAWD	1,761	1,803	1,997	2,189	2,382	2,574
MRWPCA	5,812	6,146	6,240	6,328	6,417	6,505
Source: CAW UWMP 2010 Update, July 2012						

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CAWD provides primary treatment, secondary treatment (activated sludge), disinfection and advanced wastewater treatment to Title 22 compliant standards. Almost all treated wastewater is sent to Del Monte Forest where it is used to irrigate eight golf courses: Pebble Beach Golf Links, Poppy Hill, The Links at Spanish Bay, Spyglass Hills, Peter Hay Golf Course, Cypress Point, and the Monterey Peninsula Country Club (Shore Course and Dunes Course).

CAWD and PBCSD operate a newly constructed Microfiltration/Reverse Osmosis (MF/RO) facility designed to produce 1.5 mgd of blended recycled water to a sodium ion concentration content of not more than 55 milligrams per liter (mg/l). The plant can also operate to produce 1.9 mgd of recycled water, with sodium content between 120 to 150 mg/l. The recycled blend is composed of MF filtrate and RO permeate at a ratio determined by the influent, target effluent sodium content, and the total flow volume received by the treatment plant.

All of the recycled water in conveyed to golf courses and other recreational open spaces within Pebble Beach for irrigation. During the winter months, recycled water is stored in the 375 AF capacity Forest Lake reservoir to meet seasonal demands.

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3 TREATMENT REQUIREMENTS FOR DISCHARGE AND REUSE

The City is pursuing the construction of a new SRWTP for the production of recycled water from its raw municipal wastewater. Since the recycled water is intended to be used as a replacement for potable water at non-potable water demands such as irrigation, toilet flushing, and industrial use, it must provide a level of treatment consistent with the requirements of the State of California pursuant to Recycling Criteria as specified in Title 22 of California Code of Regulations (CCR) Division 4; Environmental Health Chapter 3. The recycled water quality will need to meet the requirements for unrestricted use due to the proposed use of the recycled water for irrigation of an unrestricted access golf course. This will require a treatment level to disinfected tertiary recycled water.

Any waste streams from the PGLWP will be discharged to the MRWPCA regional collection system for treatment at the RTP. Coordination with MRWPCA on discharge to their system is therefore also being considered in the design and approval of the SRWTP facility.

This chapter presents a description of the regulatory framework for the production of recycled water, its treatment and planned reuse within the PGLWP's service area.

3.1 Required Water Quality

In addition to meeting the unrestricted use requirements, the effective use of the PGLWP recycled water will require production of a recycled water quality consistent with the tolerance of the most sensitive species of plant intended for irrigation. Consideration is being made of the ability to produce recycled water that is low in sodium, chlorides, has a low sodium adsorption ratio (SAR), and is not toxic to plants.

Salinity is a measure of the soluble salt concentration in water or soils. The salinity of a water sample is a measure of its TDS. TDS is measured in mg/L, parts per million (ppm), or as a function of electrical conductivity (EC). Dissolved solids, added from various sources during domestic and other water uses are generally not reduced during conventional wastewater treatment and recycling processes. As a result, recycled water generally has a higher concentration of TDS as compared to the potable water that was its source. As salinity levels increase, irrigated plants need to use more energy to concentrate solution in root cells allowing them to take up water from the soil for growth and transpiration. High salinity levels result in plant growth reduction and observable symptoms similar in appearance to those from drought conditions.

Sodicity is a condition where sodium is dominant in the soils and irrigation water results in waterlogging and poor drainage. Sodicity is usually expressed by SAR, which is the ratio of a soil's sodium concentration to the calcium and magnesium concentrations. Lower salinity in the irrigation water and a lower SAR decreases the likelihood of water infiltration problems. An adjusted SAR not to exceed 3 is typically recommended for golf course irrigation.

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3.2 Treatment and Operational Requirements

Recycled water production and use in California are governed by California Department of Public Health (CDPH) regulations and guidelines. Title 22, Division 4, Chapter 3 and Title 17, Division 1, Chapter 5 of the CCR serve as the sources for regulations relating to recycled water production and use. Current regulations, including Title 22 and Title 17, are compiled by the CDPH, in the publication California Health Laws Related to Recycled Water "The Purple Book" updated in 2009.

The recycled water produced at the proposed SRWTP will meet the requirements for disinfected tertiary recycled water and is therefore suitable for use on unrestricted access golf courses, parks and playfield, school grounds, and other irrigation uses, as well as approved dual plumbed uses for toilet and urinal flushing and industrial reuse. The SRWTP will adhere to the following disinfection criteria prescribed by the CDPH:

- Filtered wastewater will be disinfected by either:
    - A chlorine disinfection process following filtration that provides a modal contact time (CT) – the product of total chlorine residual (C) and contact time (T) measured at the same point – of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow; or
    - A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and /or remove 99.999% (or a 5-log reduction) of the plaque-forming units of F-specific bacteriophage MS2 virus[3], or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of demonstration.

The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed a most probable number (MPN) of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MNP of 23 per 100 milliliters in more than one sample in any one 30-day period. No sample shall exceed an MPN of 230 total coliform bacteria per 100 milliliters.

The disinfected tertiary recycled water produced at the proposed Pacific Grove SRWTP will be permitted for all irrigation and industrial uses that were identified in the market analysis contained in this report.

3.3 Waste Discharge Requirements

A new Waste Discharge Requirement (WDR) permit for the use of recycled water would need to be issued by the Central Coast Regional Water Quality Control Board (RWQCB) to the City of Pacific Grove. The WDR Permit will require that the City comply with the

[3] MS2 is a virus that infects the bacterium E. coli and lives in the human gut.

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following standards:

- Produce disinfected tertiary recycled water, as defined in CCR Title 22, sections 60301.230 and 60301.320, at a municipal WWTP; and
- Distribution shall comply with the applicable uniform statewide reclamation criteria established pursuant to California Water Code (CWC) section 13521 (i.e., CCR Title 22 section 60301 et. seq., or "Title 22 Requirements").
- Recycled water customers shall comply with the applicable uniform statewide reclamation criteria established pursuant to Title 22 Requirements. Recycled water customers will be provided applicable training in the use of recycled water and cross-connection prevention.
- The producers and distributors of the recycled water shall satisfy all applicable requirements of the Recycled Water Policy.

3.4 Waste Discharge Quality Requirements

The California Recycled Water Policy requires the preparation of Salt and Nutrient Management Plans (SNMP) to be prepared to ensure that the water quality of surface or groundwater is protected from water quality degradation resulting from recycled water use. The SNMP for each basin/sub-basin is to be prepared by local water and wastewater entities, together with local salt/nutrient contributing stakeholders, who will fund locally-driven and controlled collaborative processes open to all stakeholders. The SNMPs must be completed and proposed to the RWQCB within five years of the date of the Recycled Water Policy, unless extended by the RWQCB but in no case shall the period of completion exceed seven years. The following components must be included in each salt and SNMP:

(a) A basin/sub-basin wide monitoring plan,

(b) A provision for annual monitoring of Emerging Constituents/Constituents of Emerging Concern (e.g., endocrine disrupters, personal care products or pharmaceuticals) (CECs),

(c) Water recycling and storm water recharge/use goals and objectives,

(d) Salt and nutrient source identification, basin/sub- basin assimilative capacity and loading estimates, together with fate and transport of salts and nutrients,

(e) Implementation measures to manage salt and nutrient loading in the basin on a sustainable basis, and

(f) An antidegradation analysis.

The MPWMD is currently preparing a SNMP for the SGWB. The PGLWP will coordinate with the RWQCB and MPWMD to determine the requirement of a site specific SNMP for the PGLWP.

California's Recycled Water Policy addresses landscape irrigation projects that use recycled water, including the control of incidental runoff of recycled water. Landscape

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irrigation projects must include recycled water monitoring for CECs on an annual basis and priority pollutants on a twice per year basis, in addition to any other appropriate recycled water monitoring requirements.

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4 RECYCLED WATER MARKET ASSESSMENT

This chapter describes the methodology used to identify potential recycled water customers and quantifies the recycled water market in the PGLWP study area.

4.1 Market Assessment Procedures

The following resources were considered to gather data on water usage for potential recycled water customers:

- Monterey County Aerial Photography Data;
- Monterey County GIS database (Parcel and Land Use Data);
- City of Pacific Grove GIS database (Parcel, Land Use, Sewer Infrastructure Data);
- City of Pacific Grove Land Use Data;
- CAW metered water use data;
- CAW Urban Water Management Plan 2010 Update;
- Direct customer coordination and contact.

Where water demand data was not available for specific landscape irrigation sites, an acreage and water usage analysis was performed. Acreage was estimated based upon analysis of available aerial photographs and coordination with site managers. The average irrigation requirement was calculated based upon local Evapotranspiration (ET) Factors and the local Maximum Applied Water Allowance (MAWA) requirements. Average annual demands estimated using this method may be more conservative than those calculated based on actual historical water meter data provided by CAW. However, the use of ET based demand estimates are considered sufficiently accurate for the development of water demands in this Facility Plan.

Table 3 presents a list of potential recycled water customers identified using the methods described. Additionally, the PGLWP may provide a connection pipeline to the CAWD/PBCSD recycled water system to supplement recycled water supplies used for irrigation of the Pebble Beach area golf courses.

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Table 3 – Potential Recycled Water Customers and Estimated Recycled Water Demands

ID	Customer	Owner	3-Year Reported Non-Potable Water Demand (AFY)	Estimated Actual Non-Potable Water Requirement (AFY)	Peak Demand (gpd)
1	Muncipal Golf Links	City of Pacific Grove	75	90	179,000
2	El Carmelo Cemetery	City of Pacific Grove	8	10	20,000
3	Crespi Pond Restroom	City of Pacific Grove	0.3	0	0
4	Truck Fill	City of Pacific Grove	20	24	48,000
5	Golf Maintenance Facility	City of Pacific Grove	0.3	0.4	1,000
6	Environmental Research Division	NOAA	0.2	0.2	400
7	Oceanview Restroom	City of Pacific Grove	3	4	8,000
8	Calendonia Park	City of Pacific Grove	1	1	2,000
9	Post Office	United States Postal Service	1	1	2,000
10	Jewell Park	City of Pacific Grove	1	1	2,000
11	Pacific Grove Museum	City of Pacific Grove	0.2	0.2	0
12	Pacific Grove Public Library	City of Pacific Grove	0.4	0.5	1,000
13	Oceanview Berwick Park	City of Pacific Grove	2.5	3	6,000
14	City Hall	City of Pacific Grove	1	1	2,000
15	Pacific Grove Community Center	City of Pacific Grove	0.3	0.4	1,000
16	Pacific Grove Middle School	Pacific Grove Unified School District	2	2	4,000
17	Platt Park	City of Pacific Grove	1	1	2,000
18	Pacific Grove Community High	Pacific Grove Unified School District	2	2	4,000
19	Arnett Park	City of Pacific Grove	0.5	1	2,000
20	Pacific Grove High School	Pacific Grove Unified School District	20	24	48,000
21	Robert Down Elementary	Pacific Grove Unified School District	4	5	10,000
22	Private Industry	Private Customer	40	48	96,000
23	Sunset Corp Yard	City of Pacific Grove	0.3	0.4	1,000
24	Asilomar Conference Grounds	California State Parks	0.5	1	2,000
25	George Washington Park	City of Pacific Grove	0.5	1	2,000
26	Pacific Grove Adult Education	Pacific Grove Unified School District	0.6	1	2,000
27	Monarch Grove Sanctuary	City of Pacific Grove	1	1	0
	CAWD/PBCSD for Golf Course Irrigation	CAWD/PBCSD	209	261	520,000
	Presidio of Monterey	United States Department of Defense	10	15	30,000
	Del Monte Golf Course	Pebble Beach Company	67	100	199,000
	Total		472	600	674,400

4.2 Description of User Categories

To analyze discrete market segments and assist the City in making decisions related to recycled water service, potential customers were classified using criteria related to water use patterns, service needs and onsite management.

4.2.1 Public/Institutional Landscapes

Public and institutional accounts include the City's Municipal Golf Links, El Carmelo Cemetery, parks, schools, government complexes, and publicly maintained landscaped open areas. These landscapes are typically professionally managed and maintained by city staff, and often have a dedicated irrigation meter. The City is therefore able to serve as site supervisor for the purposes of the recycled water use permit.

Public and institutional landscapes have high visibility throughout the community and may contain recreational amenities. Therefore, public opinion and public perception are important to the planning of irrigation and maintenance requirements of these landscapes.

4.2.2 Commercial/Industrial Landscapes and Industrial Processing

Commercial and industrial landscapes are typically contracted to professional landscaping firms. Site owners or managers are typically present onsite providing the City with a ready point of contact for a potential Site Supervisor to assist with implementation of recycled water program requirements. While these landscapes are typically open to the public, the level of public access is low as the landscape is intended as aesthetic enhancement rather than a recreational amenity.

Industrial processors typically have plant managers that are onsite during operations that would be able to serve as a potential Site Supervisor to assist in implementation of recycled water program requirements specific for dual plumb applications.

4.2.3 Residential Common Areas

This class includes the common areas associated with apartment complexes, condominium complexes, mobile home parks, and single-family residential developments, with common areas maintained by homeowner's associations. While professionally managed, decisions about these landscapes typically rest with or could be highly influenced by residents, potentially making decisions and communications a challenging process.

This customer class may require additional outreach and education regarding recycled water quality and safety to become comfortable with its use at these locations.

4.3 Customer Demand Volume

The annual volume of recycled water required by each customer has a significant impact on the decision for their inclusion in any recycled water program. Long pipeline extensions to serve relatively small volumes of recycled water to potentially remote customers may not be cost effective. Additionally, the requirements for site supervision and monitoring are more efficient when they can be focused on relatively larger customers, or customers in tight clusters, rather than multiple, scattered, small customer sites.

Large volume customers and groups of customers provide anchor points for the recycled water distribution system and justify the economic decisions of the system.

4.3.1 Large Volume Customer Demand

For purposes of this Facility Plan, a Large Customer is defined as a single customer with a demand over 1 AFY. This equates to the irrigation of a turf area of approximately 25,000 square-feet (0.6 acres).

4.3.2 Groups of Customers

Groupings of individual customers with smaller demands may also serve as anchors to the recycled water distribution system.

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4.4 Assessment Criteria

4.4.1 Average Annual Demand

Average annual demand is the average annual recycled water demand for each potential recycled water customer. Customers in the City of Pacific Grove may have a domestic water meter, a dedicated irrigation meter, or both. Separate meters are provided for fire suppression at non-residential sites; however, recycled water is not proposed for fire suppression as part of the PGLWP.

4.4.2 Peak Demands

The following metrics are used to size facilities based on instantaneous maximum rates of recycled water demands:

- Peak Monthly Demand – A monthly peaking factor applied to the average monthly demand to obtain the average daily demand during the peak month. The peak month represents the maximum irrigation season for Pacific Grove.

- Peak Hourly Demand – An hourly peaking factor is applied to the maximum month, average day peak to obtain the maximum month, average day, peak hour demands.

4.4.3 Water Quality Requirements

All applicable regulatory requirements will be met for the unrestricted use of recycled water. Water quality requirements assessed are those that are operational rather than regulatory in nature. Examples of water quality issues include salinity, turbidity, and chlorine residual. Particular water quality needs were identified through customer coordination.

4.4.4 Retrofit Requirements

The proposed recycled water customer sites will require that existing irrigation systems will need to be retrofitted to include an additional meter for recycled water with a backflow prevention device on the potable system. Other onsite retrofits include purple sprinkler head installation, recycled water valve box covers, cross-connection prevention, and isolation of the recycled water system from water fountains, picnic area, etc. For services with on-site fire suppression systems, additional backflow prevention devices may be required, unless already equipped.

4.4.5 Irrigation Supply Reliability Requirements

In the event that the recycled water system is unavailable for a prolonged period of time, potable water will continue to be available to each customer to supply water demands. Back-up supplies could be provided through a central back-up supply at the SRTWP, or through individual connections. Customers would be equipped with appropriate backflow and cross-connection prevention devices for protection of the potable water system.

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4.5 Recycled Water Market Survey Results

This section summarizes the results of the Recycled Water Market Survey, including a geographical analysis of the results and identification of the PGLWP study area. For the purposes of this Facility Plan, the following recycled water Demand Groups are identified:

- Demand Group I: Customers adjacent to the proposed treatment plant
- Demand Group II: Other Citywide customers
- Demand Group III: Customers outside of the City of Pacific Grove.

4.5.1 Market Survey Results Summary

The potential use of recycled water within the City of Pacific Grove is predominately for landscape irrigation. There is one private industrial customer that could potentially use recycled water for its industrial process. Dual plumbing retrofits of existing commercial buildings for recycled water use in toilets and urinals are typically cost prohibitive, thus those applications are not generally considered within this Facility Plan. Dual plumbing of public restroom facilities at city owned parks are specifically considered as these buildings are typically constructed with simple plumbing that is easily retrofitted for dual plumbing.

The Market Survey estimated that average recycle water demand for the City of Pacific Grove area and other regional customer sites is a minimum of approximately 263 AFY. This demand is based upon metered water use between 2010 and 2012. This does not include demands from the CAWD/PBCSD system that may vary dependent upon available storage in Forest Lake Reservoir. Due to the escalating cost of potable water, the Municipal Golf Links and cemetery have significantly reduced irrigation over the past five years. The City has been actively implementing conservation best management practices and limited water use to the greatest extent feasible. Site supervisors have indicated that additional water for irrigation will provide benefits to the site landscaping and improved golf play. Calculations for irrigation demand based upon turf requirements and local ET rates indicate an irrigation requirement of approximately 20% greater than recent actual metered water use. Therefore the estimated recycled water demands in this Facilities Plan are calculated with a contingency factor of 20% above the reported water use records.

Table 3 presented the recycled water customers with estimates of demand over three years, available data on metered demand, and an estimate of peak demands. Based on these estimates, there is a minimum recycled water demand of 339 AFY, with additional potential recycled water demands from CAWD/PBCSD to supplement CAWD/PBCSD supplies.

Figure 11 presents the location of potential recycled water customers in the City of Pacific Grove.

Figure 12 presents all potential recycled water customers and identifies potential customer geographic groups.

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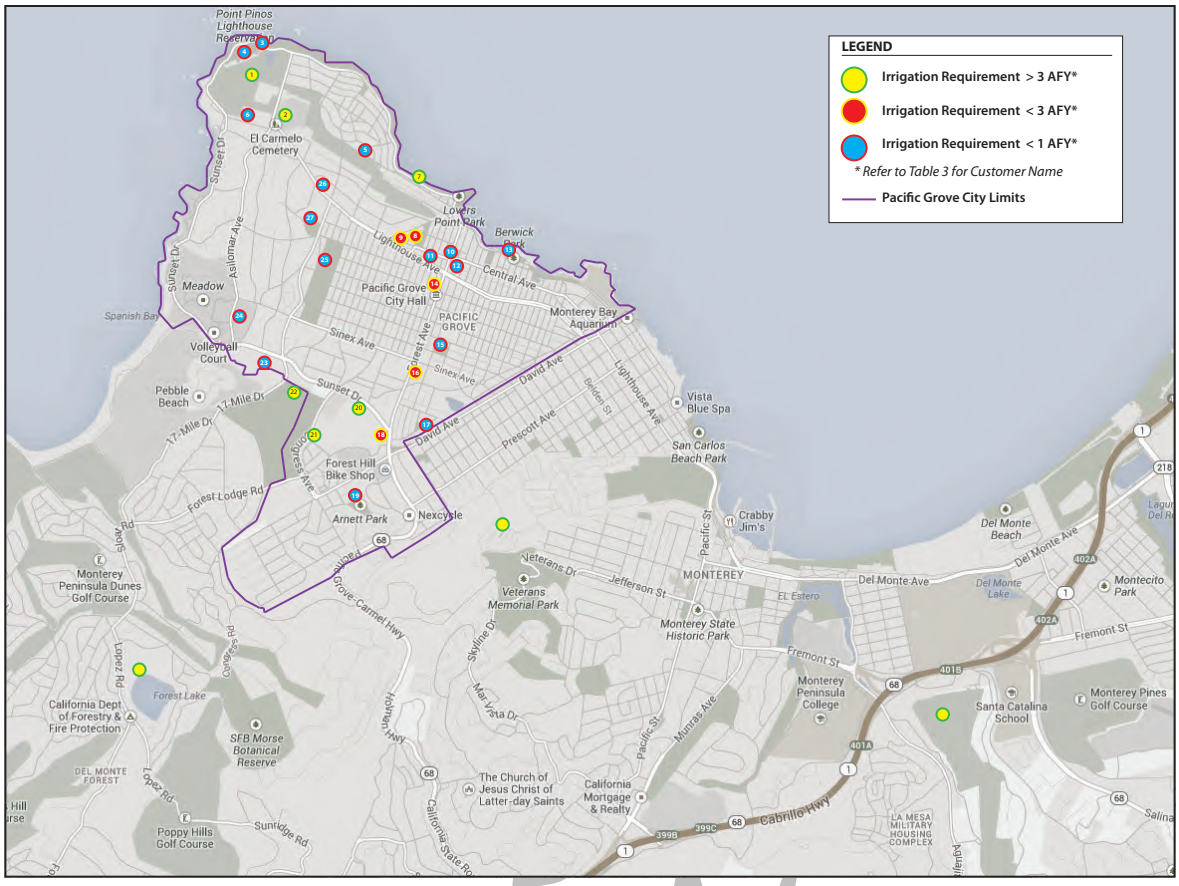

Figure 11 - Potential Recycled Water Demands (Demand Groups I, II, and III)

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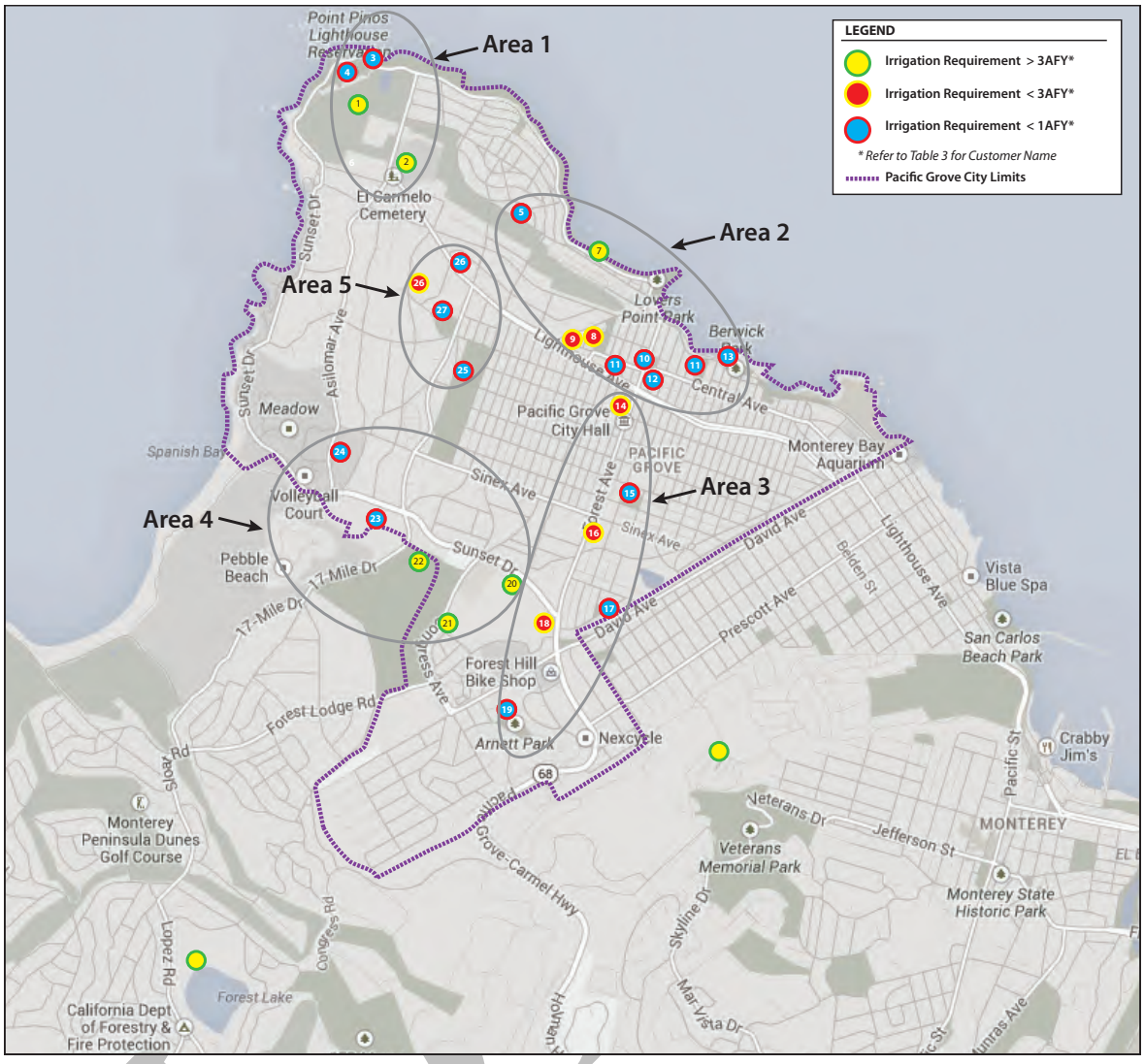

Figure 12 - Recycled Water Customer Geographic Areas

The majority of recycled water demand is from landscape irrigation sites owned by the City of Pacific Grove and the Pacific Grove Unified School District (PGUSD). Discussions with site supervisors at the City and PGUSD indicated a willingness and desire to use recycled water for landscape irrigation and for toilet and urinal flushing. One private industrial site and one private landscaping site has been considered in this evaluation.

Geographic Area 1 serves Demand Group I and includes the Pacific Grove Municipal Golf Links, the El Carmelo Cemetery, construction and street sweeping truck fill, and the Crespi Pond Restrooms (toilet flushing only). These customers are located directly adjacent to the proposed SRWTP site at the Point Pinos WWTP. The average demand for Area 1 is approximately 125 AFY.

The following tables list customers by Demand Group for each Area.

Table 4 - Demand Group I Area 1 Irrigation Demands

ID	Customer	Demand Type	3-Year Reported Non-Potable Water Demand (AFY)	Estimated Actual Non-Potable Water Requirement (AFY)	Peak Demand (MGD)
1	Muncipal Golf Links	Landscape Irrigation	75	90	0.179
2	El Carmelo Cemetery	Landscape Irrigation	8	10	0.020
3	Crespi Pond Restroom	Toilet Flushing	0.3	0.4	0.001
4	Truck Fill	Construction, Sewer Flushing, and Street Sweeping	20	24	0.048
5	Golf Maintenance Facility	Toilet Flushing	0.3	0.4	0.001
6	Environmental Research Division	Landscape Irrigation	0.2	0.2	0.000
	Total		104	125	0.25

Demand Group II includes other potential recycled water customers within the City of Pacific Grove. Demand Group II is divided into 4 geographic areas. Area 2 includes landscape irrigation at City parks and public facilities adjacent to the Ocean View Recreation Trail and Central Avenue.

Table 5 - Demand Group II Area 2 Recycled Water Demands

ID	Customer	Demand Type	3-Year Reported Non-Potable Water Demand (AFY)	Estimated Actual Non-Potable Water Requirement (AFY)	Peak Demand (MGD)
7	Oceanview Restroom	Landscape Irrigation and Toilet Flushing	3	4	0.008
8	Calendonia Park	Landscape Irrigation	1	1	0.002
9	Post Office	Landscape Irrigation	1	1	0.002
10	Jewell Park	Landscape Irrigation	1	1	0.002
11	Pacific Grove Museum	Landscape Irrigation	0.2	0.2	0.000
12	Pacific Grove Public Library	Landscape Irrigation	0.4	0.5	0.001
13	Oceanview Berwick Park	Landscape Irrigation	3	3	0.006
14	City Hall	Landscape Irrigation	1	1	0.002
	Total		10	12	0.02

Area 3 includes sites adjacent to Forest Avenue and Sunset Drive. The total demand for this location is 3.7 AFY.

Table 6 - Demand Group II Area 3 Recycled Water Demands

ID	Customer	Demand Type	3-Year Reported Non-Potable Water Demand (AFY)	Estimated Actual Non-Potable Water Requirement (AFY)	Peak Demand (MGD)
15	Pacific Grove Community Center	Landscape Irrigation	0.3	0.4	0.001
16	Pacific Grove Middle School	Landscape Irrigation	2	2	0.004
17	Platt Park	Landscape Irrigation	1	1	0.002
	Total		3	3	0.01

Area 4 includes the Pacific Grove High School and a private industrial use. The total demand for this area is approximately 81 AFY.

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Table 7 - Demand Group II Area 4 Recycled Water Demands

ID	Customer	Demand Type	3-Year Reported Non-Potable Water Demand (AFY)	Estimated Actual Non-Potable Water Requirement (AFY)	Peak Demand (MGD)
18	David Avenue School and Pacific Grove Community High	Landscape Irrigation	2	2	0.004
19	Arnett Park	Landscape Irrigation	1	1	0.002
20	Pacific Grove High School	Landscape Irrigation	20	24	0.048
21	Robert Down Elementary	Landscape Irrigation	4	5	0.010
22	Private Industry	Landscape Irrigation	40	48	0.096
23	Sunset Corp Yard	Landscape Irrigation	0.3	0.4	0.001
24	Asilomar	Landscape Irrigation	1	1	0.002
	Total		67	81	0.16

Area 5 includes demands adjacent to 17 Mile Drive. Total demands in this area are approximately 3 AFY.

Table 8 - Demand Group II Area 5 Recycled Water Demand

ID	Customer	Demand Type	3-Year Reported Non-Potable Water Demand (AFY)	Estimated Actual Non-Potable Water Requirement (AFY)	Peak Demand (MGD)
25	George Washington Park	Landscape Irrigation and Toilet and Urinal Flushing	1	1	0.002
26	Pacific Grove Adult Education	Landscape Irrigation	1	1	0.02
27	Monarch Grove Sanctuary	Landscape Irrigation	1	1	0.02
	Total		2	3	0.05

Recycled water demands outside of the City boundaries were considered as Demand Group III. The POM (14 AFY) and Del Monte Golf Course (100 AFY) were evaluated. However, the cost of the required recycled water distribution pipeline to those locations was deemed to be economically infeasible for the initial phase of the PGLWP. These customers may be added to the recycled water system at a later time.

CAWD/PBCSD has also expressed interest in additional recycled water to provide additional dry season capacity to their Forest Lake Reservoir that currently provides approximately 800 AFY of recycled water storage to the CAWD/PBCSD recycled water system. Additional coordination is ongoing and is intended to result in a determination of the specific annual volume of recycled water desired by PBCSD/CAWD.

Table 9 presents potential recycled water customers located outside of the City of Pacific Grove limits.

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Table 9 - Demand Group III Recycled Water Demands

Customer	Owner	Estimated Actual Non-Potable Water Requirement (AFY)	Peak Monthly Demand (MGD)
CAWD/PBCSD	CAWD/PBCSD	261	0.05
Presidio of Monterey	United States Navy	15	0.03
Del Monte Golf Course	Pebble Beach Resorts	100	0.20

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4.6 Recycled Water Supply

4.6.1 Source Water Quality

Source water quality to the SRWTP is expected to be that of typical municipal wastewater characteristic of predominately residential sources. Wastewater quality is also affected by the potable water source. The potable water sources are local groundwater and the Carmel River Basin that is suitable for recycling. Table 10 presents the assumed raw wastewater quality parameters.

Table 10 - Assumed Raw Wastewater Quality

Parameter [(a)]	Value
Biochemical Oxygen Demand (BOD)	250 mg/l
Total Suspended Solids (TSS)	250 mg/l
Total Kjedahl Nitrogen (TKN)	40 mg/l
Minimum Temperature	12 °C
Maximum Temperature	25 °C

(a) Adapted from Water Reuse, Technologies, and Applications, Metcalf & Eddy, AECOM; 2006

Flow to the proposed SRWTP will be diverted from the existing City sanitary sewer manhole (MH 801) located near the intersection of Asilomar Avenue and Del Monte Boulevard. Base wastewater flows at this location are estimated to be approximately 600,000 gallons per day based upon recent sewer flow monitoring conducted by the City as part of their Sanitary Sewer Collection System Master Plan (Wallace, 2013). Flow monitoring was conducted upstream of MH 803 for two months in 2013.

Wastewater flows are seasonal and typically are higher in winter months due to infiltration from storm water and groundwater sources. Flow monitoring on the Asilomar Avenue pipeline has not been completed for a 12-month period; therefore existing flow monitors located at the Regional Pump Station No 13 were used to develop a seasonal wastewater curve. Figure 13 presents the extrapolated seasonal wastewater curve in acre-feet per month for MH 803.

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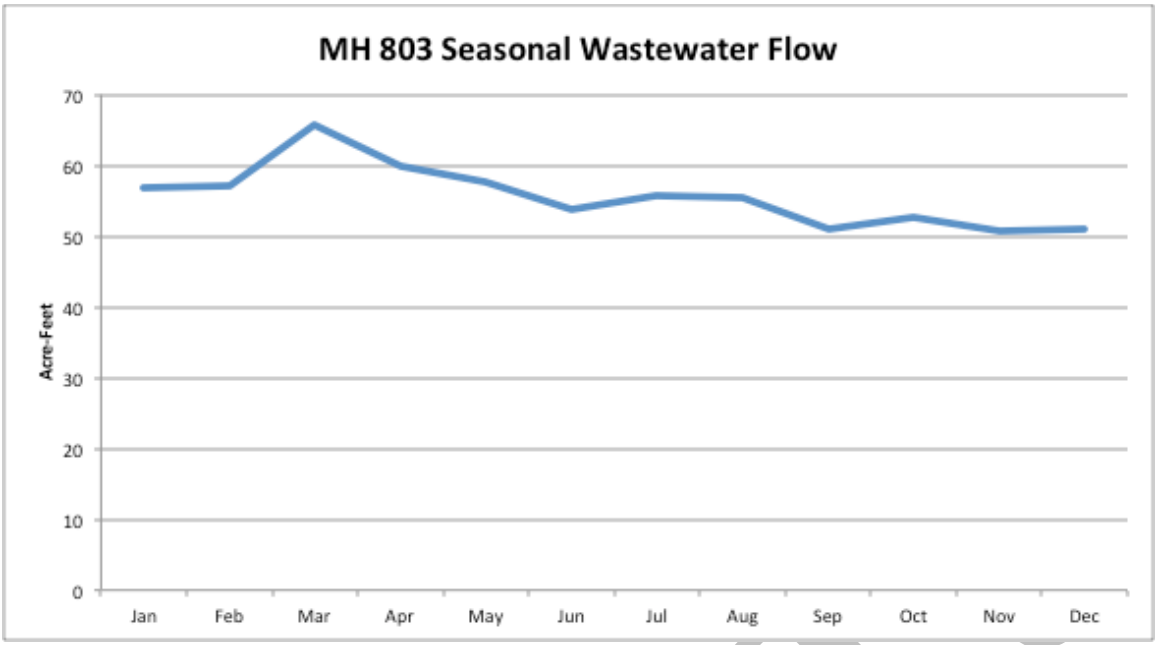

Figure 13 – Raw Wastewater Flows

Typical landscape irrigation occurs between March through October. Cumulative wastewater flow available during the irrigation season is approximately 447 AFY. Total average annual wastewater flow available is 677 AFY. Non-irrigation season supplies may be treated and stored for future use.

Treatment train recovery is estimated to be approximately 90% (Watereuse Research Foundation, 2009). Therefore the quantity of treated effluent available from the proposed SRWTP is estimated to be 400 AF during the irrigation season, or up to 600 AFY for the year.

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5 PROJECT ALTERNATIVE ANALYSIS

This chapter summarizes the techniques used to evaluate alternatives for implementing the PGLWP. As described previously, the PGLWP consists of a recycled water treatment and distribution system. This chapter discusses the pipeline alignments, treatment, and storage alternatives for those components associated with the proposed treatment, distribution, and use of municipal recycled water.

5.1 Design and Planning Criteria

The recycled water treatment and distribution system will be designed to meet Title 22 and Title 17 standards for landscape irrigation.

5.1.1 Pipeline Criteria

The recycled water system will be designed as a pressurized water piping network. Requirements include:

- Distribution pipeline is sized to limit maximum velocities to 4 to 8 feet per second.
- Pipeline material will be C-900 PVC, Class 150 or 200 and colored purple.
- Pipelines will be separated from potable water pipeline as required by the CDPH with a minimum separation of not less than 1-vertical foot and 4-horizontal feet and with appropriate and approved mitigation measures.

5.1.2 Distribution System Pressure Criteria

The distribution system will be designed to provide an operating pressure range of 40 to 80 pounds per square inch (psi) for direct user connections. A minimum pressure of 80 psi is required at customer irrigation system sprinkler heads. The pipelines will be sized to maintain a unit head loss below 6 feet per 100 feet.

5.1.3 Peak Delivery Criteria

The system alternatives will be designed to meet the peak monthly demands from the SRWTP with augmentation from system reservoirs to meet the increases necessary for peak day and diurnal variations (operational storage).

5.1.4 Operational Storage Criteria

Operational storage is sized for two maximum demand days. Customer access to potable water supplies will be made available to augment recycled water supplies, if needed, during peak demand months, or during outages to the SRWTP.

5.1.5 Cost Basis

All costs are based on year 2014 dollars with a discount rate of 2 percent used for economic analyses. The useful lives for mechanical and electrical equipment are assumed at 20 years, structures at 30 years, pipelines at 50 years and reservoir facilities at 75 years.

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The cost estimating approach used in this Facility Plan is based on guidelines developed by the American Association of Cost Engineers (AACE). AACE has developed definitions for levels of accuracy commonly used by professional cost estimators. The AACE defined the three levels as cost estimates as order-of-magnitude, budget, and definitive estimates. The costs presented in this Facility Plan are best characterized as an opinion of the order-of-magnitude estimates. An order-of-magnitude estimate is made without detailed engineering data, and is prepared at the end of a schematic design phase of the design process. It is normally expected that an estimate of this type would be accurate within plus 50 percent to minus 30 percent of the estimated cost.

5.1.6 Rights-of-Way

It is anticipated that most of the facilities that would be constructed would be in public Rights-of-Way (ROW) or through the City owned golf course. Most of the facilities would be within local street ROW. For expansion to Demand Group 3, some pipelines may be located within Union Pacific Railway ROW for which an inter-agency or purchase agreement may be required.

5.1.7 Planning Period

The planning period for each of the alternative projects is based on the initial 20 years of operations. Assuming that the initial recycled water deliveries are made by the third quarter of 2016, the planning period would be through 2036.

5.2 Treatment Alternatives

5.2.1 Satellite Recycled Water Treatment Plant

Flow from the sewage collection system would be diverted and pumped from the sewage diversion station to the SRWTP and would be split into two separate treatment trains. Two trains are recommended for system redundancy. Figure 14 presents a planning level process flow diagram for this alternative of the SRWTP.

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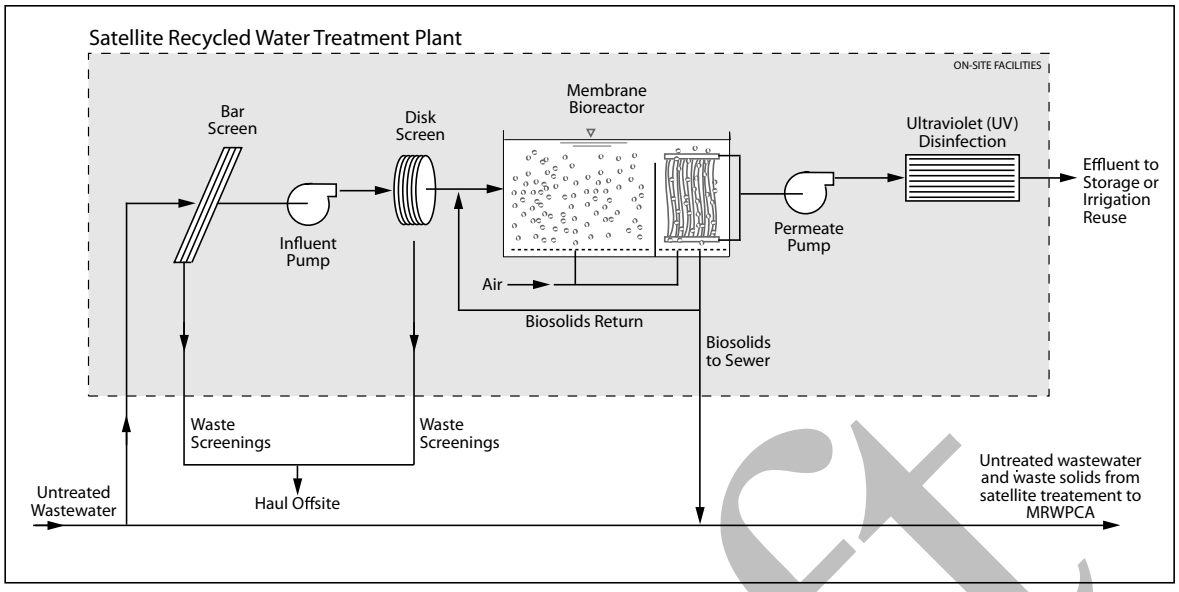

Figure 14 – Typical Satellite Recycled Water Treatment Facility Process Flow Diagram

Raw sewage would flow though a bar screen to remove large debris and then be pumped to a fine screen. Screened wastewater would next be routed to the biological process in the membrane bioreactor (MBR). The MBR would have aerated and unaerated zones to help reduce nutrients such as ammonia and phosphorous in the recycled water. Filtration membranes would separate suspended solids from the water. Permeate from the membranes would be conveyed to an ultraviolet (UV) light based disinfection system. The finished irrigation water would be pumped to an onsite storage tank, and further disinfected prior to distribution.

5.2.1.1 Satellite Recycled Water Treatment Plant Site

The proposed SRWTP would be located at the retired Point Pinos WWTP. The site is approximately 1 acre in size. The site is located on a heavily disturbed lot adjacent to the Pacific Grove Municipal Golf Links and Ocean View Boulevard. The City of Pacific Grove owns and operates the site as a secondary corporation yard and water filling facility. The City pumps and stores groundwater seepage in the existing WWTP clarifier and digester tanks for use by street sweeping trucks, sewer flushing, and construction. The two large tanks (retired WWTP facilities) and heavily traveled dirt driveways dominate the lot. Construction materials and spoils are temporarily stockpiled onsite around the driveways and in the northwestern corner of the site.

A condition assessment to determine the structural integrity of the existing tanks was completed and reports are included in Appendix A. Historical Survey and Archaeological onvestigations were completed and reports are included in Appendices B and C respectively. Geotechnical, topographic, and biological surveys have also been completed at the site and are included in Appendices D, E, and F respectively.

It is anticipated that much of the existing infrastructure will be repurposed for use by the PGLWP.

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5.2.1.2 Wastewater Treatment Technology

Several types of treatment systems can be used for satellite recycled water systems depending on the amount of recycled water to be produced, the finished water quality required, and site and environmental constraints. MBRs and sequencing batch reactors (SBR) provide more compact treatment than conventional secondary treatment, and are typically the treatment system of choice for satellite treatment applications where space is limited.

The compact size, ability to expand, minimal odor generation, reliable operations, operational automation, effluent quality and treatment efficiency provided by MBR facilities make them particularly well suited for satellite treatment applications. MBRs combine biological treatment with a membrane system to provide organic and suspended solids removal, reducing space requirements and treatment costs. Pretreatment with a fine screen is required to prevent solids clogging of the membranes.

SBR is an activated sludge process that minimizes space requirements by performing multiple steps within a single vessel. The SBR process uses a fill-and- draw reactor with complete mixing during the batch reaction step; aeration and clarification occur in the same tank. SBR operation encompasses four steps: (1) fill, (2) aeration, (3) sedimentation, and (4) decant. Changing the time for the aeration cycle may be used to meet other treatment objectives such as ammonia and phosphorous removal.

MBRs have been typically used for satellite reclamation systems in recent years. The advantages of MBR systems over other biological systems include better quality effluent than traditional coagulation and filtration treatment, smaller space requirements, and ease of automation. The effluent from MBRs contain low concentrations of bacteria, total suspended solids (TSS), biochemical oxygen demand (BOD), and phosphorous, facilitating high level disinfection.

5.2.1.3 Disinfection

To meet Title 22 requirements, the recycled water will be disinfected after treatment by the MBR. Typical mechanisms for disinfection of recycled water are Chlorine (Chlorine gas, Sodium hypochlorite, Combined chlorine, Chlorine dioxide), Ozone, and UV radiation.

Table 11 presents a comparison of the characteristics of common disinfectants used in water reclamation.

Chlorine and related compounds are applied to the treated wastewater through baffled contact chambers or long pipelines designed to perform as plug-flow reactors.

Ozone is typically applied by bubbling ozone gas through the treated wastewater in a contact chamber or a sidestream using fine bubble diffusers.

Open and closed contact reactors are typically used for UV disinfection. Open channel reactors are commonly used for low-pressure low-intensity and low-pressure high-intensity UV lamps. Closed proprietary reactors are used for low-pressure high-intensity and medium-pressure high-intensity UV lamps. Contact time is short in UV reactors; therefore the design of the UV system is critical.

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Table 11 - Common Disinfectants for Water Reclamation

Characteristic	Chlorine Gas	Sodium Hypochlorite	Combine Chlorine	Chlorine Dioxide	Ozone	UV
Deodorizing	High	Moderate	Moderate	High	High	NA
Interaction w/ Organic Matter	Oxidizes	Oxidizes	Oxidizes	Oxidizes	Oxidizes	Absorbance of UV Radiation
Corrosiveness	Highly Corrosive	Corrosive	Corrosive	Highly Corrosive	Highly Corrosive	NA
Toxicity to higher forms of life	Highly Toxic	Highly Toxic	Toxic	Toxic	Toxic	Toxic
Penetration to Particles	High	High	Moderate	High	High	Moderate
Safety Concern	High	Moderate to low	High to Moderate	High	Moderate	Low
Solubility	Moderate	High	High	High	High	NA
Stability	Stable	Slightly Unstable	Slightly Unstable	Unstable	Unstable	NA
Effectiveness as disinfectant						
	Excellent	Excellent	Good	Excellent	Excellent	Good
Protozoa	Fair to Poor	Fair to Poor	Poor	Good	Good	Excellent
Viruses	Excellent	Excellent	Fair	Excellent	Excellent	Good
Byproduct Formation	THMs and HAAs	THMs and HAAs	THMs and HAAs, cyanogens , NDMA	Chlorite and Chlorate	Bromate	None Known
Increases TDS	Yes	Yes	Yes	Yes	No	No
Use as a disinfectant	Common	Common	Common	Occasional	Occasional	Common in California

(Source: Water Reuse, 2009)

Disadvantages of disinfection by chlorine and related compounds include increased space requirements, increased TDS levels, long contact times, hazardous material upset risk, and disinfection byproducts. Therefore, the shorter contact times, improved safety, smaller required footprint, and disinfectant effectiveness make ozone and UV preferred methods of disinfection for satellite recycled water treatment on small sites such as at the 1 acre Point Pinos site. UV does not require chemical storage and forms no disinfection byproducts in comparison to ozone.

Chlorination is required for treated effluent that is to be recycled and/or stored in recycled water storage tanks. A UV system can be used for disinfection of recycled water, but cannot provide the residual to prevent the re-growth of bacteria or algae in the piping or storage tanks. A chlorination system can provide this residual. For this project, UV is recommended followed by chlorination with sodium hypochlorite.

If chlorine is used as the only disinfectant, chlorination would occur either in a separate chlorine contact channel, or in the recycled water storage tank. The recycled water storage tank can be designed with baffles to provide the 90 minutes of contact time required to comply with Title 22 chlorination requirements. A 5 mg/L residual is also required for the effluent, resulting in compliance with the minimum dose requirements.

5.2.1.4 Residuals Management

The SRWTP will produce the following wastes that will require further treatment or disposal:

- Screenings (both large debris and fine screenings)
- Waste activated sludge (WAS) (from bioreactor)
- Fine Screen wash water
- Membrane Cleaning Solution.

Debris from the fine screens will be processed through a washer/compactor to remove organic materials and minimize odors. The screenings will be continuously collected and routinely hauled off-site for disposal.

Sludge is the biomass produced from the biological treatment process that removes BOD. Following its optimal growth and age, biomass must be removed from the system to disposal as WAS. Approximately 2 gallons per minute (gpm) of WAS solids from the SRWTP will be returned to the wastewater collection system for conveyance to and treatment at the MRWPCA RTP. The waste sludge pipeline is assumed to be 2-inches in diameter and would be installed using trenchless technology on the golf course. Waste sludge will be pumped to the MRWPCA RTP collection system downstream through a modified Pump Station 15.1. A 1,000-gallon tank for temporary waste solids storage will be required at Point Pinos.

Residual solids content of the WAS from the treatment process are mostly fine solids in 98% liquid and typically do not interfere with normal wastewater flows or treatment. It is anticipated that the organic strength of the residuals would be less than that of the source wastewater.

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5.2.1.5 Storage

Finished irrigation water would be pumped and stored in the existing 200,000-gallon clarifier and 430,000-gallon digester. Recycled water storage will provide flow equalization, storage for irrigation water, and hydraulic residence time adequate to meet regulatory disinfection requirements. The existing concrete tanks will be retrofitted to meet current American Water Works Association (AWWA) and Occupational Safety and Health Administration (OSHA) standards. The need for equipment to mix the tank contents will be evaluated in future engineering analysis.

5.3 Backbone Recycled Water Distribution Pipeline Alternatives

Backbone pipeline alignment alternatives were evaluated for the delivery of recycled water to its point of reuse. The purpose of the alterative analysis as to identify a backbone pipeline alignment that is cost-effective while providing recycled water service to the greatest recycled water demands, and has minimal utility, traffic, and constructability issues.

A variety of construction methods were considered as potential means for pipeline installation. Selected construction methods typically correlate to cost and environmental impacts associated with the Project. The following construction methods may be used:

- Open Trench with shoring when appropriate;
- Microtunneling;
- Pipe bursting and replacement;
- Slip lining of existing pipeline;
- Boring and jacking,
- Horizontal directional drilling.

Installation of the distribution system may use combinations of the above methods along the pipeline reaches depending on site-specific ground, soil, geotechnical conditions, existing utilities and structures, and potential traffic impacts. For purposes of this Facility Study, trenchless construction methods were assumed to minimize impacts to traffic and golf play. Construction of the pipeline will require, but is not limited to, the following equipment: excavator, backhoe, front-end loaders, pavement saw, dump trucks, diesel generator, water truck, flat-bed truck, compactors, double transfer trucks for soil hauling, concrete trucks, and paving and striping equipment as needed. Equipment and vehicle staging would be accommodated at a centralized staging area.

Assessment criteria used to evaluate the pipeline alternatives is presented in Table 12.

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Table 12 - Pipeline Assessment Criteria

Criteria	Description
Recycled Water Demand	Total Volume of Recycled Water Served
Pipeline Length	Total Pipeline Length
Demand per Foot	Total Average Demand Per Foot Along Reach
Raw Construction Cost	Raw Cost of Pipeline Installation
Traffic Concerns	Considers traffic impacts, congestion, and emergency response access
Utility Concerns	Considers utility congestion and conflicts, separation and mitigation requirements Maintenance of existing utility services
Constructability	Considers general construction issues

5.3.1 Service to Demand Group I

Backbone pipeline alignment for the Demand Group I system will include the recycled water distribution system to the Area 1 with service to the Municipal Golf Links and the El Carmelo Cemetery. The alternative alignments presented in Table 13 are considered for Demand Group I.

Table 13 - Area 1 Pipeline Alignment Alternatives

Area 1 Alternatives	Description
Alternative 1A	From the SRWTP, along existing sewage easement from City Municipal Golf Links to Asilomar Road; along Asilomar Road to Del Monte Blvd.
Alternative 1B	From SRWTP, along SRWTP driveway to Sunset Avenue; along Sunset Avenue to Asilomar Road; along Asilomar Road to Del Monte Blve.

The pipeline alignment will follow the existing easement from the SRWTP to Asilomar Avenue. Figure 15 presents the proposed alignments for Phase I.

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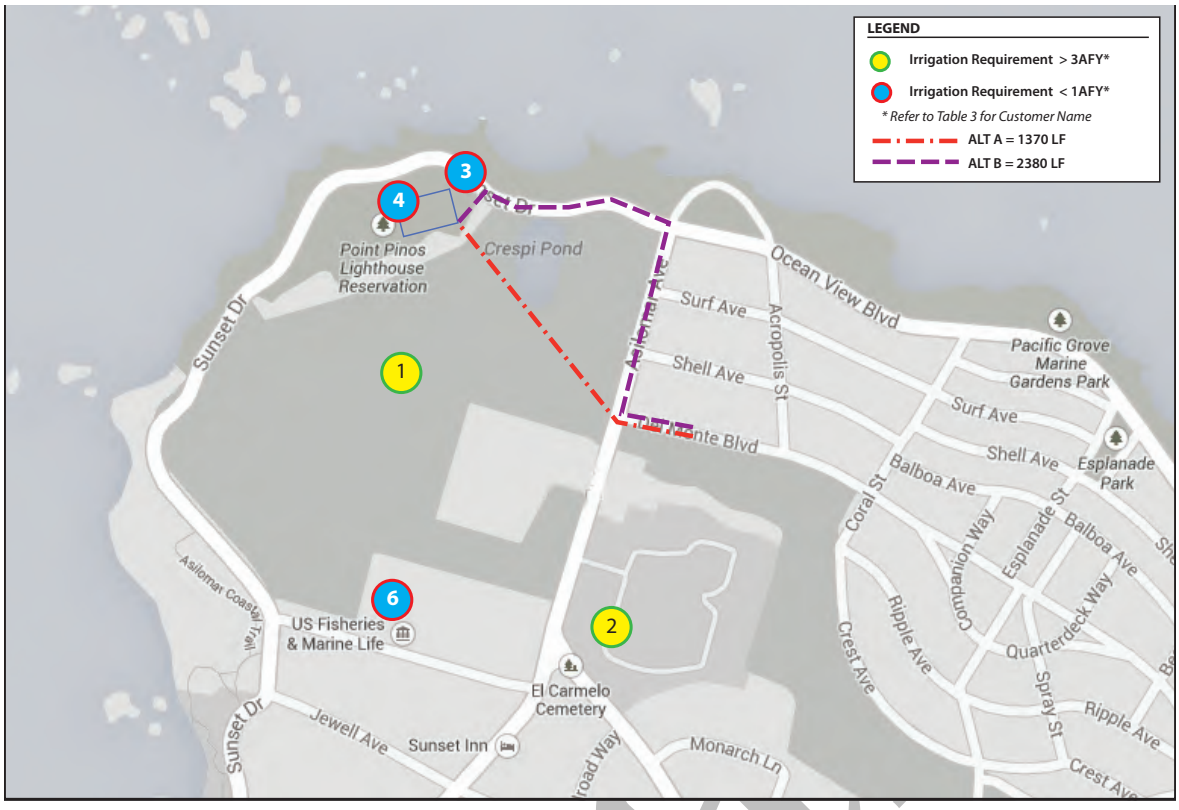

Figure 15 - Demand Group I Area 1 Pipeline Alternative Alignments for Phase I

5.3.2 Service to Demand Group II

Backbone pipeline alignment for the Demand Group II system will include service to Areas 2-5. Figures 16-19 present the alternative pipeline alignments to provide service to Demand Group II.

The following alternative pipeline alignments considered for Area 2 are presented in Table 14.

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Table 14 - Area 2 Pipeline Alignment Alternatives

Area 2 Alternatives	Description
Alternative 2A	Along Ocean View Boulevard to 17th Street (Lovers Point Park); Along 17th Street to Central Avenue.
Alternative 2B	From Asilomar Avenue to Del Monte Boulevard; Along Del Monte Boulevard to Crest Avenue; Along Crest Avenue to 17 Mile Drive to Sea Palm Avenue; Along Sea Palm Avenue to Del Monte Boulevard to Sea Palm Avenue Easement; Along Sea Palm Avenue Easement to Mermaid Avenue Alley to Briggs Avenue to Jewell Avenue; Along Jewell Avenue to 19th Street.
Alternative 2C	From Asilomar Avenue to Municipal Golf Links; Along upper property line of Municipal Golf Course to Briggs Avenue to Jewell Avenue; along Jewell Avenue to 19th Street.

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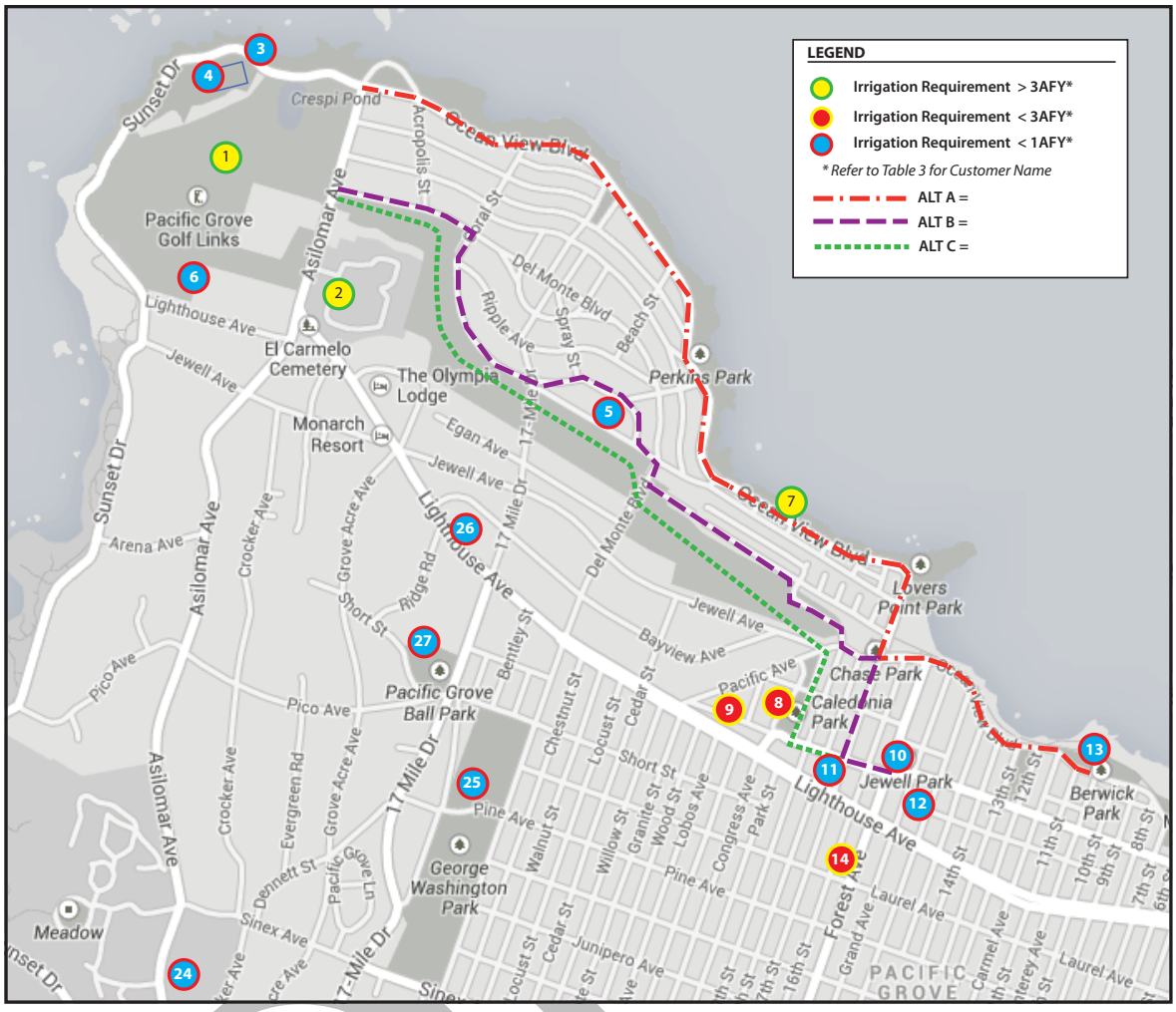

Figure 16 - Area 2 Pipeline Alternative Alignments

The following alternative pipeline alignments considered for Area 3 are presented in Table. 15.

Table 15 - Area 3 Pipeline Alignment Alternatives

Area 3 Alternatives	Description
Alternative 3A	Along Central Avenue to Forest Avenue; Along Forest Avenue to Sunset Drive.
Alternative 3B	Along Central Avenue to Fountain Avenue; along Fountain Avenue to Beaumont Drive; Along Beaumont Drive to McFarland Avenue; Along McFarland Avenue to Morse Drive.

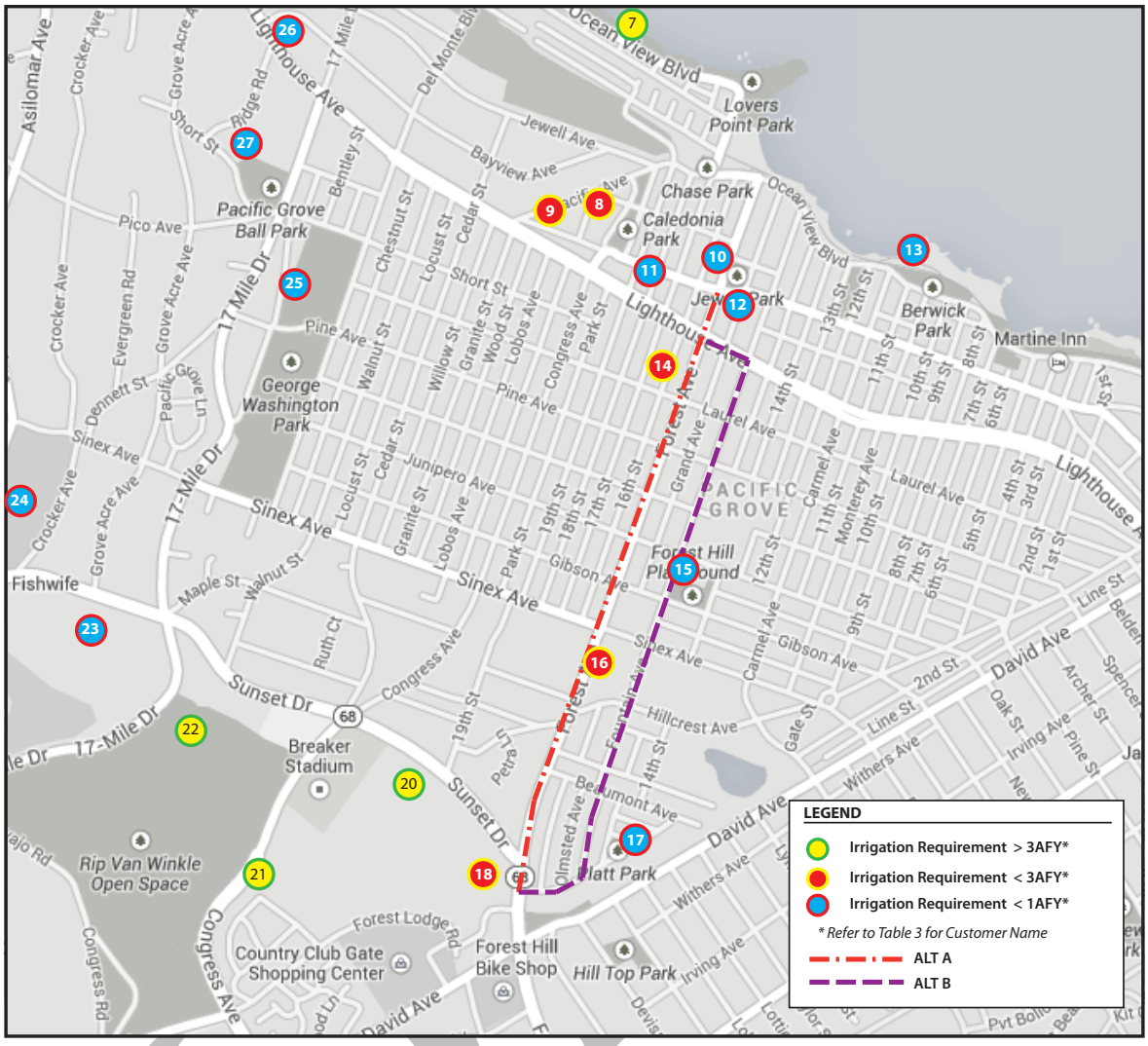

Figure 17 - Area 3 Pipeline Alternative Alignments

The following alternative pipeline alignments considered for Area 4 are presented in Table. 16.

Table 16 - Area 4 Pipeline Alignment Alternatives

Area D Alternatives	Description
Alternative 4A	From Forest Avenue to Sunset Drive; Along Sunset Drive to Asilomar Avenue.
Alternative 4B	From Forest Avenue to Forest Lodge Road; Along Forest Lodge Road to Country Club Gate; along Country Club Gate to cross country through Rip Van Winkle Open Space; Along cross country through Rip Van Winkle Open Space to cross country through City Corporation Yard on Sunset Drive to Sunset Drive; Along Sunset Drive.

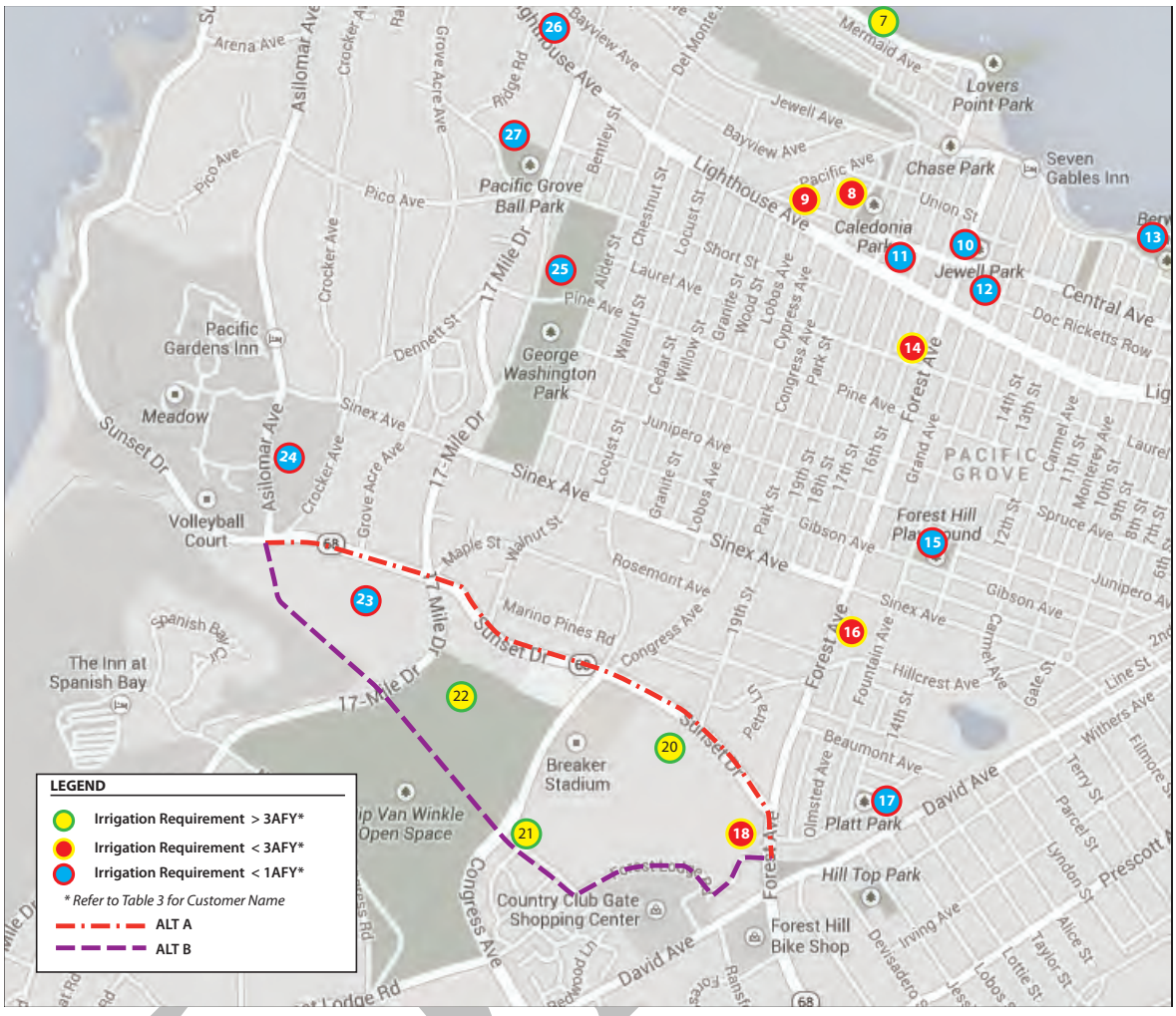

Figure 18 - Area 4 Pipeline Alternative Alignments

The following alternative pipeline alignments considered for Area 5 are presented in Table. 17.

Table 17 - Area 5 Pipeline Alignment Alternatives

Area E Alternatives	Description
Alternative 5A	From Sunset Drive to 17 Mile Drive; along 17 Mile Drive to Lighthouse Avenue; along Lighthouse Avenue to Asilomar Avenue.
Alternative 5B	From Sunset Drive to Crocker Avenue; Along Crocker Avenue to Evergreen Road; Along Evergreen Road to Railroad Alignment; Along Railroad Alignment to Railroad Way; Along Railroad Way to Asilomar Avenue.

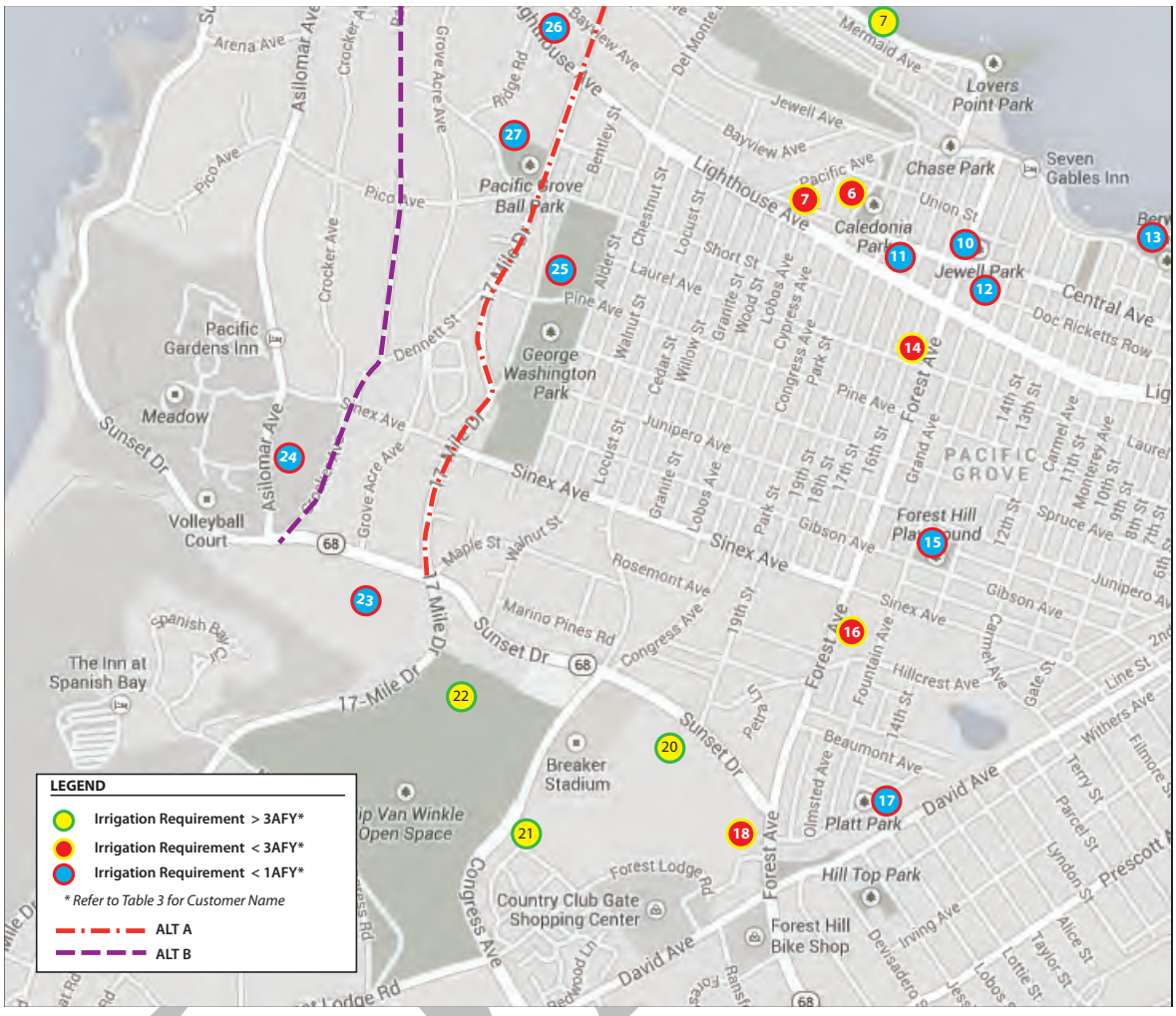

Figure 19 - Area 5 Pipeline Alternative Alignments

5.3.3 Service to Demand Group III

Backbone pipeline alignment for the Demand Group III system will include the extended recycled water distribution system to service recycled water demands in the City of Monterey and the community of Pebble Beach, a total potential demand of 275 afy. The estimated capital costs to extend the recycled water distribution system to Demand Group III are approximately $2.25 million. Figure 20 presents the proposed pipeline alignments for Demand Group III.

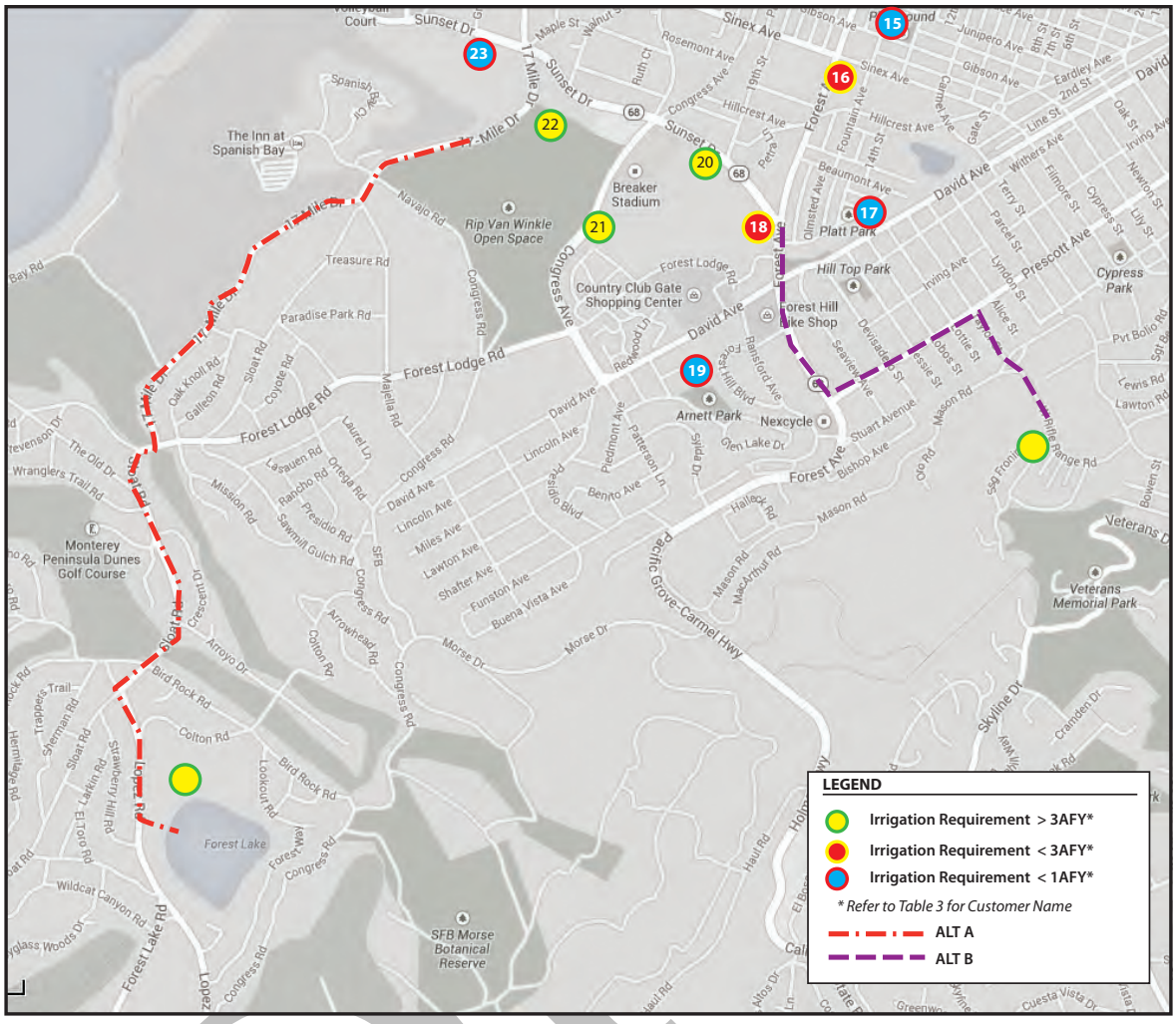

Figure 20 - Demand Group III Alternative Pipeline Alignments

5.3.4 Alternatives Evaluation

A summary of the alignment pipeline alternatives evaluation is presented in Table 18. The comparison criteria include raw construction cost, demand services, and implementation issues such as traffic, utility, and constructability. Based upon these criteria, the recommended conceptual alignment and viable alternatives were identified.

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Table 18 - Demand Groups 1 and 2 Alternatives Evaluation

	Area 1	Area 1	Area 2	Area 2	Area 2	Area 3	Area 3	Area 4	Area 4	Area 5	Area 5
Comparison Criteria	1A	1B	2A	2B	2C	3A	3B	4A	4B	5A	5B
General Location	Through Municipal Golf Links	Along Ocean View/Asilomar	Along Ocean View	Along DelMonte, Sea Crest	Northern Edge of Municipal Golf Links	Forest Avenue	Fountain Avenue	Sunset Drive	Forest Lodge Road	17 Mile Drive	Railway Alignment
Recycled Water Demand (AF)	125	125	12	12	12	3	3	81	81	3	3
Pipeline Length	1370	2380	7635	5815	5230	3900	4200	5300	5600	4200	7200
Demand per Foot	0.09	0.05	0.0015	0.0020	0.0022	0.0009	0.0008	0.0154	0.0145	0.0007	0.0004
Dominant Pipeline Diameter (inches)	8	8	8	8	8	8	8	8	8	8	8
Opinion of Planning Level Construction Cost	$ 150,000.00	$310,000.00	$990,000.00	$700,000.00	$580,000.00	$470,000.00	$500,000.00	$640,000.00	$620,000.00	$500,000.00	$790,000.00
Traffic Impacts	No Specific Issue	Heavy Traffic	Heavy Traffic	Moderate Traffic	No specific Issue	Heavy Traffic	Moderate Traffic	Heavy Traffic	No Specific Issue	Heavy Traffic	Moderate Traffic
Utlity Concerns	Overhead Electrical; Former Sewage Pipeline	Potential Utility Congestion	Potential Utility Congestion	Potential Utility Congestion	No specific Issue	Potential Utility Congestion	Potential Utility Congestion	Potential Utility Congestion	No Specific Issue	Potential Utility Congestion	No Specific Issue
Constructibility	Trenchless Construction Assumed	Trenchless Construction Assumed at Intersections	Trenchless Construction Assumed at Intersections	Trenchless Construction Assumed at Intersections	Trenchless Construction Assumed	Trenchless Construction Assumed at Intersections	Trenchless Construction Assumed at Intersections	Trenchless Construction Assumed at Intersections	Trenchless Construction Assumed at Intersections	Trenchless Construction Assumed at Intersections	Trenchless Construciton Assumed at Intesections; Coordination with Southern Pacific Railway regarding Easement
Recommendations	Preferred Alternatives	Back up Alternative	Alternative to be discarded	Back up Alternative	Preferred Alternatve	Preferred Alternatives	Back up Alterantive	Back up Alterantive	Preferred Alternatives	Preferred Alternatives	Back up Alterantive

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5.4 Baseline Backbone System Alignment

Based on the criteria of recycled water demand served, utility, traffic, constructability issues and cost-effectiveness, the recommended pipeline alignment was based on Alternatives 1A, 2C, 3A, 4B, and 5A. The recommended backbone alignments for Demand Groups I through III is presented in Tables 19 through 21.

Table 19 -Demand Group I - Backbone Alignments

Description	Units	Quantity
Alignment Length	LF	1,370
	Miles	0.03
Demand on Alignment	AFY	100
Backbone Demand	AFY	100
Number of Users Identified		3

Table 20 -Demand Group II - Backbone Alignments

Description	Units	Quantity
Alignment Length	LF	1,500
	Miles	0.30
Demand on Alignment	AFY	100
Backbone Demand	AFY	100
Number of Users Identified		23

Table 21 - Demand Group III - Backbone Alignment

Description	Units	Quantity
Alignment Length	LF	12,000
	Miles	2.3
Demand on Alignment	AFY	215
Backbone Demand	AFY	215
Number of Users Identified		3

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Figure 21 presents the recommended alignments.

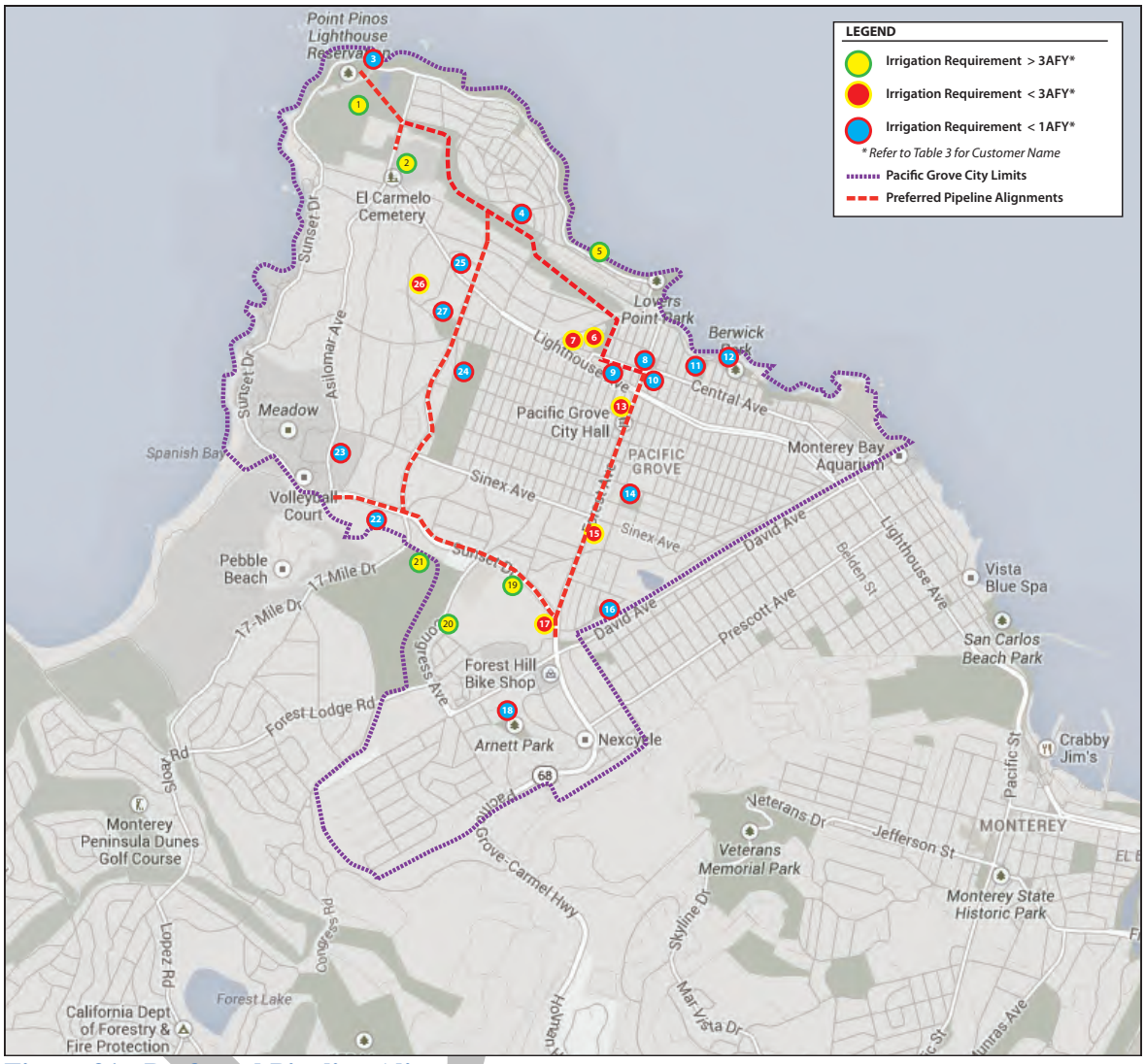

Figure 21 - Preferred Pipeline Alignments

5.5 System Hydraulics and Operation

Hydraulic simulation modeling was used to estimate preliminary pipeline sizing and to estimate system pumping and storage requirements. Planning level design criteria were developed for pumping and storage facilities. The following information is reviewed:

- Description of hydraulic model and criteria
- Analysis of hydraulics from the SRWTP to the distribution system
- Analysis of storage alternatives
- Evaluation of pumping facilities including noise, power, and visual impacts
- Evaluation of pipeline sizing.

5.5.1 System Hydraulics and Operation

Hydraulics for the recommended project were modeled using EPAnet, software developed by the EPA that models pressurized distribution piping systems. The hydraulic model was used to help define the pipeline sizing and alignments for the proposed project. Junctions/nodes were created in the model at appropriate locations along the pipeline alignment to represent anticipated demand points.

5.5.2 Hydraulic Criteria

Hydraulic design criteria for the proposed recycled water system are presented in Table 22.

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Table 22 - Hydraulic Design Criteria

Item	Value
Minimum Pressure at Customer Connections	40 to 80 psi (80 psi required at for sprinkler irrigation)
Maximum Pressures at Customer Connections	180 psi
Minimum Pipeline Diameter	4 inches
Maximum Head Loss	6 feet per 100 feet
Maximum Velocity	4 to 8 fps
Annual Average Demand – Demand Group I	110 AFY
Annual Average Demand – Demand Group II	100 AFY
Annual Average Demand – Demand Group III	215 AFY
Peak Daily Demand – Demand Group I	0.22 mgd
Peak Daily Demand – Demand Group II	0.24 mgd
Peak Daily Demand -- Demand Group III	0.43 mgd
Peak Hour Demand – Demand Group I	136 gpm
Peak Hour Demand – Demand Group II	137 gpm
Peak Hour Demand – Demand Group III	260 gpm

5.5.3 SRWTP Pumping Requirements

The design of the SRWTP will provide adequate pumping capacity to maintain minimum delivery pressure for Demand Group I customers. The SRWTP will include a recycled water pump station to deliver 0.22 mgd of recycled water flows to Demand Group I end users. Future engineering analysis will be completed during the design phase of the project to confirm recycled water pump station sizing required to service Demand Group I.

Additional engineering analysis will be required to consider future pumping capacities required for expansion of the PGLWP to Demand Group II and III customers.

5.5.4 SRWTP Storage Capacity

The existing Point Pinos clarifier and sludge digester will be retrofitted as a part of the proposed proejct to provide 2 days of operational storage for the Demand Group I end users. The retrofit clarifier and digester could provide up to approximately 630,000 gallons of recycled water storage, sufficient for 2 days of peak hour demands for the Demand Group I customers

Additional storage capacity will be considered for future expansion of the PGLWP to Demand Group II and III end users.

Table 23 presents the hydraulic capacities of SRWTP facilities.

Table 23 - SRWTP Hydraulic Capacity

Description	Capacity
SRWTP Pumping Capacity	300 gpm
SRWTP Storage Capacity	630,000 gallons

5.5.5 Pipeline Sizing

An 8 inch 1,370 ft recycled water pipeline size is recommended from the results of the hydraulic analysis. Final pipeline sizing would be conducted during the design phase of the project.

5.6 Recycled Water Market Alternatives

Raw wastewater and urban runoff from the proposed ASBS project could be conveyed to the MRWPCA RTP for inclusion in the MRWPCA GWR Project. The GWR will produce highly treated water for injection to the SGWB that would later be extracted by CAW for potable water use in the Monterey Peninsula. In this case, the PGLWP source water would be treated by MRWPCA for indirect potable reuse.

Recycled water from the PGLWP could also used for local GWR if suitable injection sites were available within feasible locations.

5.7 Non-Recycled Water Alternatives

For the Non-recycled water alternative, potable water would continue to be used by existing customers. If the proposed demands were not served with recycled water:

- Up to 125 AFY of existing potable water supplies from CAW would continue to be used, potentially requiring continued pumping of Carmel River aquifer supplies or

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increased operations of CAW's proposed desalination plant.

- Any delays in the construction of the MPWSP would continue to negatively impact the Carmel River. By not developing the PGLWP, there would be no decrease in the effects to impacts on habitat and species in the Carmel River Watershed.

- Operational requirements of the MPWSP would increase by 125 AFY at CAW's proposed desalination facility.

- Anticipated cost escalation of potable water sold to the City by CAW could significantly impact the operations of the Municipal Golf Links. Reduced golf play reduces needed revenue to the City.

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6 RECOMMENDED PROJECT

This chapter describes the recommended project including target customers, facilities, cost estimates, construction financing plan, and implementation strategy. The recommended project is the first increment of the PGLWP that would be constructed. Additional increments of the PGLWP may occur in the future to provide service to other demand groups.

6.1 Target Customers and Facilities Description

The recommended project would include the construction of a sewage diversion structure, SRWTP, recycled water pump station, approximately 1,370 LF of 8 inch diameter recycled water pipeline, and customer connections. The recommended project would also include replacement of an existing sanitary sewer pump station and approximately 1,000 LF of 6-inch diameter force main. The project facilities would be designed to service Demand Group I customers, with the potential to expand to Demand Groups II and III in the future. The project would be sized to initially serve approximately 125 AFY of recycled water, mostly to the City of Pacific Grove Municipal Golf Course and El Carmelo Cemetery. The predominant use of recycled water would be landscape irrigation. Irrigation would primarily occur between 10:00 p.m. and 6:00 a.m. to maximize water use efficiency and minimize public contact.

Figure 22 presents the recommended target recycled water users and project facilities. Table 24 presents the target user name and recycled water demand. Table 25 presents the recommended project facilities. Figure 23 presents the proposed SWTP Site Plan.

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Figure 22 - Recommended Project

Table 24 - Recommended Project User Name and Demand

ID	Customer	Demand Type	3-Year Reported Non-Potable Water Demand (AFY)	Estimated Actual Non-Potable Water Requirement (AFY)	Peak Demand (MGD)
1	Muncipal Golf Links	Landscape Irrigation	75	90	0.179
2	El Carmelo Cemetery	Landscape Irrigation	8	10	0.020
3	Crespi Pond Restroom	Toilet Flushing	0.3	0.4	0.001
4	Truck Fill	Construction, Sewer Flushing, and Street Sweeping	20	24	0.048
5	Golf Maintenance Facility	Toilet Flushing	0.3	0.4	0.001
6	Environmental Research Division	Landscape Irrigation	0.2	0.2	0.000
	Total		104	125	0.25

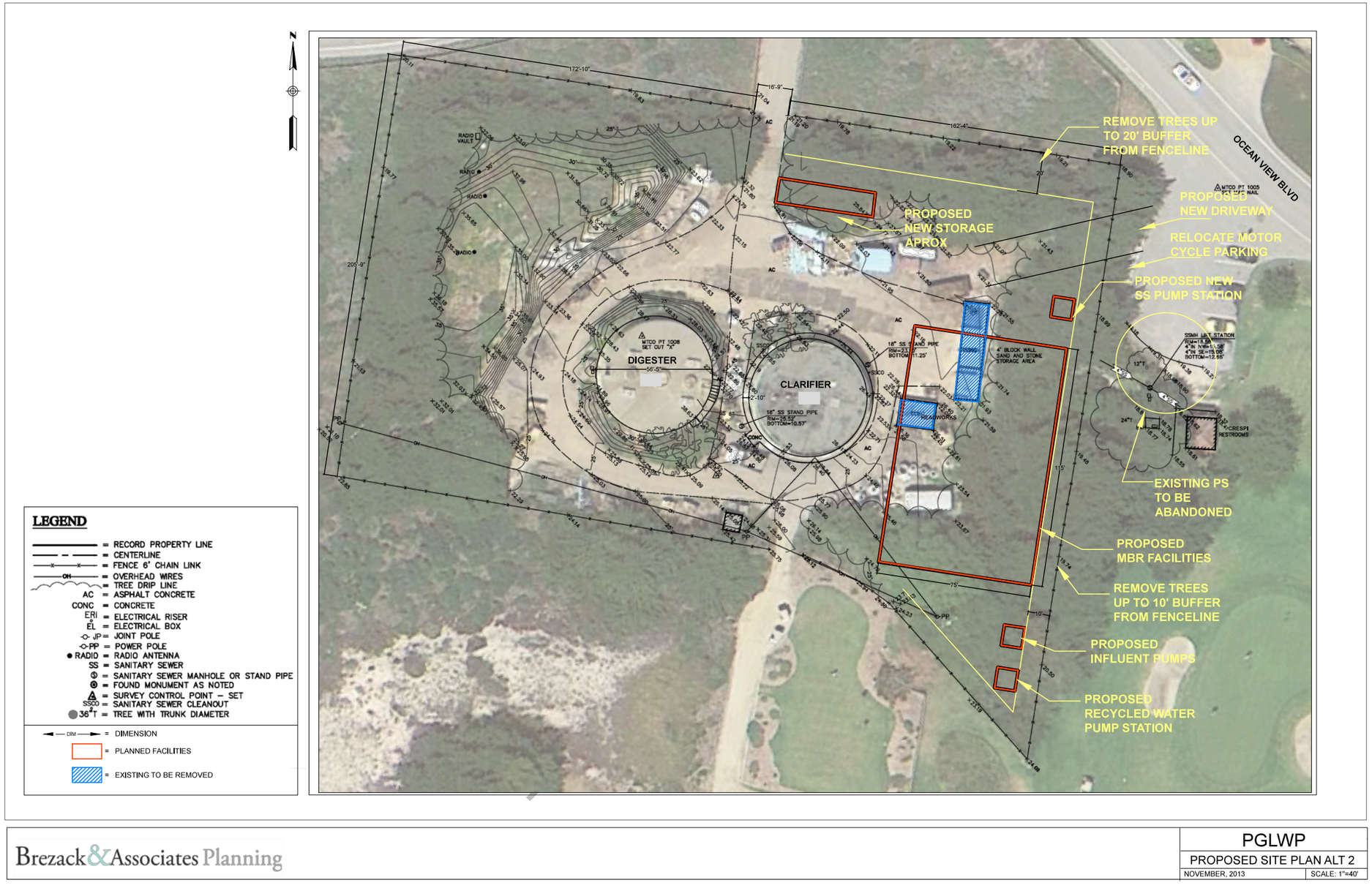

Figure 23 – Proposed SRWTP Site Plan

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Table 24 - Recommended Project Facilities

Description	Quantity	Units
Number of Customers	6	
Annual Average Demand	125	AFY
Peak Month Demand	0.25	MGD
Peak Hour Demand	0.43	MGD
Peak Hour Demand	136	gpm
Sewer Diversion Capacity	0.6	MGD
SWRTP Average Capacity	0.114	MGD
SWRTP Peak Capacity	0.28	MGD
New Sanitary Sewer Pump Station 15.5	15	hP
New 6" Force Main	1000	LF
New Recycled Water Pump Station	30	hP
Total Recycled Water Distribution Pipeline Length	1600	LF
8" Sewer Diversion Pipeline	1370	LF
Golf Course Easement (Open Cut through Turf)	1100	LF
Asilomar (Open Cut through pavement)	270	LF

The proposed recycled water distribution pipeline alignment would begin with a connection point from the SWRTP pump station. The pipeline would be constructed parallel to the proposed sewage diversion pipeline through the Municipal Golf Course to Asilomar Avenue. The pipeline would continue in Asilomar Avenue to the El Carmelo Cemetery turn out.

The recommended project includes work for furnishing and installing connections between the recycled water distribution system and the customer's existing irrigation system, recycled water meters, valves, valve boxes, and appropriate backflow and cross-connection prevention equipment, as required by CDPH regulations. Site retrofits include necessary signage, painting vaults, and above ground piping purple, tags, and purple sprinkler heads.

6.2 Opinion of Probable Project Cost

The planning level cost estimate for the recommended project is summarized in Table 26. Appendix G presents details on the cost estimate.

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Table 25 - Recommended Project Opinion of Probable Cost

Description of Expense [6]	Cost
Concrete	$ 10,700.00
Excavation and Back fill (10%)	$ 1,100.00
Miscellaneous Metals (4%)	$ 4,300.00
Yard Piping (7%)	$ 800.00
Total Concrete	$ 16,800.00
Equipment [5]	$ 1,460,000.00
Tax and Delivery (11%)	$ 160,600.00
Installation (20%)	$ 292,000.00
Manufacturer Services (4%)	$ 58,400.00
Total Mechanical	$ 1,971,000.00
Protective Coating (7%)	$ 139,100.00
Electricity (10%)	$ 197,200.00
Instrumentation (10%)	$ 198,800.00
Housing	$ 139,000.00
Subtotal	$ 2,661,900.00
Contingency (30%)	$ 798,600.00
Total Construction Cost	$ 3,480,500.00
Engineering Design (10%)	$ 348,100.00
Total Capital Cost	$ 3,828,600.00
Annualized Capital Cost	$170,900.00
Annualized O&M (5% Construction Cost)	$ 191,430.00
Capital Cost per AFY	$ 1,400.00
O&M Cost per AFY	$ 1,500.00
Total Cost per AFY	$ 2,900.00

(1) Assumes retrofit of existing clarifier/administration building per Harper Eng Estimate
(2) Assumes retrofit of existing headworks
(3) Assumes MBR cost provided by equipment supplier and include headworks through disinfection
(4) Assumes retrofit of existing digester per Harper Eng Estimate
(5) Equipment is defined as mechanical equipment or pipeline
(6) Cost Estimating Factors pursuant to Table 4-6 of Watereuse Research Foundation, Decision Support System for Selection of Satellite vs. Regional Treatment for Reuse Systems, 2009.

6.3 Construction Financing Plan

This section discusses potential funding sources available to the recommended project. Project capital funds will likely come from a combination of funds from the City, grants, loans and willing project partners. The estimated project costs are within the funding range for available SWRCB grants and loans. Financing is intended for the recommended project only. Any future expansion to serve Demand Groups 2 and 3 would be separately pursued.

6.3.1 SWRCB State Revolving Fund (SRF) Loan

The SRF Loan Program is administered by the SWRCB. The program provides low-interest loan financing for a wide array of design and construction projects, including

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construction of publicly-owned wastewater treatment facilities, local sewers, sewer interceptors, and wastewater reclamation facilities. The SRF Loan Program provides 20 and 30-year loans with an interest rate set at half of the State Bond General Obligation Rate (State rate has been in the range of 1.7% to 2.9% over the last seven years). There is no maximum loan amount. The SWRCB is accepting new applications on a continuous basis.

6.3.2 SWRCB Water Recycling Funding Program (WRFP) Construction Grant

A Construction Grant is available through the WRFP administered through the SWRCB. The Construction Grant can provide up to 25% of the construction cost with a cap of $5 million. The applicant must submit a Facilities Plan and Water Conservation Plan as specified in WRFP Guidelines (SWRCB, 2008). It is currently unknown how much is available for grant funding as the legislature has suspended those funds.

6.3.3 United States Bureau of Reclamation (USBR) Title XVI

In 1992, Congress authorized the USBR to participate in local recycled water projects under "The Reclamation Wastewater and Groundwater Studies and Facilities Act," known as Title XVI. Title XVI funds are available for feasibility studies and/or design and construction costs. The Federal contribution is capped at 50% of the total study cost, and 25% of the total project cost (including construction), or $20 million per project.

The federal appropriation process typically requires that the project sponsor notifies the USBR two years prior to the year the funds are sought. In order to be eligible, the project must meet legal and institutional requirements, including National Environmental Policy Act (NEPA) compliance and consultation with US Fish and Wildlife Service and National Marine Fisheries Service. A cost sharing agreement can be approved only after all feasibility and environmental requirements are met.

6.3.4 DWR Proposition 84

DWR Proposition 84 is an implementation grant program for California with two rounds of funding. A number of project types are eligible for funding. They include: flood control projects, planning and feasibility studies focusing on climate change and impacts on flood and water systems; integration of flood and water systems, prevention of storm water contamination, urban greening energy reduction, water conservation, and improvements to water quality. Competitive grants are also available for local and regional parks, land use plans designed to promote water conservation, and community revitalization.

The City, in partnership with the City of Monterey, is implementing the ASBS Storm Water Protection Project as part of a Proposition 84 grant through the Monterey Regional Integrated Water Resources Management Plan (MRIWRMP).

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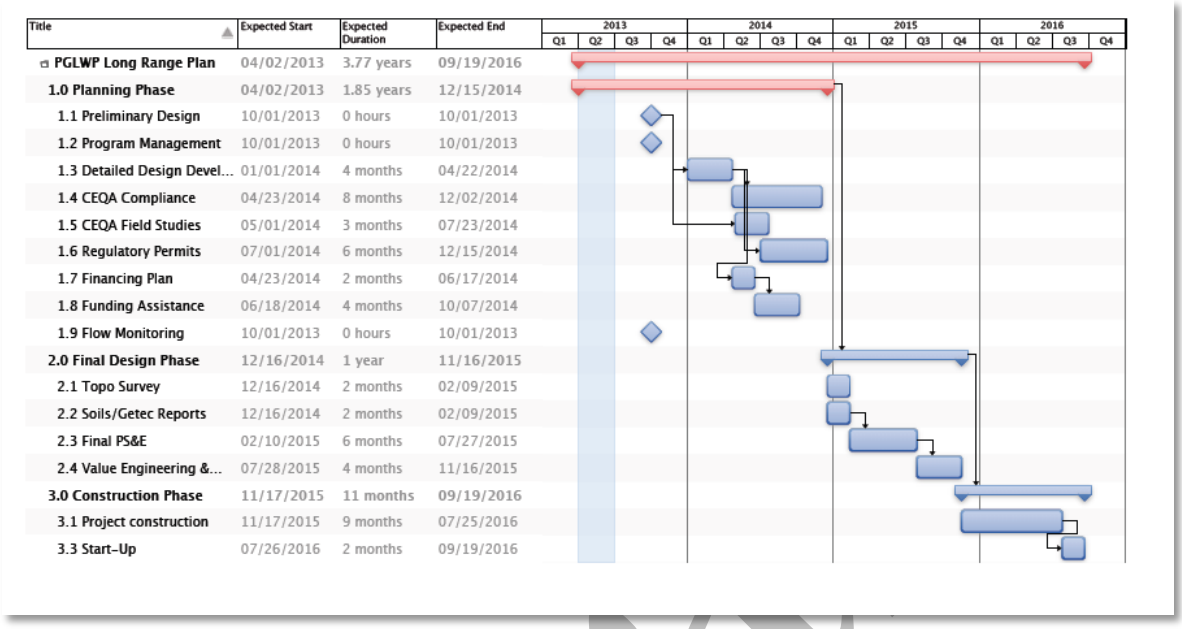
7 IMPLEMENTATION PLAN

This chapter describes the implementation plan for the recommended project. Figure 24 presents the major milestones for the recommended project implementation schedule.



Title	Expected Start	Expected Duration	Expected End
PGLWP Long Range Plan	04/02/2013	3.77 years	09/19/2016
1.0 Planning Phase	04/02/2013	1.85 years	12/15/2014
1.1 Preliminary Design	10/01/2013	0 hours	10/01/2013
1.2 Program Management	10/01/2013	0 hours	10/01/2013
1.3 Detailed Design Devel...	01/01/2014	4 months	04/22/2014
1.4 CEQA Compliance	04/23/2014	8 months	12/02/2014
1.5 CEQA Field Studies	05/01/2014	3 months	07/23/2014
1.6 Regulatory Permits	07/01/2014	6 months	12/15/2014
1.7 Financing Plan	04/23/2014	2 months	06/17/2014
1.8 Funding Assistance	06/18/2014	4 months	10/07/2014
1.9 Flow Monitoring	10/01/2013	0 hours	10/01/2013
2.0 Final Design Phase	12/16/2014	1 year	11/16/2015
2.1 Topo Survey	12/16/2014	2 months	02/09/2015
2.2 Soils/Getec Reports	12/16/2014	2 months	02/09/2015
2.3 Final PS&E	02/10/2015	6 months	07/27/2015
2.4 Value Engineering &...	07/28/2015	4 months	11/16/2015
3.0 Construction Phase	11/17/2015	11 months	09/19/2016
3.1 Project construction	11/17/2015	9 months	07/25/2016
3.3 Start-Up	07/26/2016	2 months	09/19/2016

Figure 24 - Project Implementation Schedule

7.1 Environmental Compliance

It is assumed that an environmental impact report with necessary mitigations will be required for compliance with the California Environmental Quality Act (CEQA) and the environmental policy of the SWRCB, implemented as CEQA-Plus will be required.

The City will serve as the lead agency for the environmental compliance requirements.

It is assumed that compliance with the National Environmental Protection Act (NEPA) will not be required for this project.

7.2 Procurement

This section provides a review of the various procurement options potentially available to the City to achieve design completion, construction, and operation of the proposed project including the SRWTP and its associated facilities.

The traditional approach to construction of public works projects requires that separate and distinct specialists be brought in to play their specific and independent roles in the completion of the proposed project. However, many new entrants to the field of design and construction now offer specialized expertise that can facilitate the work. As a result, there is a higher likelihood of on-time and on-budget project completion. The following methodologies of design, construction, and operations are evaluated:

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1. Design-Bid-Build (DBB)

- Traditional methodology.
- Requires the City select and contract individually with 2 entities: a design firm, and a construction contractor. The construction contractor would provide a construction manager.
- City maintains responsibility of integrating the work of the design engineering with the construction contractor. Therefore, City is likely to want to hire a separate owners representative or Construction Manager to assist with the integration responsibilities.
- Neither the design engineer nor the construction contractor are responsible for ensuring the operational integrity of the finished facility.
- Following construction, the City would likely hire a start-up and operations contractor to ensure operations to specification and to maintain the system on a daily basis as no current City staff has availability or expertise on operations and maintenance of a wastewater treatment facility.

2. Construction Manager At Risk (CMAR)

- Some characteristics are the same as traditional DBB procurement:
    - Requires that the City select and contract individually with 2 entities: a design firm and, a construction contractor.
    - City maintains responsibility of integrating the work of the design engineering with the construction contractor.
    - Neither the design engineer nor the construction contractor are responsible for ensuring that the operational integrity of the finished facility.
- The construction contract is phased into two distinct parts to enable the selection and participation much earlier in the process than under a DBB scenario.
    - Part 1: The construction contractor is brought on at approximately the 10 to 20% level of detailed design completion. They assist in pre-construction services that tend to facilitate a better on-time, on-budget result. These activities include estimating, surveying, value engineering, constructability review, planning of subsequent work packages; and review/selection assistance in bringing sub-contractors on board.
    - Part 2: At approximately the 60% level of detailed design completion, the Contractor would provide the City with a guaranteed maximum price (GMP) for the construction of the project. The City can either accept the GMP or reject it and then proceed with a traditional DBB scenario.

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3. Design – Build (DB)

- The City would select a design-build contractor under a single contract.
- The DB Contractor becomes responsible for the integration of the project design with the construction. This relieves the City from having to be responsible for the integration efforts.
- The City can select the DB Contractor on the basis of their combined technical capabilities and price creating a lump-sum best value proposition for the City's evaluation. Alternatively, the DB Contractor can be selected using a negotiated progressive approach where the contractor is selected on the basis of their qualifications and subsequently provide the City with a proposal for all preliminary work. Next the DB Contractor completes the design and construction through start-up.
- The City would need to supply the prospective DB Contractors with a sufficiently detailed technical package as the basis for their bid.
- Some of the construction activities can be initiated much earlier than with traditional contracting methods and before design has been completed. However, long-lead items for regulatory permitting approvals and environmental documentation still must be completed first.

4. Design – Build Plus (DB+)

- Specialized Design Build Contractors have entered the wastewater recycling market and have been offering highly refined and tailored services. This has expanded the offering of the DB contractor (described above) to include a variety of additional services that may be particularly suitable for the City.
- The following additional services can be provided by qualified DB entities:
    - **Operate:** A design-build-operate contractor would include the responsibilities for daily operational activities, and maintain compliance with applicable permits. The DBO contract would need to evaluate and negotiate a price for the recycled water produced by the plant.
    - **Own:** In this case the contractor would be Design-Build-Own-Operate (DBOO). The plant could be built to be owned by the DB contractor, thereby relieving the City from operational, managerial, regulatory and other responsibilities. A contract for DBOO could include a by-back provision that would be available to the City following a specified number of years.
    - **Finance:** In this case the contractor would be Design-Build-Finance (DBF). Additionally, depending on the DB contractor's capabilities, the contractor could also include operations and ownership.

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To expedite the design and construction process, it is recommended that the City move forward with a DB contractor suing the DB+ scenario for the proposed project. The City would evaluate proposals to include an operations contractor within the DB contractor procurement, or initiate a separate contract for operations and maintenance. It is recommended that a preliminary evaluation of financing and funding opportunities be completed prior to committing to Contractor ownership and financing options.

7.3 Permitting and Agency Coordination

The City will need to address permitting issues and stakeholder agency coordination during the design and construction process. Construction, operation, and environmental permits will be required for the construction and operation of the SRWTP. Permitting requirements will be dependent upon the project location, ownership, operations and environmental documentation that will be required prior to construction. A detailed review, assessment, and scheduling of regulatory approvals for the Project will be conducted.

7.3.1 Institutional Agreements

7.3.1.1 MRWPCA

An agreement will MRWPCA will be required for discharge of the SRWTP solids to the sanitary sewer system. The City will be required to adhere to flow and quality requirements for discharges to the system.

7.3.1.2 CAW

A review of the existing franchise agreement between the City and CAW will be required to determine any potential modifications to the agreement.

7.3.2 Coastal Development Permit (CDP)

A CDP will be required because of the “change in the intensity of use of water” that will occur within the Coastal Zone as a result of the project. “Development" as defined within the Coastal Act means, on land, in or under water, the placement or erection of any solid material or structure. Further "structure" includes, but is not limited to, any building, road, pipe, flume, conduit, siphon, aqueduct, telephone line, and electrical power transmission and distribution line. Therefore, it is anticipated that a CDP will be required for the construction of the wastewater pipeline diversion and the reclaimed water pipeline extension, and upgrades to the former Point Pinos WWTP. The City does not have a certified Local Coastal Plan in place, and therefore it is anticipated that the permit will be issued by the California Coastal Commission.

7.3.3 Construction Permits

The following permit approvals are assumed to be required for the project:

- Authority to Construct (Monterey Bay Air Quality Management District)

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- General Construction Storm Water NPDES Permit (RWQCB)
- Construction, Trenches, Excavation, and Demolition (California OSHA)
- Sewer Discharge and Connection Permits (MRWPCA).

7.3.4 Operational Permits

7.3.4.1 Title 22 Engineering Report

The City will need to prepare a Title 22 Engineering Report for the recommended project in accordance with CCR Title 22 and CDPH Guidelines for the Preparation of an Engineering Report for the Production, Distribution, and Use of Recycled Water (2001). The report is prepared for submittal to the Central Coast RWQCB, CDPH, and Monterey County Department of Health Services as part of the project permitting process. The report content typically includes significantly more details on the recycled water production facilities, transmission and distribution facilities and use areas.

7.3.4.2 Water Recycling Waste Discharge Permit

A WDR will be obtained from the RWQCB for the discharge of recycled water to land.

The WDR will require that a recycled water program be established. The recycled water program will include requirements for on-site design, installation, and operations of recycled water system. The recycled water program will also outline the standards for site construction, inspection, and training for recycled water site supervisors.

7.3.4.3 Other Operational Permits

Other operational permits that may be required include:

- Permit to operate (Monterey Bay Air Quality Management District)
- Permit for the storage of hazardous materials (Monterey County Environmental Health)
- Compliance with backflow prevention requirements (CAW and MPWMD)

The City may elect to include compliance with all permitting regulations as part of the contract requirements with a private treatment operator. In this case, the operator would be charged with obtaining and ensuring regulatory compliance as an agent to the City. The City would continue to be responsible for compliance as the permit holder and system owner.

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APPENDIX A Condition Assessment

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CORROSION REPORT

PROJECT: Corrosion Engineering Evaluation of Two Concrete Water Storage Structures

STRUCTURE: 210,000 Gallon Reinforced Concrete Clarifier

OWNER: Brezack & Associates Planning

LOCATION: Pacific Grove, California

INVESTIGATED BY: Andre Harper, Project Engineer

DATE: July 2013

I GENERAL INFORMATION

A. Construction and Maintenance Details

Structure is a partially buried circular reinforced concrete clarifier which is currently being utilized for water storage. The structure is located in Pacific Grove, California. The clarifier was constructed in 1952 and has a diameter of 55 feet, an approximate overall height of 15 feet, and a maximum water depth of approximately 12 feet. The roof is self supporting. Access into the clarifier is through the floor of the administration building.

B. Site Conditions

The clarifier is located on a dirt and asphalt site and enclosed by a chain link fence. The clarifier is partially buried with approximately three feet of the clarifier wall exposed. There is adequate vehicle access around the clarifier. No difficulty is anticipated for Contractor mobilization, assuming use of normal portable air compressor and related equipment.

There is a golf course in close proximity which could be adversely affected by dust and contamination associated with abrasive blast cleaning and painting operations. Accordingly, extreme caution must be exercised during all cleaning and painting operations.

C. Existing Coating, Paint, and Sealant Systems

1. No records for the coatings, paints, or sealants were made available to HAE for review. The field investigation indicates the following:

a. Interior Surfaces

1) Concrete surfaces are uncoated.

2) The interior appurtenances appear to be a combination of coated carbon and galvanized steel, and random plastic.

b. Exterior Surfaces

1) Concrete roof surfaces are covered with a tar and gravel roofing system.

2) Concrete wall surfaces are painted with an unknown paint system.

3) Exterior appurtenances appear to be a combination of galvanized, stainless, and painted carbon steel, and plastic.

D. Cathodic Protection System

The clarifier has no cathodic protection system installed on the interior of the structure.

E. Heavy Metal Analyses

No samples of interior coatings or paints were removed for analyses for the presence of heavy metals, specifically lead, chromium compounds, zinc, or asbestos, as this was not included in the scope of work.

F. Contract Information

Harper & Associates Engineering, Inc. was retained by Brezack & Associates Planning to accomplish field investigation of two concrete structures to observe interior and exterior surfaces and conditions, with photographs taken to record conditions. This report has been prepared with remedial repair/recoating/repainting recommendations and cost estimates for accomplishing the work.

This Corrosion Report is prepared solely on the basis of noted field investigation. Conclusions and recommendations are strictly those determined by Consultant to be consistent with the best and most experienced practice within the corrosion engineering profession.

II INVESTIGATION

A. Investigation was accomplished as follows:

1. Exterior Surfaces

a. Investigation of the roof surfaces and appurtenances on the roof was accomplished by traversing the roof.

b. Investigation of the exposed portion of the wall was accomplished by traversing the perimeter of the clarifier from ground level, examining areas above grade and within reach.

c. Photographs were taken of typical and specific areas to illustrate condition of surfaces.

2. Interior Surfaces

a. No interior ladder is present so a temporary extension ladder was utilized to access the interior of the clarifier.

b. Interior surfaces were examined visually by traversing the upper portion of the slope as the water was too deep to access the middle of the bottom surfaces.

c. Light was supplied via high intensity portable light and natural light from roof hatches.

d. Various chipping tools were employed to examine typical areas of defective concrete and coating within reach.

e. Photographs were taken of typical and specific areas to illustrate condition of surfaces.

III OBSERVATIONS

A. Based upon the above reported investigation, the following observations were noted:

1. Exterior Surfaces

a. Administration Building Roof and Appurtenances

1) Overall, the roofing material and appurtenances are in fair to poor condition. (Photos E-2 through E-5)

2) Minor corrosion is present on the vent covers. (Photo E-3)

3) Sections of the roof have minimal gravel remaining. (Photos E-2 through E-5)

4) Severe corrosion is present at the roof ports. (Photos E-4 and E-5)

b. Above Grade Wall Surfaces

1) The exposed portions of the walls are in overall fair to good condition with random isolated spalls, cracks, and surface

deterioration present. (Photos E-6 through E-18)

2) Delamination of the paint system is present on the top of the wall. (Photos E-6 and E-8 through E-10)

3) Severe corrosion is present on the ladder and the side rails at the top of the ladder have corroded off. (Photos E-6 and E-7)

4) Corrosion is present at the miscellaneous hardware and appurtenances. (Photos E-8 through E-12 and E-15 through E-18)

5) Spalling with corroding reinforcing steel is present randomly on the walls above grade. (Photos E-12 through E-14 and E-16 through E-18)

c. Interior of Administration Building

1) The concrete surfaces in the administration building are in overall good condition with black soot on a majority of the upper surfaces. (Photos E-19 through E-26)

2) Minor to moderate corrosion is present at a roof access hatch and door frame. (Photos E-22 and E-23)

3) Existing doors in the interior concrete walls were widened by saw cutting adjacent concrete, leaving reinforcing steel exposed to the elements. (Photos E-20, E-24, and E-25)

2. Interior Surfaces

a. Underside of Roof

1) The concrete roof surfaces are in overall good condition. (Photos I-1 through I-12)

2) Random minor spots of corrosion are present on the roof surfaces. (Photos I-1 through I-5, I-11, and I-12)

3) The top layer of concrete is randomly delaminating. (Photo I-7)

4) Moderate to severe corrosion is present at a secondary roof hatch, fittings, and piping. (Photos I-8 through I-10)

b. Effluent Weir

1) The concrete surfaces in the effluent weir are in fair condition, however severe corrosion is present on the weirs and piping. (Photos I-9 through I-22)

2) Severe corrosion and rust scale are present at the weirs, mounting brackets, and piping. (Photos I-9 through I-16 and I-18

through I-22)

3) The top layer of concrete is randomly delaminating on the roof. (Photos I-15 and I-16)

4) Minor deterioration of the concrete is present at the top of a column. (Photo I-17)

5) Spalls are developing on the corner of a support beam. (Photos I-21 and I-22)

c. Walls, Appurtenances, and Bottom

1) The concrete walls are in overall good condition with dark staining present. The bottom surfaces could not be evaluated due to water and debris covering the horizontal surfaces. (Photos I-23 through I-37)

2) Moderate corrosion is present at the primary roof hatch. (Photos I-24 through I-26)

3) Random debris and dirt are present on the bottom surfaces. (Photos I-27 through I-29 and I-32 through I-37)

4) An oily substance is present randomly on the walls. (Photo I-31)

3. Safety, Health, and Code Features

a. No handrailing assembly is present on the roof at the ladder.

b. No self-closing gate is present at the termination of the ladder onto the roof.

c. The exterior ladder is severely corroded.

IV CONCLUSIONS

A. Based on the above noted observations, the following conclusions are drawn:

1. Exterior Surfaces

a. Administration Building Roof and Appurtenances

1) Roofing materials and appurtenances are in fair to poor condition.

2) Minor corrosion on the vent covers appears to be the result of impurities in the stainless steel covers and the corrosive saltwater environment.

3) Sections of the roof with minimal gravel remaining appear to be the result of the age of the roofing system and weathering that

has occurred over the years.

4) Severe corrosion on the roof ports appears to be the result of the paint and coating systems protecting the substrate far exceeding their life expectancy. Typical paint and coating systems have a 20 to 25 year life expectancy.

b. Above Grade Wall Surfaces

1) The visible portions of the walls are in fair to good condition even though there are isolated areas of exposed reinforcing steel, random hairline cracking, and miscellaneous cosmetic issues that could lead to further damage if they are not remediated.

2) Delamination of the paint system on the concrete surfaces appears to be due to the age of the system and lack of maintenance.

3) Severe corrosion on the ladder and miscellaneous hardware and appurtenances appears to be the result of the paint system far exceeding its life expectancy and damage and/or defects to the galvanized components.

4) Spalling is the result of either cracks in the concrete or placing the reinforcing steel too close to the surface. When moisture reaches the steel, it begins to corrode and rust scale forms causing the spalling.

5) Random minor corrosion on the wall is typically the result of tie wire not having sufficient coverage or form hardware not being completely removed.

c. Interior of Administration Building

1) The concrete surfaces inside the building are in good condition.

2) Black soot on a majority of the surfaces is the result of a fire previously set by vandals.

3) Corrosion on the access hatch and door is due to a combination of the age of the paint system, corrosive saltwater environment, and damage to the paint system caused by personnel.

4) Corrosion on the exposed reinforcing steel at the widened doorway is the result of not protecting the carbon steel after saw cutting the door.

2. Interior Surfaces

a. Underside of Roof

1) The condition of the interior roof surfaces must be rated as good.

2) Random minor spots of corrosion on the roof are due to the same reasons noted above in section 1. b. 5).

3) The delaminating top layer of concrete is typically the result of poorly mixed concrete or excess water to cement ratio.

4) Moderate to severe corrosion at appurtenances is the result of the coating system far exceeding its expected life and possible damage caused during previous maintenance intervals.

b. Effluent Weir

1) The condition of the concrete surfaces in the effluent weir is fair to good, but the bottom surfaces could not be evaluated as they were covered with sediment and debris.

2) Severe corrosion at the weirs, mounting brackets, and piping is the result of the coating system far exceeding its typical life expectancy of 20 to 25 years.

3) Delaminating concrete is due to the same reasons noted above in section 2. a. 3).

4) Minor deterioration of the concrete on the upper portion of a column appears to be the result of defects in the concrete during the original construction.

5) Severe cracking on the corner of the support beam does not appear to be due to internal corrosion as no rust stain is present and may be due to uneven settlement or flaws in the original construction.

c. Walls, Appurtenances, and Bottom

1) The condition of the concrete wall surfaces must be rated as good.

2) Staining on the surfaces in the fluctuation zone is the result of contaminates and minerals in the water that adhere to the surfaces over time.

3) Moderate corrosion on the roof hatch framing and cover appears to be due to the age of the galvanized coating and possible damage that occurred during previous maintenance intervals.

4) Dirt and debris on the bottom are due to a combination of contaminates coming through the inlet that settle on the horizontal surfaces over time and vandals throwing debris into the clarifier.

5) An oily substance randomly on the wall is typically the result of

contaminates in the water that adhere to the surfaces within the fluctuation zone over time.

3. Safety, Health, and Code Features

a. Lack of handrailing assembly around roof hatch/work area is in violation of OSHA Regulations and creates a safety hazard.

b. Lack of a self-closing gate at the termination of the ladder at roof level is in violation of OSHA Regulations.

c. The exterior ladder is unsafe due to the severe corrosion present.

V RECOMMENDATIONS

A. Based on the above noted observations, the following recommendations are offered:

1. Exterior Surfaces

a. The exterior surfaces are in overall fair to good condition, but do require miscellaneous repairs as noted below:

1) Corrosion on the vent covers is very minor and should be considered only an aesthetic concern at this time. However, given the severe corrosion of the miscellaneous appurtenances, the internal portions of the vent structure may require repair or replacement. Therefore, it is recommended the vent covers be removed and the structures inspected to determine if repair or replacement is necessary.

2) The roofing system is deteriorated and may result in rainwater leaking into the administration building; however the deterioration should not pose additional concerns. If it is decided to rehabilitate the administration building, the existing roof material should be removed and replaced.

3) The severely corroded roof ports and miscellaneous hardware should be replaced when the new roofing system is installed.

4) Corroded metal door frames should be replaced with new frames before new doors are hung.

5) Corroded piping and exposed reinforcing steel should be repainted at the next maintenance interval. This would require surfaces be blast cleaned to Near White Metal (SSPC-SP10), primed, and two finish coats applied.

6) All exterior concrete surfaces should be abrasively sweep blast cleaned or high pressure water blasted to remove all loose paint and concrete, and surfaces should be repainted if aesthetics are a concern.

7) Cracks and spalls on the concrete surfaces should be thoroughly cleaned by brush-off blast cleaning, chipping, grinding, etc., and the area repaired with a cementitious material.

2. Interior Surfaces

a. The interior concrete surfaces are in overall good condition. The following recommendations are based on the limited field evaluation, making assumptions due to heavy staining on the interior walls, and water, sediment, and debris in the bottom of the tank and the weir channel. For HAE to prepare a thorough specification with a complete scope of work and an accurate number of repair spots and/or lineal footage for cracks, etc., it would be necessary to clean the interior walls, floor, and weir channels.

1) Random spot corrosion, delaminating concrete, spalls, and hairline cracks on the concrete surfaces should be thoroughly cleaned by brush-off blast cleaning, chipping, grinding, etc., and the area repaired with a cementitious material.

2) The steel appurtenances, including hatches, fittings, and piping, should be abrasive blast cleaned to Near White Metal (SSPC-SP10) and a three coat epoxy coating system applied to a minimum total dry film thickness of 15.0 mils.

3) Severe cracking on the support beam would require further evaluation by a structural engineer to determine the method of repair and/or replacement.

4) The severely corroded effluent weirs should be removed during the rehabilitation of the structure. The mounting bracket bolts should be coated and/or ground down and covered with a cementitious repair material.

5) Random debris on the bottom surfaces should be removed before utilizing for water storage.

3. Safety, Health, and Code Features

a. Handrailing meeting OSHA Regulations must be installed.

b. A self-closing gate meeting OSHA Regulations must be installed at the termination of the ladder at roof level.

c. An exterior ladder meeting OSHA Regulations should be installed.

VI COST ESTIMATES

A. Based on current and previous projects of similar scope, preliminary cost estimates for work as noted in RECOMMENDATIONS were calculated by using data from those projects.

1. Exterior Surfaces

   a. If deemed necessary, replacing the roof vents after r emoving the covers would be approximately $8,000.

   b. Replacing the roofing system would be approximately $35,500.

   c. Removing or replacing the severely corroded roof por ts and miscellaneous hardware would be approximately $2,200.

   d. Repainting the exterior w all surfaces and exposed reinforcing steel and piping would be in the range of $14,000 to $18,000.

   e. Repairing random cracks and spalls would be in the range of $6,000 to $8,000.

2. Interior Surfaces

   a. Repairing random spot corrosion, de laminating concrete, spalls, and hairline cracks would be in the cost range of $80 to $100 per spot, for an estimate of approximately 300 spots, or $24,000 to $30,000.

   b. Recoating all steel appurtenances would be in the range of $10,500 t o $15,500.

   c. Removing the effluent weirs and brackets would be approxi mately $9,800.

   d. Removing the debris from the bottom surfaces could be accomplished by City personnel or added to the above contract for minimal cost.

3. Safety, Health, and Code Features

   a. Installing handrailing meeting OSHA Regulations woul d be approximately $7,000.

   b. Installing a self-closing gate at the ter mination of the ladder at roof level would be approximately $1,200.

   c. Removing the existing exterior ladder and installing one meeting OSHA Regulations would be approximately $4,000.

Respectfully submitted,

HARPER & ASSOCIATES ENGINEERING, INC.

Andre Harper
Project Engineer

HARPER & ASSOCIATES ENGINEERING, INC.

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PHOTOGRAPHIC SURVEY

PROJECT:	Corrosion Engineering Evaluation of Two Concrete Water Storage Structures
STRUCTURE:	Interior of the 210,000 Gallon Reinforced Concrete Clarifier
OWNER:	Brezack & Associates Planning
LOCATION:	Pacific Grove, California
PHOTOGRAPHED BY:	Andre Harper, Project Engineer
DATE:	July 2013

I-1 General view of the roof, illustrating good condition of the concrete with random spots of corrosion present. Note circular hole where clarifier drive mechanism has been removed.

I-2 View of a portion of the roof, illustrating good condition of the concrete with random spots of corrosion.

I-3 Same as Photo I-2, except at a different location.

I-4 View of the clarifier roof, illustrating random spots of corrosion.

I-5 View of the roof, illustrating random spots of corrosion and otherwise good condition of the concrete surfaces.

I-6 View of the roof, illustrating generally good condition of the concrete surfaces.

I-7 View of the roof, illustrating delamination of the top layer of concrete.

I-8 View of a secondary roof hatch, illustrating minor corrosion at the circumference of the hatch and on adjacent roof surfaces.

I-9 View of sanitary plumbing for the above administration building, illustrating severe corrosion on the metal fittings and adjacent weir.

I-10 View of the roof and wall, illustrating moderate to severe corrosion on the piping and weir.

I-11 View of the roof to wall transition, illustrating minor random corrosion on the support beam and severe corrosion on the weir.

I-12 Same as Photo I-11, except at a different location.

I-13 View of a portion of the weir, illustrating severe corrosion on the weir and mounting brackets.

I-14 Same as Photo I-13, except at a different location.

I-15 View of the interior effluent weir surfaces, illustrating severe corrosion on the weirs and delamination of the adjacent concrete roof surfaces.

I-16 Same as Photo I-15, except at a different location.

I-17 View of a concrete support from inside the effluent weir, illustrating minor deterioration of the upper portion of the column.

I-18 View of the interior effluent weir surfaces, illustrating the good condition of the concrete surfaces. Note moderate to severe corrosion on the pipe in the background.

I-19 Same as Photo I-18, except at a different location.

I-20 View of the interior effluent weir surfaces, illustrating severe corrosion on the weirs and piping.

I-21 View of a roof support beam just inside an effluent weir access hatch, illustrating severe cracking on the corner of the beam.

I-22 Same as Photo I-21, except from a slightly different angle.

I-23 View of the roof to wall transition, illustrating the good condition of the concrete surfaces.

I-24 View of the roof hatch, illustrating moderate corrosion at the hatch framing and cover and minor random corrosion on the adjacent concrete surfaces.

I-25 Same as Photo I-24, except a closer view.

I-26 Same as Photos I-24 and I-25, except a close-up view of the hatch opening.

I-27 View of a portion of the wall, illustrating good condition of the concrete with staining present. Note random debris floating in the water.

I-28 Same as Photo I-27, except at a different location. Note traffic cones on bottom.

I-29 View of the wall, illustrating good condition of the concrete and staining present.

I-30 Same as Photo I-29, except at a different location.

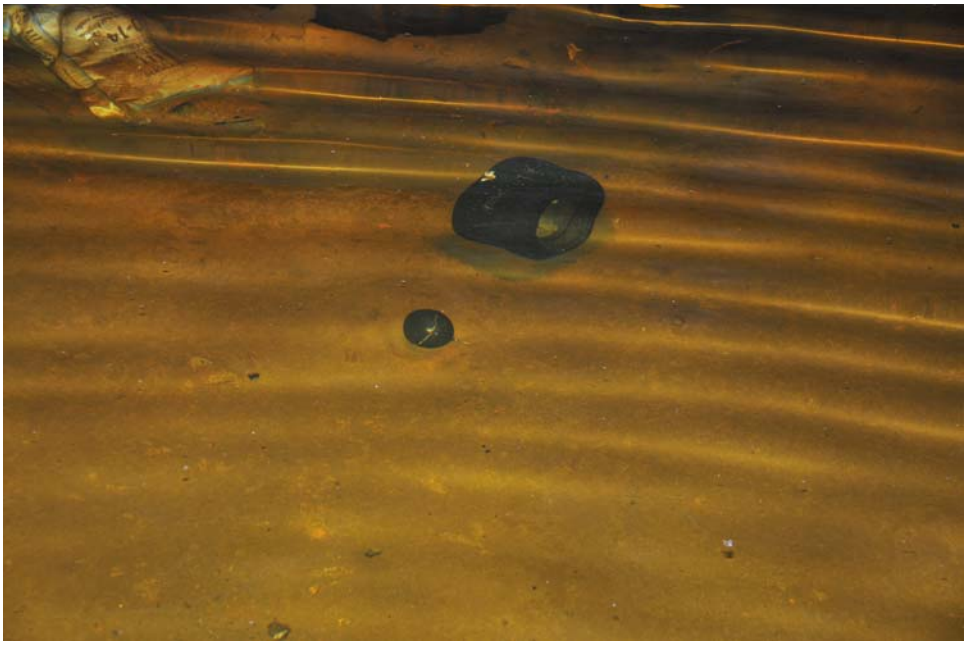
I-31 View of the wall, illustrating an oily substance on the surface.

I-32 View of the wall to bottom transition, illustrating good condition of the concrete with staining present.

I-33 Same as Photo I-32, except at a different location.

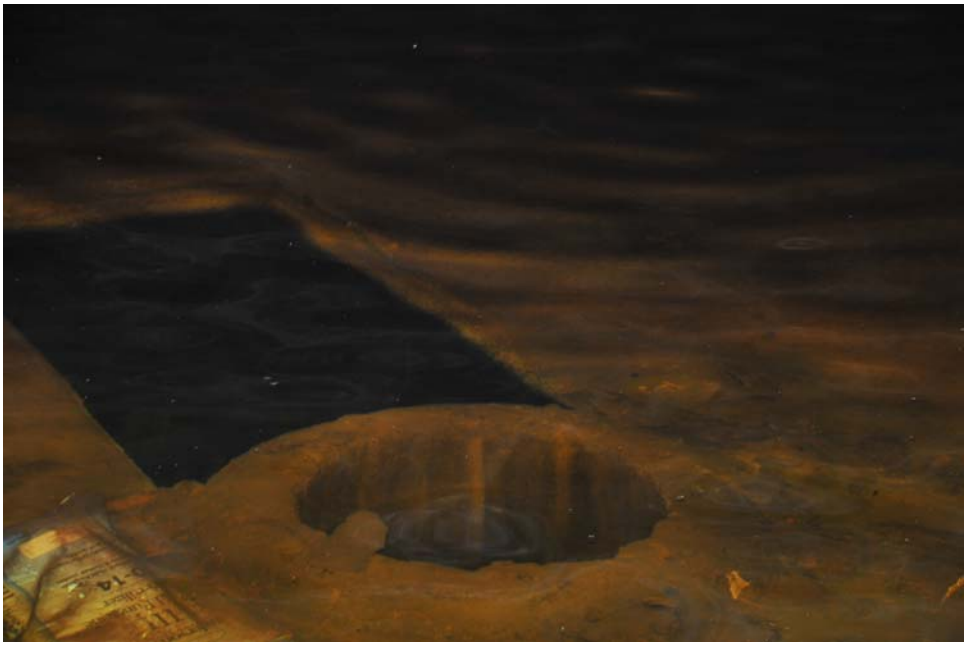
I-34 View of the bottom, illustrating dirt and debris in the water.

I-35 Same as Photo I-34, except at a different location.



I-36 View of the sludge pocket and influent well, illustrating dirt and debris on the adjacent bottom surfaces.

I-37 Same as Photo I-36, except a closer view of the penetrations.



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PHOTOGRAPHIC SURVEY

PROJECT:	Corrosion Engineering Evaluation of Two Concrete Water Storage Structures
STRUCTURE:	Exterior of the 210,000 Gallon Reinforced Concrete Clarifier
OWNER:	Brezack & Associates Planning
LOCATION:	Pacific Grove, California
PHOTOGRAPHED BY:	Andre Harper, Project Engineer
DATE:	July 2013

E-1 General view of the administration building and top of the Clarifier, illustrating generally good condition of the concrete surfaces.

E-2 Overall view of the administration building roof, illustrating the fair condition of the roofing material.

E-3 View of the roof, illustrating minor corrosion on the vent covers and sections with minimal gravel remaining.

E-4 Same as Photo E-3, except at a different location. Note severe corrosion on a roof port.

E-5 View of a roof port, illustrating severe corrosion and minimal gravel on the adjacent roof surfaces.

E-6 View of a portion of the wall, illustrating delamination of the paint system on the top of the wall and severe corrosion on the ladder. Note siderails have corroded off near the top.

E-7 Close-up view of the ladder, illustrating severe corrosion present.

E-8 General view of the exterior, illustrating delamination of the paint system and random corrosion on the appurtenances.

E-9 Same as Photo E-8, except at a different location.

E-10 Same as Photos E-8 and E-9, except at a different location.

E-11 View of a door, illustrating moderate to severe corrosion on the door frame.

E-12 View of the primary rollup door, illustrating a large spall and random corrosion on the reinforcing steel and adjacent concrete.

E-13 Same as Photo E-12, except at a different location.

E-14 Same as Photos E-12 and E-13, except at a different location. Note hairline cracking on adjacent concrete surfaces.

E-15 View of an access hatch for the effluent weir, illustrating general corrosion on the metal framing and generally good condition of the concrete at adjacent surfaces. Note severe cracking of the concrete beam just under the hatch.

E-16 View of a portion of the wall, illustrating spalling and corrosion on the exposed reinforcing steel.

E-17 Same as Photo E-16, except at a different location.

E-18 View of a penetration, illustrating moderate to severe corrosion.

E-19 General view of the interior of the administration building, illustrating generally good condition of the concrete surfaces.

E-20 Same as Photo E-19, except at a different location. Note door has been widened in this location.

E-21 View of the roof and a support beam, illustrating good condition of the concrete surfaces. Note black soot on a majority of the surfaces.

E-22 Same as Photo E-21, except at a different location. Note corrosion on the access hatch.

E-23 View of the exterior wall, illustrating moderate to severe corrosion on the door frame and good condition of the concrete surfaces.

E-24 View of an interior wall, illustrating a door that was widened and minor corrosion on the exposed reinforcing steel.

E-25 Same as Photo E-24, except at the bottom of the doorway. Note concrete on floor is not flush with adjacent surfaces.

E-26 General view of the wall and bottom, illustrating good condition of the concrete.

APPENDIX B Preliminary Historical Review

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C/o Jennifer M. Farquhar, M.A., Principal
Albion Environmental, INc.
1414 Soquel Ave., Suite 205
Santa Cruz, CA 95062

Re: former Point Pinos Wastewater Treatment Plant – Pacific Grove

Dear James and Jennifer:

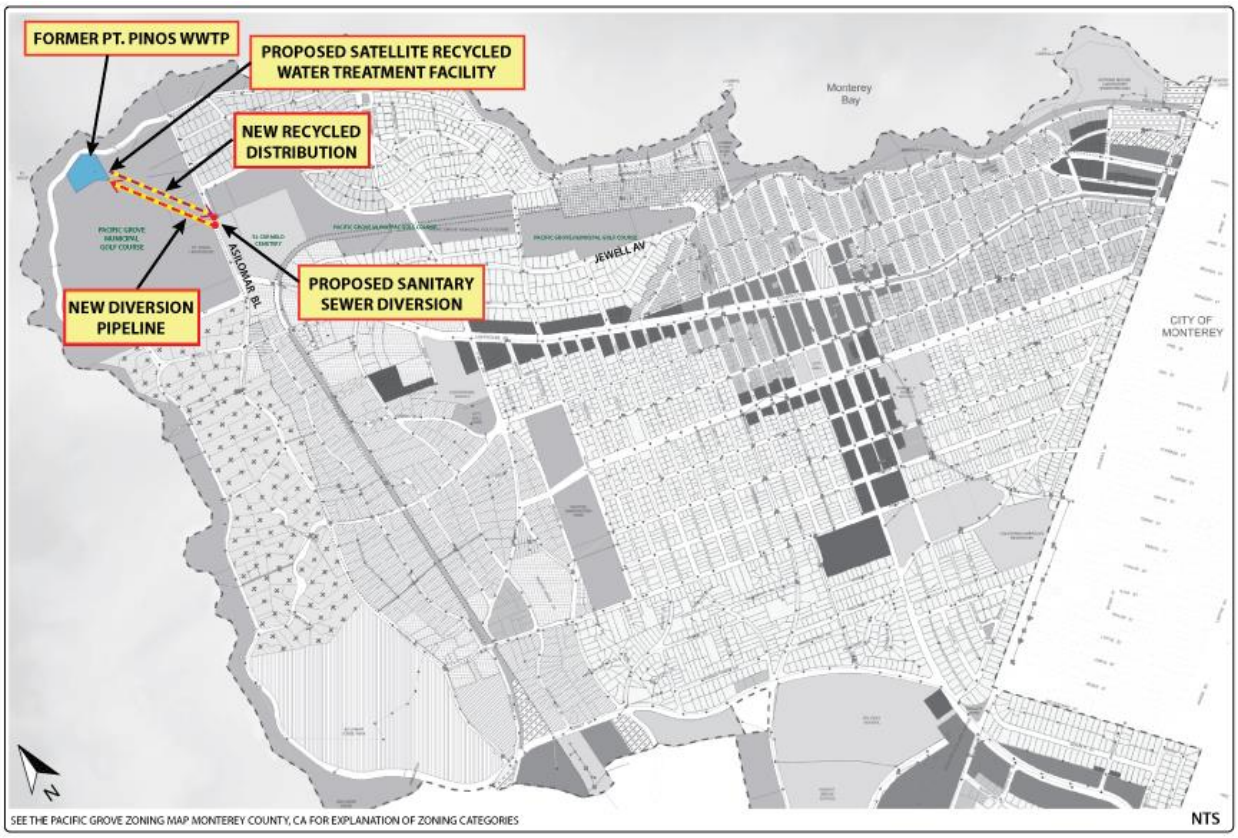
Per your request, we have conducted a preliminary review for potential historic resources (*fatal flaw analysis*) of Pacific Grove's former Point Pinos Wastewater Treatment Plant. Following is a summary of our investigation and findings:

Project Summary: Provide treatment of Pacific Grove wastewater at a new local Satellite Recycled Water Treatment Plant (SRWTP) at the former Point Pinos Wastewater Treatment Plant (WWTP) and deliver recycled water to irrigation sites in the city. To minimize environmental impacts such as odors, noise, vibration, and aesthetic impacts, the SRWTP will be enclosed in structures with adequate ventilation, air scrubbers, and architectural designs compatible with surrounding structures. The SRWTP will make use of the existing structures storage at the former Point Pinos WWTP for diurnal and operational storage if feasible. A footprint of approximately 18,000 square feet is needed for the treatment facilities. During the winter, when there is little or no irrigation demand, the SRWTP will continue to operate at a reduced rate to maintain biomass performance.

Background: Prior to connection to Monterey Regional Water Pollution Control Agency's (MRWPCA) Regional Treatment Plant, wastewater from Pacific Grove was treated at the Point Pinos Wastewater Treatment Plant. The Point Pinos WWTP was formally opened in January of 1953, although architectural plans date back to January 1952, and references in California Bureau of Sanitary Engineering Papers located at the University of California, Riverside, state that Pacific Grove was seeking permission to construct a new municipal sewage system as early as 1947.

The Point Pinos WWTP when in operation had a capacity of 2 million gallons per day (mgd). Treated wastewater was discharged through an outfall to the Pacific Ocean. The Point Pinos WWTP was decommissioned in 1980.

The former Point Pinos WWTP is surrounded by mature vegetation and trees and is screened from visibility from the Golf Links, Oceanview Boulevard, and the Pacific Ocean and Monterey Bay.



Project Details: Source water quality to the SRWTP is expected to be that of typical municipal wastewater. The wastewater to be recycled will be diverted from the collection system, owned by the City. Wastewater that will be diverted from the sewer to the proposed new satellite reclamation plant at Point Pinos will be from residences in the City of Pacific Grove. The reclaimed water that will be produced at Point Pinos will become a new water supply to California American Water (Cal-Am).

The former sewage diversion in Asilomar Drive will be reconstructed with a new controllable diversion valve. The diversion is located at Manhole 802 on Asilomar Drive between Lighthouse Avenue and Del Monte Boulevard. The diversion location is approximately 1,160 feet from the Point Pinos WWTP. Diversion of sanitary sewer flows from Manhole 802 to the Point Pinos WWTP will be accomplished by connecting the existing manhole to a new manhole adjacent to the golf links. A new 8-inch diversion pipeline will be constructed in the alignment of the former wastewater diversion pipeline to the Point Pinos WWTP. The new diversion pipeline will be constructed with pipe bursting technology. Valves will be installed to connect manholes to allow wet weather flows to remain in the Pacific Grove sewer system, while dry weather sanitary flows will be diverted to the SRWTP.

Historic Resources:

In our preliminary review of potential historic resources associated with and that may be potentially affected by the project, we found that the former Point Pinos Wasterwater Treatment Plant may have some historic significance that warrants further investigation.

In the mid-1940s, outbreaks of water-borne diseases, degradation of fishing and recreational waters, coupled with war-time industrial development and population growth prompted a new appraisal of water pollution control in California. Attempts to address and solve new pollution concerns were largely unsuccessful due to the overlap of governmental agencies. Pacific Grove, not immune to the rapid growth brought about by World War II, had unsuccessfully attempted to obtain permission to build a new treatment plant in 1947. By 1949, the California Assembly Committee on Water Pollution recommended sweeping changes in California's approach to water pollution control and water quality, and following their recommendations, the California Legislature enacted the Dickey Water Pollution Act that took effect October 1, 1949. Engineering for the Point Pinos WWTP was underway shortly after the enactment of this legislation, and may be associated in either a primary or secondary way with the significant change in patterns in pollution and water quality management at the state level.

The designer of the Point Pinos WWTP was Sanitary Engineer, Harry N. Jenks. Harry Jenks opened an engineering office in Palo Alto, where he worked from 1933 until his death in 1964. His most significant contribution was the Biofiltration Process, which became an industry standard. Eventually, Harry and his son, John who joined the firm in 1948, designed 23 of the treatment plants in the San Francisco Bay Area as well as numerous plants throughout California. During his lifetime, Jenks patented a number of new processes to treat water and wastewater, including ten new ten new treatment processes. He appears to be a significant personage in California history.

Additional research into the development of this particular treatment plant will clarify its significance within this aspect of regional public works engineering, and will place it in the larger context of Harry N. Jenks' career. Information pertaining to this subject is presently archived with California Bureau of Sanitary Engineering Papers, MS 80/3, Water Resources Collections and Archives at the University of California, Riverside.

Documentation of the Point Pinos WWTP site using California DPR523 series forms, with technical facility description, photographs, historic context, and determination of potential significance using California Register of Historical Resources significance criteria will provide information that can be used by the lead agency for this project to determine if the project involves an historic property that may qualify for the Register, and if so, if the project may affect those resources in an adverse way.

Sincerely,

Franklin Maggi, Architectural Historian

APPENDIX C Preliminary Archeological Review

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BREZACK & ASSOCIATES PLANNING

ARCHAEOLOGICAL ASSESSMENT
FOR THE
SATELLITE RECYCLED WATER TREATMENT PLANT
AT THE
FORMER POINT PINOS WASTEWATER TREATMENT PLANT

PACIFIC GROVE, CALIFORNIA

AUGUST 2013

ALBION ENVIRONMENTAL, INC.

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J2013-013.01

EXECUTIVE SUMMARY

In July 2013, Mr. James Brezack of Brezack & Associates Planning contracted with Albion Environmental, Inc. (Albion), to conduct an archaeological assessment of the proposed Satellite Recycled Water Treatment Plant (SRWTP) at the former Point Pinos Wastewater Treatment Plant (PPWWTP) in Pacific Grove. Albion's investigation included a background records search at the California Historical Resources Information System Northwest Information Center (NWIC) at Sonoma State University, and a field investigation entailing pedestrian survey and limited shovel testing of the subject parcel. The assessment was designed to adequately identify archaeological resources that may be impacted by the planned project under current CEQA guidelines (Article 5: Section 15064.5). A separate preliminary assessment of built environment resources was conducted by Archives and Architecture, LLC and is provided in Appendix A of this report.

A search of records at the NWIC indicated that the project area has been previously surveyed for cultural recourses. Fourteen sites, including 12 prehistoric and two historic age sites were identified with in a 0.25-mi radius. Two of the prehistoric sites are mapped in close proximity to the project location. CA-MNT-127 (located immediately north of the project boundary) is a rich occupation midden containing abundant shell and bone. CA-MNT-128 is a shell midden located 100 meters to the south. Historic site CA-MNT-676 is located 100 meters to the southwest; the site is reported to have produced at least six "Indian" and one "white" skeleton as well as hundreds of musket balls. Archaeological survey in 1977 (Breschini and Edwards 1977) did not relocate purported site constituents. Historic site CA-MNT-674 is the Point Pinos Lighthouse, located about 220 meters to the south. The structure was built in 1885 and is listed on the National Register of Historic Places (#7700312).

Albion's field investigation confirmed the presence of prehistoric cultural materials likely associated with a previously recorded site CA-MNT-127. Details on the nature, extent, depth, and integrity of the deposit are unknown. The site is located in an area of planned development and will therefore require consideration during the CEQA review process. Additional archaeological work is likely to include resource and impact analysis (Phase II archaeological evaluation), and possibly mitigation planning.

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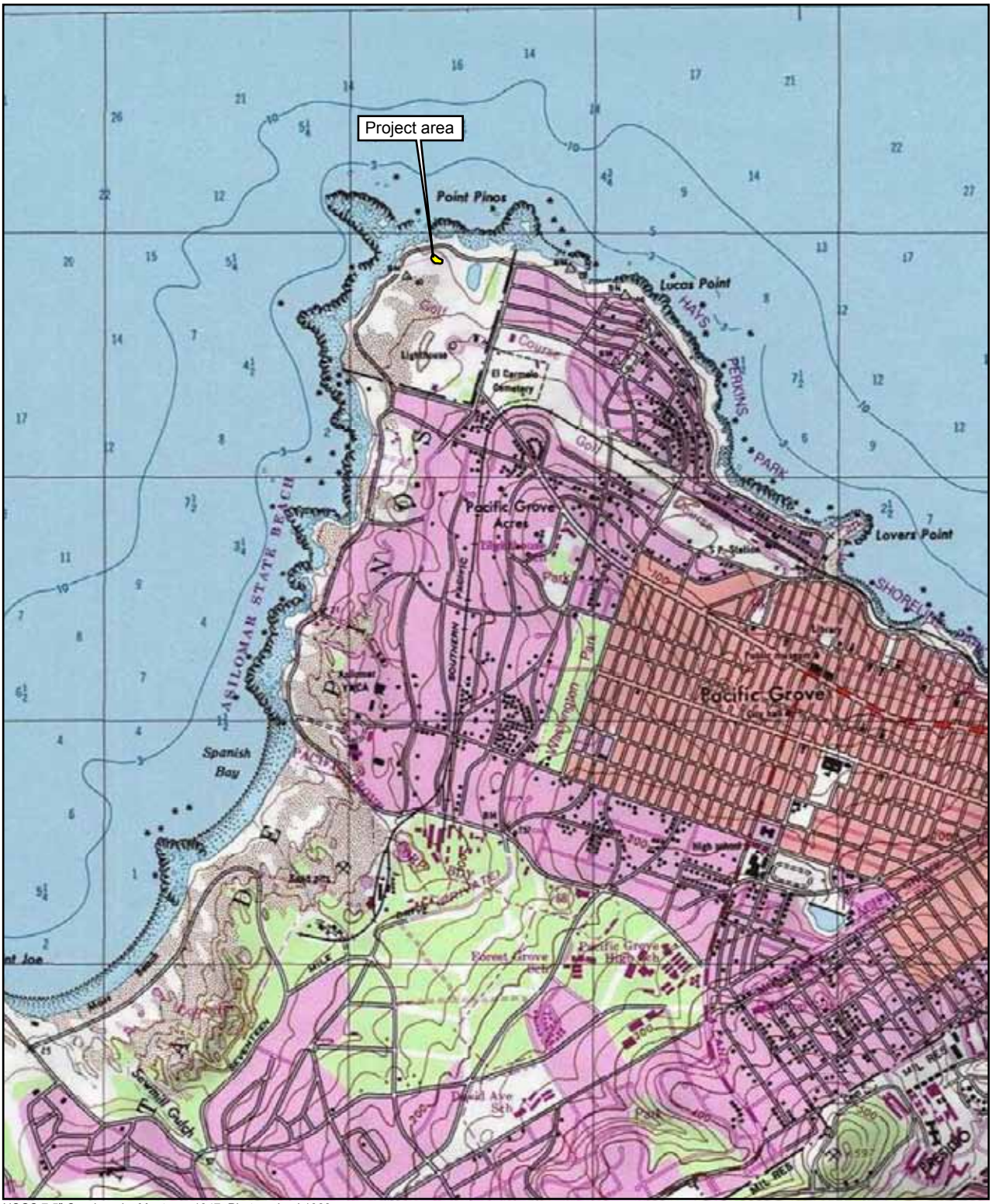
Appendix A Preliminary Historic Review Letter (Archives and Architecture, LLC).

INTRODUCTION

This report documents the results of an archaeological assessment for the proposed Satellite Recycled Water Treatment Plant (SRWTP) at the former Point Pinos Waste Water Treatment Plant (PPWWTP) in Pacific Grove (Figure 1). Current plans call for construction of a new recycled water pump station and a MBR treatment and disinfection station, situated adjacent to the existing (non-functioning) sludge digester, clarifier, and administration buildings. The existing structures were built in the early 1950s.

The completed evaluation comprised three tasks including: 1) a review of records from the NWIC; 2) a surface survey of the parcel; and 3) limited subsurface excavation. A separate preliminary assessment of built environment resources was conducted by Archives and Architecture, LLC and is provided in Appendix A of this report.The investigation was designed to address identification of archaeological resources under current California Environmental Quality Act (CEQA) guidelines under Section Article 5: Section 15064.5).

The records search was conducted by Albion archaeologist Jennifer Farquhar in July 2012 (NWIC File No.: 13-0098). The subsequent pedestrian survey and subsurface testing was conducted on July 30, 2013 by Albion staff archaeologist John Ellison, under the supervision of Jennifer M. Farquhar. Ms. Farquhar holds a M.A. in Anthropology, and has worked in California archaeology for over 20 years, the past eight years in a supervisory capacity.



USGS 7.5" Quadrangle: Monterey 1947, Photorevised 1983

0 250 500 750 1,000
Meters

0 1,000 2,000 3,000 4,000
Feet

N

Albion Environmental, Inc.

Figure 1. Site location.

File name: Figure_1.ai, J2013-013, Stella D'Oro, 01August2013

PROJECT LOCATION AND DESCRIPTION

The study area is located just west of Asilomar State Beach in the town of Pacific Grove (Figure 1). The project site is situated on a terrace, just west of the intersection of Asilomar Avenue and Ocean View Boulevard.

The project proposes to provide treatment of Pacific Grove wastewater at a new local SRWTP at the former PPWWTP and deliver recycled water to irrigation sites in the city. To minimize environmental impacts such as odors, noise, vibration, and aesthetic impacts, the SRWTP will be enclosed in structures with adequate ventilation, air scrubbers, and architectural designs compatible with surrounding structures. The SRWTP will make use of the existing structures storage at the former PPWWTP for diurnal and operational storage if feasible. A footprint of approximately 18,000 square feet is needed for the treatment facilities. During the winter, when there is little or no irrigation demand, the SRWTP will continue to operate at a reduced rate to maintain biomass performance.

The area has previously been disturbed by the construction of the Point Pinos WWTP.

SOURCES CONSULTED

In order to determine if cultural resources are recorded within or near the project area, the following sources were conducted as part of the NWIC records search:

- Office of Historic Preservation Properties Directory for Pacific Grove reveals no historic properties located within a 0.25-mile radius.
- California Inventory of Historic Resources for Pacific Grove reveals no historic resources located within a 0.25-mile radius.

A search of records at the Northwest Information Center (NWIC) at Sonoma State University indicated that the project area has been previously surveyed for cultural recourses (Breschini and Edwards 1977). Fourteen sites, including 12 prehistoric and 2 historic age sites were identified within a 0.25-mi radius. Two of the prehistoric sites are mapped in close proximity to the project location. CA-MNT-127 (located immediately north of the project boundary) is a rich occupation midden containing abundant shell and bone. CA-MNT-128 is a shell midden located 100 meters to the south.

In addition, two historic era sites are in close proximity to the project location. Site CA-MNT-676 is a historic site located 100 meters to the southwest; the site is reported to have produced at least six "Indian" and one "white" skeleton as well as hundreds of musket balls. Archaeological survey in 1977 (Breschini and Edwards 1977) did not relocate purported site constituents. Site CA-MNT-674 is the Point Pinos Lighthouse, located about 220 meters to the south. The structure was built in 1885 and is listed on National Register of Historic Places (#7700312).

BACKGROUND

Environment

The project site is located 20 feet above sea level and is situated on the upper beach terrace immediately adjacent the shoreline at Asilomar State Beach.

The area is situated on a Mesozoic-aged granitic substrate that is part of the Salinian Block (Harden 1998:270). This is apparent by outcroppings of granitodiorite and the granite-derived beach sand (Gordon 1996:9). Granite is an intrusive igneous rock that formed while magma slowly cooled underneath the earth's surface. More recently formed Miocene sedimentary rocks are present nearby, demonstrating the "accreted terraine" of the California coast where different types of stone are brought together through tectonic subduction between the Pacific and North American plates (Harden 1998:253; National Oceanic and Atmospheric Administration [NOAA] 1992:II-10). Further, the presence of several faults in the vicinity attests to the presence of tectonic activity (Jennings 1977).

The soils in the area are characterized as Baywood sand, consisting of deep, somewhat excessively drained soils that formed in old sand dunes near the coast (https://soilseries.sc.egov.usda.gov). Presently the climate of the Monterey Bay and the outer coast area in which Asilomar State Beach is located is relatively temperate. On average, Pacific Grove receives 50.8 cm (20 in) of rain a year, most of this falling between November and March (www.weather.com). The low in January and the high in July range from 6.3°C (43.3° F) to 19.9°C (67.8° F), though seasonal variability in temperature is not great (Gordon 1996:15; www.climate.fizber.com). Winter storms cause wave action which transports sand offshore, leaving shoreline cliff edges susceptible to erosion. In the summer, less ocean turbidity carries sand back to the shoreline (Schoenherr 1992:630).

Prehistoric and Ethnographic Context

Central Coast Prehistory

Although the history of archaeological investigation in California spans more than a century, certain areas of the state were largely passed over by researchers until fairly recently. Indeed, it has only been in the last few decades that California's central coast (including Santa Cruz, Monterey, and San Luis Obispo Counties) has witnessed intensive archaeological investigation. This came about primarily as a result in the 1970s of cultural resources management (CRM), which was instituted to enact a series of historic preservation laws and mandates, beginning with the National Historic Preservation Act (NHPA) of 1966. Prior to that, only a handful of archaeological investigations were completed in the region (e.g. Beardsley 1946; Reinman 1961; Clemmer 1962; Pohorecky 1964; Leonard et al. 1968). As Jones et al. (1996:34) have pointed out, the majority of these were generally descriptive in nature and, unfortunately, are of little relevance to contemporary research agendas. Much of the research in the 1970s was undertaken to comply with legally mandated environmental laws and statutes and, as a result, the work was often sporadic and geared toward resource conservation and management rather than problem-oriented research. With the advent of the 1980s, researchers began to practice more problem-oriented research in the region and, perhaps most importantly, to undertake archaeological projects that contributed significantly to understanding local prehistory. This interest continued into the next decade with several long-term research projects (e.g. Cartier 1993a, 1993b; Hylkema 1991; Hildebrandt and Mikkelsen 1993; Jones 1993; Jones et al. 1996; Milliken et al. 1999) that addressed various aspects of central coast prehistory, ranging from its earliest antiquity to the effects of environmental impacts on the area's prehistoric inhabitants.

Partly as a result of early neglect, central coast prehistory was, for many years, interpreted largely through reference to adjoining areas, such as the Santa Barbara Channel and the San Francisco Bay area. The cultural chronology developed by David Banks Rogers (1929), for instance, was routinely applied to prehistoric cultures in the San Luis Obispo region (Carter 1941). Fredrickson's (1973) five-part chronology, likewise, was often used as the basis with which to interpret the prehistoric sequences in Santa Cruz and Monterey counties (Hylkema 1991). However, in recent years, many contemporary archaeologists working along the central coast have adopted the chronological sequence proposed by Jones et al. (1996). This sequence recognizes six major prehistoric periods of cultural adaptation extending beyond the last 10,000 years of human occupancy. The proposed temporal periods emphasize changes in human adaptation over time and focus largely on the shifting significance of coastal vs. terrestrial habitats and the associated artifact assemblages. Jones et al. (2007) present a more recent application of this framework along with a regional overview.

The initial period in this sequence, termed the Paleoindian, originates in the late Pleistocene and continues until approximately 10,000 B.P. This is followed by the Millingstone Period (10,000-5,500 B.P.), and is recognized by increasingly abundant milling equipment (manos and metates) in the archaeological record when populations apparently followed a generalized subsistence pattern that placed an importance on coastal resources, namely shellfish. The ensuing Early Period (5,500-2,600 B.P.) was a time of new subsistence emphases that include a greater reliance on hunting and the initial exploitation of acorns. The Middle Period (2,600-1,000 B.P.) was marked by the intensification of subsistence practices, especially a greater reliance on marine and littoral foods where fish played an important role in the diet. During the Middle/Late Transition (1,000-750 B.P.), populations in central California experienced deteriorating environmental conditions, and apparently underwent major adaptive shifts in both subsistence and settlement. Finally, the Late Period (750 B.P.-Historic) marks the initial appearance of numerous projectile points, including small side-notched (Desert side-notched), triangular (Cottonwood), and leaf-shaped points, representing the introduction of the bow and arrow. There is an apparent shift in settlements to interior settings while the immediate coastal environments appear to have been used for more short term gathering and processing activities.

Indications of prehistoric inhabitation of the central California coast dating to the terminal Pleistocene/early Holocene is limited, with the strongest evidence supporting this argument coming from two fluted points recovered from peri-coastal contexts in San Luis Obispo County (Bertrando 2004; Gibson 1996; Mills et al. 2005). One fluted point fragment near Santa Margarita was recovered in association with two flake knives, a scraper, two cores and sixty-seven pieces of debitage (Gibson 1996). It was fabricated from pale yellow Franciscan chert. The other specimen was found near Nipomo by local rock collectors and is fabricated from Monterey chert (Mills et al. 2005). Later investigation of the area in which it was found failed to identify other archaeological remains, although the location is notable by the local presence of fossilized Pleistocene fauna (Bertrando 2004:101). Unfortunately neither of these finds comes from dated contexts, or with robust assemblages, leaving their antiquity and greater cultural context relatively ambiguous.

Few other components dating to this period have been investigated, and many questions regarding topics such as settlement, subsistence, stone industries, and social organization, remain unanswered. The dearth of sites dating to this antiquity may, in part, be related to progressively rising sea levels that accompanied the end of the Pleistocene and the early Holocene. It is well documented that in the immediate post-Pleistocene period, world sea levels began to rise with the melting of continental ice sheets. At this time, many previously exposed landscapes in California were inundated by rising waters and underwent complex landscape transformation in the vicinities of river mouths (Masters and Aiello 2007). By 10,000 B.P., for example, sea water began to penetrate San Francisco Bay, which previously had comprised a series of broad inland floodplains. Elsewhere in California, based on sediment cores and local landform configurations, marine transgression aided in the creation of

bays, lagoons, and estuaries. Between ca. 10,000 and 8,000 B.P., the Elkhorn Valley was inundated by saltwater and transformed into a high energy tidal channel (Jones et al. 1996:6). At 8,000 years ago, sea level was about 15 m below its present level at Elkhorn Slough (Masters and Aiello 2007:49). Bickle (1978:8) estimates that sea level rise has submerged 20,000 km^2 of land along the California coast. Sea level transgression slowed after about 7,000 years ago, prompting fluvial sedimentation and tectonic uplift. Consequently, coastal sites earlier than 7,000 B.P. may have been inundated by rising waters.

In general, researchers normally divide this early time span into two divisions: the Paleoindian (pre-10,000 B.P) and the Millingstone (10,000–5,500 B.P.). A coastal focused alternative to the large game focused Paleoindian model, the Paleo-Coastal Tradition, was first proposed by Davis et al. (1969) and later expanded upon by Moratto (1984). Although few sites or site components dating from this time period have been investigated and its presence is largely conjectural, some researchers have posited that Paleo-Coastal peoples established residences along estuaries and bay shores. Associated toolkits are suggested to be scrapers, scraper-planes, bifaces, and lack milling equipment (Jones et al. 2002:215). One of the few inland sites in the region that may date to this time period is the Scotts Valley site (CA-SCR-177) (Cartier 1989, 1993b) where radiocarbon assays from the site suggest that the earliest cultural stratum dates to at least 9,000 years. For the same site, G.L. Fenenga (1993:245-254) proposes two pre-8,000 B.C. phases, marked by flake tools, small leaf-shaped and medium lanceolate projectile points and/or knives, hammer stones, and ochre. Jones (1993:19), however, suggests that there are numerous issues compromising interpretations of the site's stratigraphic integrity and dating. In fact, Jones et al. (1996:39) note that "the extent to which these assemblages are constituted to some unknown degree by materials mixed from more recent contexts is indicated by the occurrence of obsidian among strata assigned to these phases since none of the obsidian hydration results equate with a time depth greater than 7000 B.C." As a result, the Paleo-Coastal Tradition is not readily described in the Monterey Bay area.

Farther south, in San Luis Obispo County, Moratto (1984:107–108) includes the lower levels of the Diablo Canyon sites (CA-SLO-2 and CA-SLO-585), which produced dates of ca. 9,320 B.P. (calibrated 10,552 B.P) and 8,410 B.P. (calibrated 8,976 B.P.), respectively, as part of the Paleo-Coastal Tradition. Greenwood (1972), however, indicates that the associated artifacts are typical of Millingstone Period assemblages rather than belonging to an earlier hypothesized Paleoindian occupation. Based on this evidence, she advances the idea that Millingstone Period adaptations may have had a greater time depth than previously conceived.

> The lowest levels at Diablo Canyon verify a Milling Stone base in San Luis Obispo county….However, the dates are earlier than any currently accepted for the Bay, Valley, and Delta manifestations (Greenwood 1972:92).

Broadening the scale of this argument, recent evidence from the Northern Channel Islands has resurrected this idea of a Paleo-Coastal people and led to a reevaluation of early Holocene California coastal adaptations (cf. Erlandson et al. 2007; Rick et al. 2001). This new conception is distinct from the earlier "Paleo-Coastal Tradition" in that it includes the use of ocean going vessels and fishhooks to represent a highly developed maritime focused adaptation that is posited to be potentially related to a second migration of people to North America (Erlandson et al. 2007).

Paleoindian occupations aside, it is apparent that the extended antiquity of the Millingstone Period is supported by the more recent findings at Cross Creek (CA-SLO-1797), a shell midden site with a typical Millingstone assemblage dating to ca. 8350-7700 B.C. (Fitzgerald 2000; Jones et al. 2002), while contexts containing "Paleo-Coastal Tradition" assemblages have remained elusive. Coastal sites attributed to the Millingstone Period (10,000-5,500 B.P.) are best characterized by high density shell

middens—composed primarily of mussel (*Mytilus* spp.)—located adjacent to extant estuaries or near areas where paleo-estuaries once existed as a result of early Holocene sea level rise.

As the name for this period implies, site assemblages generally contain abundant milling stones and hand stones (Meighan 1978; Erlandson 1991, 1994; Fitzgerald and Jones 1999), although this is not always the case (D. Jones et al. 2004; Jones et al. 1996, 2004). A good example of this expression may be drawn from CA-SLO-1797:

> The dominance of the grinding equipment, the presence of hammer stones (used for the manufacture and maintenance of the ground stone), the total absence of mortars and pestles, the 6:1 ratio of milling tools to projectile points and bifaces, and the very low density of debitage recovered per cubic meter soil excavated (ca. 20.0 m^2) are all traits diagnostic of the Millingstone Horizon (Fitzgerald 2000:116).

In addition to milling equipment, Millingstone Period sites are typified by eccentric crescents, long-stemmed projectile points, and cobble/core tools. In general, there is a low incidence of projectile points and other flaked stone. Shell beads from this time period are characterized as thick rectangular (L-series) *Olivella* beads (Glassow 1996). Erlandson (1991, 1994) has suggested that Millingstone Period groups were semi-sedentary, their diets emphasizing shellfish and small seeds. The hunting of large terrestrial game and marine mammals as well as the exploitation of fishes was apparently of minor importance. Other researchers, however, have argued that both coastal and interior habitats were exploited by early Holocene populations targeting small fauna, and a variety of grass seeds, nuts, and other inland plant taxa as well as shellfish (McGuire and Hildebrandt 1994; Jones and Richman 1995; Mikkelsen et al. 1998; Milliken et al. 1999). Jones (2003:218) argues for a more mobile settlement pattern during this time that included the exploitation of marine mammals. A recent study presents paleodietary data derived from stable isotope analysis on human remains excavated from CA-SCR-60/130 at Harkins Slough near the Monterey Bay (Newsome et al. 2004). A Millingstone Period (ca. 7000 B.P) dated population (n=5) presents data suggesting an emphasis on marine resources that includes marine fish, mammals, and shellfish, with considerably less use of terrestrial resources. Terrestrial resources are generally thought to be plant seeds and small mammals.

In Monterey County, other significant sites dating to the Millingstone Period have been investigated (e.g. CA-MNT-229, and CA-MNT-234). CA-MNT-229, also known as the "Vierra Site," is situated at the mouth of the Elkhorn Slough. Radiocarbon-dated to ca. 6200 and 4,000 B.C., the earliest levels of the site are marked by an eccentric crescent, long-stemmed points, and cobble/core tools of chert and quartzite (Jones and Jones 1992). CA-MNT-234, located near Moss Landing, also contains an early component with dates ranging from 8,000 to 6,500 B.P. The site is notable for its high frequency of milling equipment, abundant, diversified estuary shellfish, and terrestrial mammal bone dominated by small game (Milliken et al. 1999).

The next few thousand years (between 5,500 and 2,600 B.P.) are referred to as the Early Period throughout southern and central California. Most notable about prehistoric adaptations at this time are innovations in subsistence technology, especially the initial appearance of mortars and pestles (perhaps signaling acorn use) and an increase in the frequency of large side-notched and contracting-stem projectile points along with flaked stone debris. Shell beads common during this time period include thick rectangular (L-series), end-ground (B-series), and split (C-series) *Olivella* beads. The appearance of eastern California obsidian (mainly Casa Diablo) in Early Period assemblages also implies that long-distance trade and exchange relations developed during this period (Jones 1995). Jones (1995) and Jones and Waugh (1997) posit a decrease in residential mobility, which they attribute to the advent of mortar and pestle use and a clearer delineation of gender roles that accompanied a trend toward greater population circumscription. Jones and Waugh (1997) also

contend that Early Period sites, in contrast to Millingstone Period sites, are found in more diverse settings, including interior, estuary, and outer coast contexts.

In terms of subsistence, mammals and fish increased in importance relative to shellfish. These resources, coupled with the addition of acorns, signified a broadening of the diet breadth. At CA-SCR-60/130, stable isotope analysis on two individuals supports the increased importance of terrestrial resources relative to marine ones (Newsome et al. 2004). They attribute this to limitations of the marine resource base, however, this does not account for the presence of productive fisheries at Elkhorn Slough and the Pajaro River (Jones et al. 2007:143). Glassow (1996:134) has pointed out that this expansion of the diet breadth was accompanied by a significant increase in labor devoted to food processing. Before acorns can be made palatable, the toxic tannic acid must be leached out of the meal, a process not required by hard seeds. Glassow (1996:134) stated, "it is likely, therefore, that people would consume acorns no more than necessary, as insurance against normal fluctuations in food resource productivity from one year to the next." While the introduction of acorns has implications for labor organization and settlement, the peripheral role played by the resource base at this time in prehistory may relate to more of a process of "extensification" (*sensu* Beaton 1991) where new foods are introduced to the diet, rather than "intensification" where greater amounts of labor are focused on the processing of a particular resource, as is more characteristic of later prehistoric times. Acorn macrofossils are recovered in lesser amounts in these early assemblages than in later ones.

The change that occurred from the Millingstone to the Early Period has traditionally been interpreted as an adaptive shift accompanying the arrival of Rogers's (1929) "Hunting Culture." In his original conception, Rogers described Hunting Culture people as a separate ethnic population more reliant upon use of the acorn and on both terrestrial and marine mammals. These Hunting peoples, he hypothesized, entered the central coast and gradually displaced the earlier populations of Millingstone-adapted peoples. This premise, however, has more recently been discounted largely in favor of the idea that observed differences in artifact assemblages are probably more indicative of seasonal or functional variability in site occupations (Glassow 1997; Erlandson 1997). Jones, moreover, views the transition from Millingstone to Hunting technologies largely as the result of population circumscription and economic intensification, an *in situ* development that reflected the shift from an earlier, mobile, more selective adaptive strategy to one emphasizing limited mobility and decreased subsistence efficiency.

Evidence for Early Period occupation along the central California coast is abundant. Jones et al. (1996:40) suggests that the Saunders Site, CA-MNT-391, may provide the best representation of Early Period habitation in the Monterey Bay. This is a large coastal midden site located on the northern end of the Monterey Peninsula, and has been radiocarbon-dated to approximately 3,000 B.C. The assemblage contains numerous L-series, C-series, and B-series *Olivella* beads as well as *Haliotis* square beads. Projectile points include contracting stemmed, Rossi Square-stemmed, and side-notched varietals. Near Fisherman's Wharf, in the city of Monterey, is CA-MNT-108, an Early Period village site with a dense shell midden. Breschini and Haversat (1992a) contend that the site was occupied approximately 4,800 B.P. and that it represents a large residential locale. Based on an analysis of fish otoliths, the authors argue that the site was most likely occupied during the summer months, from perhaps early May through early October.

Farther north, in Santa Cruz County, is CA-SCR-239, another important Early Period site. Located in the Santa Cruz Mountains near the city of Scotts Valley, this site was investigated by Cartier (1993a). He obtained three radiocarbon dates from charcoal samples and was able to date the deposit—a thin midden—between ca. 3,700 and 3,300 B.C. CA-SCR-38/123, the "Wilder Ranch Site," which is located just north of the city of Santa Cruz, also represents an Early Period occupation. Excavated by D. Jones and Hildebrandt (1994), the site consists of dark midden soils with a high density of

shellfish, mortars and pestles, and flaked stone debris. Radiocarbon dates from samples of mussel shell (*Mytilus californianus*) recovered from the subsurface stratum indicate site occupation dating to 3,995 B.P. Consistent with this date are several diagnostic projectile point forms: Año Nuevo Long-stemmed (1,000-4,000 B.P.), large Side-notched (2,800-5,000 B.P., corner/Side-notched (2,000-4,000 B.P.), and Rossi Square-stemmed (2,000-4,000 B.P). Several *Olivella* B-series shell beads were also obtained during the excavation. The nearby site of CA-SCR-10 contains an artifact assemblage very similar to that of CA-SCR-38/123, including large corner/Side-notched points and a contracting stemmed point similar in form to the Año Nuevo series.

Cultural changes marking the transition from the Early to Middle Period (2,600-1,000 B.P.) were much less pronounced than during the Millingstone/Early Period transition. Instead, many of the adaptive traits initiated during the Early Period continued and grew in relative importance. The use of mortars and pestles increased, as did reliance on small schooling fishes (e.g. anchovies, herring, smelt). The use of shellfish, however, appears to have steadily declined. Middle Period populations also began to focus more on the exploitation of smaller, more elusive game; sea otters and rabbits, for instance, were more important than they had been previously. Glassow (1996) and Lambert (1993) place a slightly stronger emphasis on the importance of increasingly maritime adaptations during this time, arguing that fishing and sea mammal hunting were important subsistence pursuits. Artifact assemblages are typified by large-stemmed points, mortars, pestles, handstones, and milling slabs. Shell beads include *Olivella* saucer (G-series) and saddle (F-series) types. Perhaps the most significant change in the artifact assemblage was the introduction of the circular shell fishhook. This artifact class is recovered more commonly on rocky coasts than in protected slough habitats where schooling fishes were likely captured through other means such as baskets, nets, or other trapping methods (Jones et al. 1996:193; Strudwick 1986). Circular shell fishhooks no doubt facilitated an increase in the exploitation of fishes, but, at the same time, may have resulted in a decrease in dietary efficiency (Jones 2003:226; Glassow 1990:89), a pattern that continues throughout the Holocene. Trans-Sierran trade, especially in obsidian, appears to increase during the Middle Period. Casa Diablo obsidian, a source whose origin is east of the Sierra Nevada Mountains was the chief import in the vicinity Monterey Bay, whereas Coso obsidian is more common to the south (Jones et al. 1996:197, 199). Jones (2003:226) also notes a high frequency of sea otter (*Enhydra lutris*) bones at Middle Period sites, which he interprets as evidence of exchange in otter pelts.

It was also during the Middle Period that a few researchers (Breschini 1983; Moratto 1984; Whistler 1977, 1980) have suggested a major shift in population occurred in the Bay Area. This shift is usually viewed within an ethnolinguistic framework, whereby an indigenous Hokan-speaking population merged with or was displaced by a later Penutian-speaking population. Specifically, Breschini (1983) and Breschini and Haversat (1980) contend that ca. 2,500 B.P. a distinct ethnic population speaking a Penutian language expanded into the Monterey Bay area. These new peoples were the precursors of the ethnohistoric Ohlone, or Costanoans. Their settlement-subsistence pattern was characterized by low mobility, logistical organization, and a more specialized subsistence regime based primarily on the exploitation of the acorn. Breschini (1983) dubbed this the "Monterey Pattern," and stated that it was akin to a "collector" pattern (*sensu* Binford 1980). The prior language group, which Breschini argued had characterized the area since approximately 4,000 years B.P., was organized more around a "forager" pattern. Breschini called this the "Sur Pattern" and argued that it was typified by high mobility and a generalized adaptive pattern geared toward the exploitation of a wide range of resources and environments.

Using this linguistic model as a guide, Dietz and Jackson (1981) excavated 19 sites near the City of Monterey. They concluded that the Monterey Peninsula was first occupied approximately 4,000 years ago. They also claimed to confirm the existence of the two distinct archaeological patterns hypothesized by Breschini. The first occupants, they claimed, were organized around a forager

pattern, which "included seasonal residential moves among a series of resource patches" (Dietz and Jackson 1981:700-701). Resources were gathered on an "encounter" basis within a limited foraging radius and storage was not practiced. Later populations, occupying the area between 2,000 and 1,500 B.P., were logistically organized and practiced food storage (primarily acorns).

However, several researchers have cast this linguistic scenario in considerable doubt. Patch and Jones (1984) concluded from their excavations at Elkhorn Slough that, although two distinct archaeological assemblages were indeed evident, a process of *in situ* intensification rather than an immigration of new people into the area more parsimoniously accounted for the observed changes. Several other archaeological investigations carried out along the central coast (e.g. Hildebrandt 1983; Hildebrandt and Mikkelsen 1993; Dietz, Hildebrandt and Jones 1988) failed to demonstrate the kinds of shifts predicted by the linguistic model. Bouey and Basgall (1991:18) summed up the controversy by concluding:

> If there is one major problem with this model, it relates to the too literal application of the forager-collector dichotomy. In failing to consider the adaptive variability that might be encompassed within either of these strategies, it ignores the possibility that both poses might well be part of a single subsistence-settlement one season, and collector-like traits during another. In view of the productive and diverse environments characteristic of the central California coast, it would be more useful to search for relative variability in logistic organization than force archaeological materials into a rigid dichotomy between extreme foragers and extreme collectors.

While much ink has been spilled over the matter of differences between the Sur and Monterey patterns, the fact that these are based largely on the presence of "shell middens" or "middens with shell", along with radiocarbon dates does not provide much utility in the understanding of past lifeways, nor is it related to any empirically quantifiable evidence that can be used to distinguish between the two (D. Jones 1992). Presently, archaeologists prefer to study artifact assemblages to identify differences in past lifeways, rather than differences in midden characteristics (Jones et al. 2007:138).

Evidence of Middle Period occupation in central California is best represented by the Little Pico Creek Phase II component of CA-SLO-175. This component contains numerous contracting-stemmed projectile points, mortars and pestles, and fishing equipment, including grooved and notched net weights and shell fishhooks. A component of the Vierra Site, CA-MNT-229, and CA-MNT-282, located in southern Monterey County near Cape San Martin, also represent Middle Period occupations. In Santa Cruz County, the Middle Period is best represented by CA-SCR-9, which is located in the Santa Cruz Mountains. Hylkema (1991:141-183) identified a single-component deposit that yielded Año Nuevo Long-stemmed, Rossi Square-stemmed, Contracting-stemmed, side-notched, and concave base projectile points, *Olivella* saucer (G2) beads, mortars and pestles, milling stones and handstones. CA-SCR-7 also contains a Middle Period component that was dated using obsidian hydration to between 1,000 and 2,800 years B.P. (D. Jones and Hildebrandt 1990:69).

The Middle/Late Transition (1,000-750 B.P.) is a short period of time when there appears to have been a time of rapid change in settlement organization. It is represented along the central California coast by Contracting-stemmed and double Side-notched projectile points. Small leaf-shaped points also occur alongside these larger points, though their numbers are few (Jones 2003:221). Several types of *Olivella* shell beads, including split punched (D-series), are also found. Hopper mortars make their first appearance in the archaeological record and are found in tandem with bowl mortars and pestles, as well as handstones and milling slabs. Subsistence regimes during this time demonstrate substantial differences from the previous period. Marine resources, such as fish and marine mammals,

appear to have been largely dropped from native diets. Instead, populations emphasized terrestrial resources, especially small mammals and acorns. This stands in marked contrast to developments along the Santa Barbara Channel where prehistoric populations underwent increasingly progressive maritime adaptations, and fishing was a major subsistence pursuit.

As originally perceived, these changes were largely considered to have resulted from an overexploitation of coastal resources accompanying the increased demographic pressures that were initiated during the Middle Period. However, more recent evidence suggests that other factors, especially environmental degradation, played a more significant role. Coinciding with the Middle/Late Transition (1,000-750 B.P.), California and parts of western North America underwent a dramatic warming trend, known as the "Medieval Climatic Anomaly" (Graumlich 1993; Stine 1990, 1994; Jones et al. 1999). Researchers have identified three major environmental trends during this period: (1) changing sea temperatures (Arnold 1992; Kennett 1998; Kennett and Kennett 2000; Pisias 1978); (2) warmer summer temperatures (Graumlich 1993); and (3) decreased precipitation (Stine 1990, 1994). According to Jones (1995:223), this latter trend had especially serious consequences for prehistoric coastal populations.

Serious drought after A.D. 1000 (950 B.P.) caused such rapid, severe deterioration of the resource base that major subsistence problems developed, causing widespread settlement shifts and resource competition. Unlike the environmental changes of the early and Mid-Holocene, technological innovations could not mitigate the environmental problems, because they developed rapidly and were severe.

In a recent paper, Jones and Ferneau (2002) posit the argument that central coast populations during this time underwent a process of "deintensification." Population growth declined, diet breadth contracted, and interregional exchange systems collapsed. In Monterey County, for example, numerous coastal sites were abandoned and populations relocated to more interior settings (Jones 1995:215). Populations also apparently declined, perhaps as a result of resources stress, and systems of trade and exchange collapsed. Obsidian, for instance, virtually disappears from the archaeological record.

In general, archaeological sites dating to the Middle/Late Transition are poorly represented along the central California coast. In Monterey County, for example, Jones has noted that only a handful of sites in the Big Sur locality (e.g. CA-MNT-1233, CA-MNT-281, and CA-MNT-1754) date to this interval. In San Luis Obispo County, likewise, the sample of archaeological sites is relatively small. Ephemeral deposits are found at the Little Pico Creek site (CA-SLO-175), the Talley Farms site (CA-SLO-1796), and at CA-SLO-165. One exception, however, is CA-SLO-239, a large residential site originally located on the shores of Morro Bay at the current location of a PG&E power plant. The site was originally excavated by Clemmer (1962) who encountered a large sweat lodge, multiple hearth features, several burials, and a rich midden deposit containing stone and bone tools reflecting a wide range of residential activities.

Late Period (750 B.P.-Historic) populations on the central coast apparently rebounded from the environmental stresses that characterized the previous period. However, unlike native groups farther south – such as the Chumash and the Gabrieleño – the inhabitants of the central coast did not undergo increasingly maritime adaptations. Their subsistence practices continued to demonstrate a terrestrial focus. Jones (1995:221), for example, indicates that the consumption of fish and other marine resources was less intensive and the extraction of mussels perhaps more selective than during the previous interval. From his analysis of several sites in Big Sur, Jones (1995:206) suggests that Late Period populations focused their subsistence activities on black-tailed deer (*Odocoileus hemionus*). This view has recently been challenged by the findings from CA-MNT-1942 (Wolgemuth et al.

2002), where fish, including several species of clupeidae (such as anchovies and herrings), constitute significant portions of the overall faunal assemblage.

Nevertheless, it appears that Late Period habitation on the central coast shifted to inland localities (Jones and Ferneau 2002:230), and many coastal sites occupied during the Middle Period were no longer used in the Late Period, or see less intensive use (Jones et al. 1996:196; Milliken et al. 1999:153). Late period midden sites on the interior are often associated with bedrock mortars (Jones et al. 2007:140), and on the coast are more often shellfish processing sites (Jones et al. 1996:41). Population circumscription is suggested by a drop off in the diversity of obsidian sources and its use as a raw material. In fact, a decrease in the presence of Franciscan chert relative to the more locally available Monterey chert has been identified in Late Period contexts, suggesting more restricted mobility (Hylkema 1991; Jones et al. 2007:143). Additionally, sites at interior localities, such as in the Gilroy area (Hildebrandt and Mikkelson 1993) show a significant decrease in coastal resources with a concomitant increase in locally available ones (Jones et al. 1996:41).

Jones (1995, 2003) suggests that central coast sites dating to this time period, excluding habitation sites along productive estuaries, probably represent specialized forays made from large interior settlements. During this time, populations did not undergo transformational changes in social and political organization that led to greater complexity. Instead, human populations in these areas maintained a tribelet system of socio-political organization (Jones 1995:223). Artifact assemblages from this time are marked by contracting-stem, leaf-shaped, and small, triangular-shaped and side-notched projectile points, mortars and pestles, and a variety of late prehistoric bead types, including *Olivella* lipped (E-series) and callus (K-series). Clam shell disk beads and talc schist disk beads are also common during this time. Bifacial bead drills and detritus from *Olivella* bead manufacture are also common at well sampled late period sites, suggesting bead manufacture was common and widespread, though not intensive (Jones et al. 2007:140).

Few Late Period components in San Luis Obispo County have been identified (D. Jones et al. 2002:13; Basgall 2003:15). One of the few well-studied Late Period components is found at CA-SLO-214, and was first identified by Hoover and Sawyer (1977). Located south of Morro Bay, CA-SLO-214 yielded numerous small projectile points (such as small, side-notched and Cottonwood triangular types), and a small collection of ground stone implements (such as handstones, pestles, and milling stones). Several bead types were also recovered during the excavations and included E1, E2, H3, K3, and K1 *Olivella* beads, *Mytilus* disk beads, steatite beads, and clam disk beads. Late Period sites in Monterey County are much more numerous than those in San Luis Obispo County. As reported by Jones (1993), CA-MNT-1223 produced an assemblage of side-notched and Cottonwood triangular points, a mortar hopper, and Class E *Olivella* beads.

In Monterey County, the Late Period is represented by several sites including CA-MNT-1765, the "Moro Cojo" site. This site is located on the western shore of the upper reaches of Moro Cojo Slough, approximately 720 meters southeast of the intersection of Castroville Boulevard and Meridian Road. Based on radiocarbon-dating, Fitzgerald et al. (1995:35) concluded that the site was occupied sometime between A.D. 1450 and 1800, and that it likely functioned as "a combination collection station and field camp." Two other Late Period sites, argued to represent residential activities are found at Rancho San Carlos (CA-MNT-1485/H, CA-MNT-1486/H) in the upper Carmel Valley (Breschini and Haversat 1992b; Jones et al. 1996:41). While these sites have evidence of occupation from late Middle Period times up to Protohistoric ones, the Late Period assemblage includes Desert Side-notched projectile points, various types of *Olivella* beads, *Haliotis* disks, mortars, pestles, handstones, earspools, and a charmstone. Together, these three sites support greater residential use of the interior in Late Period times.

In Santa Cruz County the discontinuity between Middle and Late site locations is not as readily apparent as in Monterey County (Hylkema 1991). Late Period sites include CA-SCR-117, a relatively dense shell midden located one mile north of the town of Davenport. Dating of the site was accomplished with two radiocarbon assays that yielded dates of ca. A.D. 1680 and A.D. 1505. It is likely, however, that the site is probably 100 to 150 years older at its base, setting the occupation of the site approximately from the 15th to the 18th centuries (Fitzgerald and Ruby 1997). The subsistence data indicate that a wide variety of resources were exploited by the site's prehistoric inhabitants. These included a host of shellfish dominated by rocky shore species (primarily *Mytilus californianus*) and a smaller proportion of species that inhabit calmer waters. Fish also played a significant role in the diet as evidenced by the remains of several species, including cabezon (*Scorpaenichthys marmoratus*), lingcod (*Ophiodon elongatus*), steelhead rainbow trout (*Salmo gairdnerii*), rockfish (*Sebastes* sp.), and barracuda (*Sphyraena argentea*). Mammals from both terrestrial and marine contexts are represented in the faunal assemblage as well, though Fitzgerald and Ruby (1997:49) contend that proportionally deer seem to have been the most important source of animal protein.

Drawing upon the archaeology of the greater region may help to identify larger patterns of past lifeways, but it is also important to focus on more localized archaeological efforts to draw conclusions about how specific areas were used. To this end, one may turn to two other sites located along the Asilomar State Beach shoreline have undergone minimal subsurface evaluation (Breschini and Haversat 1994; Schwaderer 2005b). The first, CA-MNT-137, is located approximately 0.4 km north of CA-MNT-143. Two 25 x 25 cm test units were excavated to 10 cm below the surface (Schwaderer 2005b). The first unit, located at the base of the dune contained 15 faunal bone, one chert flake, and fire affected rock. The second unit contained only three bone fragments and some charcoal. At 10 cm, the extent of the cultural deposit appeared to have been reached. One 25 x 25 x 10 cm column sample was removed from the first unit.

The second site, CA-MNT-134, had a 40 x 50 cm column sample removed in 50 cm levels to 150 cm beneath the dune's surface (Breschini and Haversat 1994). Artifacts recovered were restricted to a battered cobble, an abalone shell disc, and what appears to be a whale bone pry bar. The small amount of lithic material is restricted to Monterey Chert. *Haliotis*, *Mytilus*, and *Tegula* were the predominant shellfish recovered. Three radiocarbon dated were recovered from *Haliotis* shell, one from each level, and they ranged between 480±60 and 1140±70 B.P., suggesting that on a gross scale the site retains its vertical stratigraphy.

Though the samples are small, the paucity of artifacts recovered from two sites tested suggests that the rocky coast of Asilomar State Beach is an area that has seen short term use for specific subsistence tasks for little over the past millennia. This is a question that may be tested through the current efforts at CA-MNT-143.

Ethnographic Background

Native American populations living on the Monterey Peninsula at the time of European contact are attributed to the Ohlone. The Ohlone occupied lands from the Monterey peninsula inland to San Juan Bautista, and north to Santa Cruz, the Santa Clara Valley, the Delta, San Francisco Peninsula and the East Bay (Levy 1978). Organized as tribelets, the Ohlone were noted to have lived in approximately 50 autonomous villages (Kroeber 1925). During the course of the year it is likely that families came and went from a particular village depending on the season and important resources available, though winter was a time when families often coalesced and made use of food stores as well as to partake in ceremonial activities (Broadbent 1972; Margolin 1978). From the time of European contact and missionization, the Ohlone populations experienced a rapid decline from the 1770s to the mid-1800s (Cook 1943). Though the population suffered much from disease and discrimination, important

information regarding language, folkways and material culture has been preserved among the few survivors. Likewise other pieces of information have been able to piece together a generalized picture of pre-contact Ohlone culture (Kroeber 1925, Broadbent 1972; Levy 1978; Bean 1994; Milliken 1995).

As the Ohlone inhabited varied coastal and interior environments, their subsistence practices varied depending on where they were. They were hunter-gatherers who supported themselves through the hunting and harvesting of plants and animal. They were noted to rely on acorn as a staple food, though other seeds, berries and roots, as well as kelp were regularly partaken of. Important terrestrial animals included deer, pronghorn and tule elk, though small game including squirrel, woodrats, and mice were also taken (Baumhoff 1963:17; Levy 1978:491).

Shellmounds common to the Bay Area attest to the importance of shellfish to the Ohlone diet. Mussels, abalone, clam and oyster were among important shellfish species eaten. These, in addition to sea lions, seals and sea otters were important coastal resources, along with fish and waterfowl in both coastal and inland contexts (Baumhoff 1963; Levy 1978).

While the Ohlone reportedly inhabited the coastal area where CA-MNT-143 is located, further south in the Carmel River Valley were the Esselen, their neighbors to the south. Little is known of the Esselen, likely due to their territory being largely comprised of thickly wooded mountainous habitats in the Carmel Valley down to Point Lopez (Hester 1978). It is likely that the two groups interacted, and that socio-political boundaries may have shifted at different points in prehistory.

Historic Context

Spanish-Mexican Period

The Carmel Mission
The Carmel River was named *El Rio de Carmelo* by the order of the friars who "discovered" it during Vizcaíno's expedition in 1603. European occupation of Carmel begins with the establishment of the *Misión San Carlos Borroméo de Carmelo*. The Mission, founded by Padre Junípero Serra in 1770, was the 2nd Franciscan mission in *Alta California*. Originally located at the Presidio of Monterey and called *Misión San Carlos Borroméo de Monterey,* it was moved to the Carmel River area a year later and renamed. The Mission church is the final resting place of Padre Serra (Clark 1991).

The Rumsen group of Ohlone inhabited the area at the time of colonization. There were five principal villages known to the missionaries: *Ichxenta*, located somewhere south of the mouth of the Carmel River, *Achasta* located at the current Carmel Mission site, *Tucutnut* located on the Carmel River about three miles from the ocean, *Soccorronda* near the Carmel Valley Village, and *Echilat* on the San Francisquito Flat (Breschini and Haversat 1992b). *Tucutnut* is mentioned in the early records of the Carmel Mission as being near the margins of the Carmel River. Milliken (1990) suggests the site is probably located were Potrero Creek meets the Carmel River and claims the large archaeological site near the Quail Lodge Golf Course is the site of *Tucutnut* (Clark 1991).

After secularization during the formation of the Mexican Republic in 1822, the Roman Catholic Church petitioned for return of Church lands. Nine acres were granted in 1855 and included many structures, cemeteries, vineyards, orchards, and grazing lands. The present Mission church, located on the southwest corner of Lasuen Drive and Rio Road, was built between 1793 and 1797, destroyed in the mid-1800s, restored in 1884 and again in 1920. In 1960, Pope John XXIII elevated the Carmel Mission to the rank of Minor Basilica which implies special historical and religious importance taking precedence over all other churches except cathedrals.

American Period

Pacific Grove

The subject parcel is located on the south side of Ocean View Boulevard, west of its intersection with Asilomar Ave. in the City of Pacific Grove (Figure 1). Pacific Grove is a historically significant area once known as the Methodist Christian Seaside Retreat, established in 1875 by David Jacks (City of Pacific Grove General Plan). The seaside retreat marked the birth of Pacific Grove, one of the few towns in California to be established for primarily religious purposes. Early settlement included small lots in which seasonal visitors pitched tents. Over the next several decades a permanent population began to grow within the area as well as permanent dwellings. Under pressure of overcrowding and lack of utilities Pacific Grove incorporated in 1889.

The proposed project is located at the site of the former Point Pinos Wastewater Treatment Plant (WWTP). The Point Pinos WWTP was formally opened in January of 1953, although architectural plans date back to January 1952, and references in California Bureau of Sanitary Engineering Papers located at the University of California, Riverside, state that Pacific Grove was seeking permission to construct a new municipal sewage system as early as 1947. The Point Pinos WWTP when in operation had a capacity of 2 million gallons per day (mgd). Treated wastewater was discharged through an outfall to the Pacific Ocean. The Point Pinos WWTP was decommissioned in 1980.

FIELD WORK

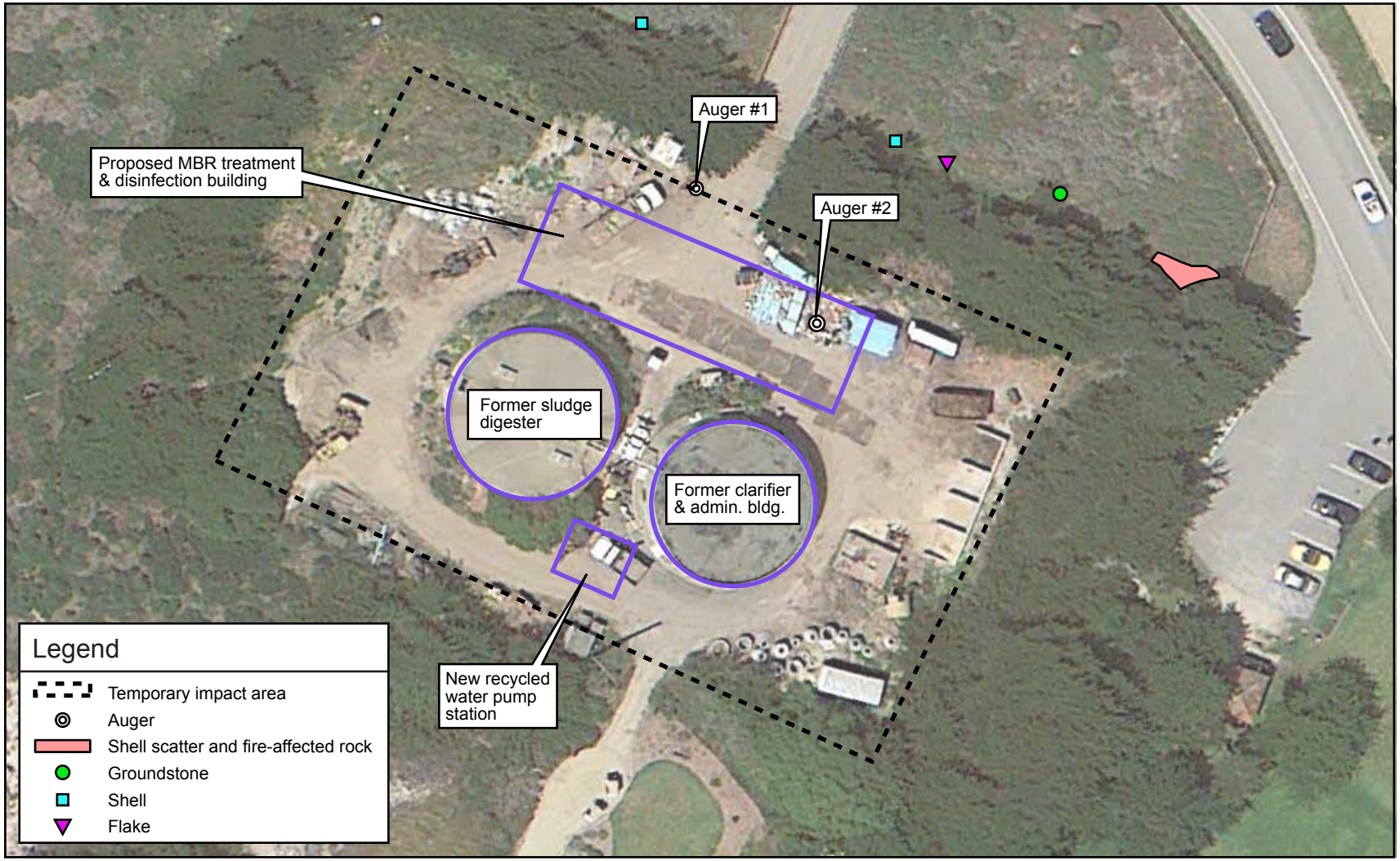
On July 30, 2013, Albion staff archaeologist John Ellison conducted surface and subsurface archaeological investigations at the subject parcel. The inspection included a delineated Temporary Impact Area as well as a 30 meter buffer around said boundary (Figure 2). Soil visibility was fair to poor due to pavement cover and imported fill. Native soil was observed in a few locations, characterized as a dark brown sand. The surface inspection revealed a sparse scatter of prehistoric artifacts and ecofacts including one ground stone tool, a chert flake, fire affected rock, and marine shell. Materials were located about 20 meters from the north boundary of the Temporary Impact Area (Figure 2).

Following surface inspection, two shovel tests were excavated to check for subsurface cultural deposits (Figure 2). The shovel tests measured approximately 30 cm in diameter; Auger 1 was terminated at about 10 cm, where rock was encountered. Auger 2 was excavated to a depth of 80 cm below current grade. Soils were removed in four 20 cm increments. Excavated soils were screened through $^{1}/_{8}$-inch mesh. The shovel tests were distributed in the northeastern section of the parcel, closest to the nearby recorded archaeological site, CA-MNT-127.

Shovel Test Probe #2 was placed approximately south east of the north entrance to the parcel. Soils in the 0-20 cm level consisted of very dark brown (10YR 2/2) loosely-compacted sand. Ten pieces (2.2g) of fragmented abalone shell and one piece of metal were found in this level. Soils in the second level, 20–40 cm, were similar in color and texture, and produced 1.5g of marine shell. Soils from 40–60 cm were consistent with the previous layer, and produced 6.0 grams of marine shell and two pieces of unidentified mammal bone. No cultural materials were found from 60–80 cm; at 78 cm, soils were lighter in color, identified as dark yellowish brown sand.

The surface reconnaissance and limited subsurface investigation confirmed the presence of a prehistoric archaeological site within the proposed area of development. The types of materials observed, including dietary remains and stone tools/manufacturing debris is consistent with other nearby sites, and are probably associated with nearby CA-MNT-127. Overall integrity of the deposit is unknown. Previous construction and maintenance of the facility has likely damaged the site, however, it is possible that intact portions of the site still exist on the property.

File name: Figure 2.ai, J2013-013, Stella D'Oro, 01August2013



Google Earth aerial, accessed August 1, 2013

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Albion Environmental, Inc.

Figure 2. Project area and location of shovel tests.

STUDY FINDINGS AND CONCLUSIONS

Albion's investigation confirmed the presence of prehistoric cultural materials likely associated with previously recorded site CA-MNT-127. Surface artifacts include one ground stone tool, a single chert flake, fire altered rock, and marine shell. Dietary remains (marine shell and mammal bone) were observed to a depth of 60cm below current grade. Details on the nature, extent, depth, and integrity of the deposit are unknown; however, the assemblage is consistent with other prehistoric occupation sites in the vicinity.

The archaeological site is located in an area of planned development and will therefore require consideration during the CEQA review process. Additional archaeological work is likely to include resource and impact analysis (Phase II archaeological evaluation), and possibly mitigation planning and execution.

Evaluation will minimally entail assessment of the resource for significance under CEQA, and if needed, will include an assessment of project impacts and recommendations for mitigation measures. Significance assessments should focus on deposit content, extent, and integrity, and therefore should incorporate an appropriate level of sub-surface investigation. In other words, evaluations should not be based solely on examination of surface materials. As part of the Phase II evaluation, any necessary supplemental DPR resources recordation forms should be completed (i.e., Archaeological Record; Building, Structure, Object Record; Linear Feature Record; Milling Station Record; Artifact Record).

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APPENDIX A

PRELIMINARY HISTORIC REVIEW LETTER (ARCHIVES AND ARCHITECTURE, LLC)

ARCHIVES & ARCHITECTURE, LLC

PO Box 1332
San Jose CA 95109-1332
1.408.297.2684 OFFICE
1.408.228.0762 FAX

James M. Brezack, President
Brezack & Associates Planning
3000 Citrus Circle, Suite 210
Walnut Creek, CA 94598

C/o Jennifer M. Farquhar, M.A., Principal
Albion Environmental, INc.
1414 Soquel Ave., Suite 205
Santa Cruz, CA 95062

Re: former Point Pinos Wastewater Treatment Plant – Pacific Grove

Dear James and Jennifer:

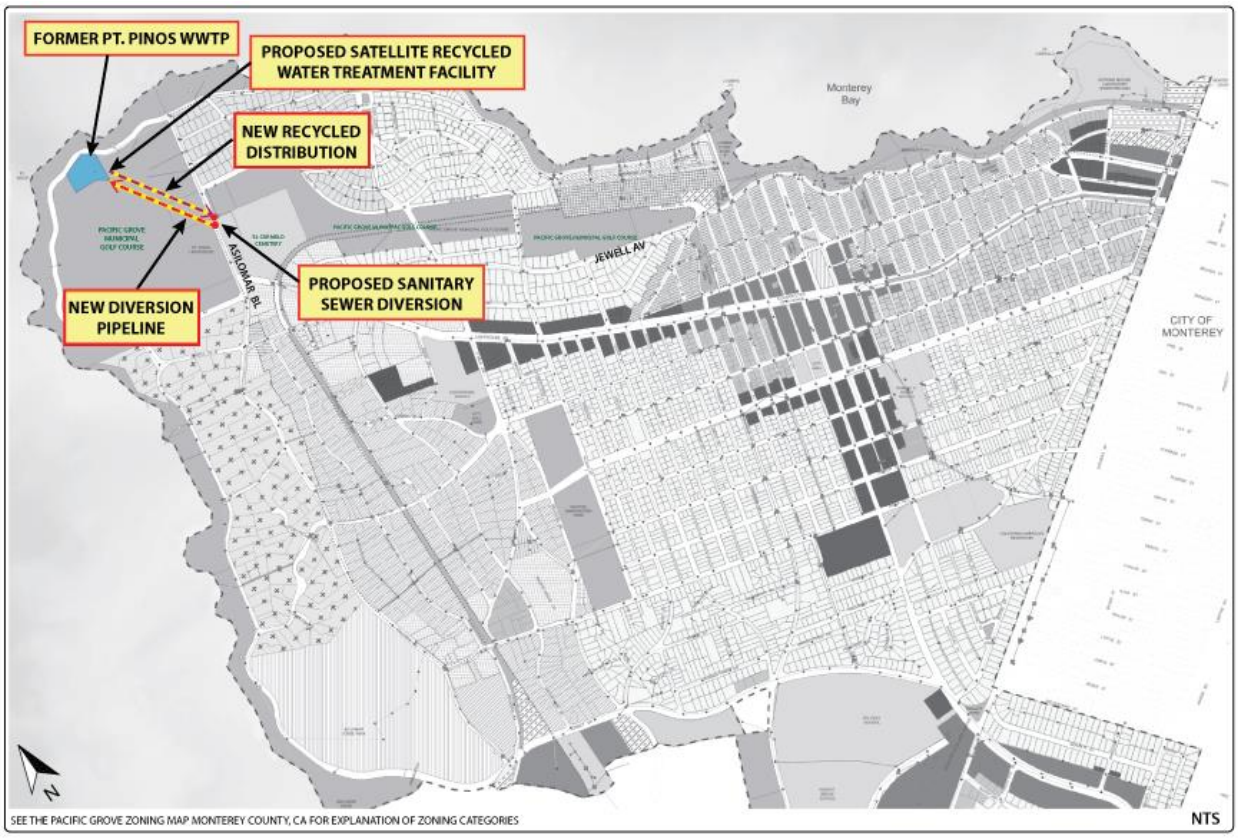
Per your request, we have conducted a preliminary review for potential historic resources (*fatal flaw analysis*) of Pacific Grove's former Point Pinos Wastewater Treatment Plant. Following is a summary of our investigation and findings:

Project Summary: Provide treatment of Pacific Grove wastewater at a new local Satellite Recycled Water Treatment Plant (SRWTP) at the former Point Pinos Wastewater Treatment Plant (WWTP) and deliver recycled water to irrigation sites in the city. To minimize environmental impacts such as odors, noise, vibration, and aesthetic impacts, the SRWTP will be enclosed in structures with adequate ventilation, air scrubbers, and architectural designs compatible with surrounding structures. The SRWTP will make use of the existing structures storage at the former Point Pinos WWTP for diurnal and operational storage if feasible. A footprint of approximately 18,000 square feet is needed for the treatment facilities. During the winter, when there is little or no irrigation demand, the SRWTP will continue to operate at a reduced rate to maintain biomass performance.

Background: Prior to connection to Monterey Regional Water Pollution Control Agency's (MRWPCA) Regional Treatment Plant, wastewater from Pacific Grove was treated at the Point Pinos Wastewater Treatment Plant. The Point Pinos WWTP was formally opened in January of 1953, although architectural plans date back to January 1952, and references in California Bureau of Sanitary Engineering Papers located at the University of California, Riverside, state that Pacific Grove was seeking permission to construct a new municipal sewage system as early as 1947.

The Point Pinos WWTP when in operation had a capacity of 2 million gallons per day (mgd). Treated wastewater was discharged through an outfall to the Pacific Ocean. The Point Pinos WWTP was decommissioned in 1980.

The former Point Pinos WWTP is surrounded by mature vegetation and trees and is screened from visibility from the Golf Links, Oceanview Boulevard, and the Pacific Ocean and Monterey Bay.



Project Details: Source water quality to the SRWTP is expected to be that of typical municipal wastewater. The wastewater to be recycled will be diverted from the collection system, owned by the City. Wastewater that will be diverted from the sewer to the proposed new satellite reclamation plant at Point Pinos will be from residences in the City of Pacific Grove. The reclaimed water that will be produced at Point Pinos will become a new water supply to California American Water (Cal-Am).

The former sewage diversion in Asilomar Drive will be reconstructed with a new controllable diversion valve. The diversion is located at Manhole 802 on Asilomar Drive between Lighthouse Avenue and Del Monte Boulevard. The diversion location is approximately 1,160 feet from the Point Pinos WWTP. Diversion of sanitary sewer flows from Manhole 802 to the Point Pinos WWTP will be accomplished by connecting the existing manhole to a new manhole adjacent to the golf links. A new 8-inch diversion pipeline will be constructed in the alignment of the former wastewater diversion pipeline to the Point Pinos WWTP. The new diversion pipeline will be constructed with pipe bursting technology. Valves will be installed to connect manholes to allow wet weather flows to remain in the Pacific Grove sewer system, while dry weather sanitary flows will be diverted to the SRWTP.

Historic Resources:

In our preliminary review of potential historic resources associated with and that may be potentially affected by the project, we found that the former Point Pinos Wasterwater Treatment Plant may have some historic significance that warrants further investigation.

In the mid-1940s, outbreaks of water-borne diseases, degradation of fishing and recreational waters, coupled with war-time industrial development and population growth prompted a new appraisal of water pollution control in California. Attempts to address and solve new pollution concerns were largely unsuccessful due to the overlap of governmental agencies. Pacific Grove, not immune to the rapid growth brought about by World War II, had unsuccessfully attempted to obtain permission to build a new treatment plant in 1947. By 1949, the California Assembly Committee on Water Pollution recommended sweeping changes in California's approach to water pollution control and water quality, and following their recommendations, the California Legislature enacted the Dickey Water Pollution Act that took effect October 1, 1949. Engineering for the Point Pinos WWTP was underway shortly after the enactment of this legislation, and may be associated in either a primary or secondary way with the significant change in patterns in pollution and water quality management at the state level.

The designer of the Point Pinos WWTP was Sanitary Engineer, Harry N. Jenks. Harry Jenks opened an engineering office in Palo Alto, where he worked from 1933 until his death in 1964. His most significant contribution was the Biofiltration Process, which became an industry standard. Eventually, Harry and his son, John who joined the firm in 1948, designed 23 of the treatment plants in the San Francisco Bay Area as well as numerous plants throughout California. During his lifetime, Jenks patented a number of new processes to treat water and wastewater, including ten new ten new treatment processes. He appears to be a significant personage in California history.

Additional research into the development of this particular treatment plant will clarify its significance within this aspect of regional public works engineering, and will place it in the larger context of Harry N. Jenks' career. Information pertaining to this subject is presently archived with California Bureau of Sanitary Engineering Papers, MS 80/3, Water Resources Collections and Archives at the University of California, Riverside.

Documentation of the Point Pinos WWTP site using California DPR523 series forms, with technical facility description, photographs, historic context, and determination of potential significance using California Register of Historical Resources significance criteria will provide information that can be used by the lead agency for this project to determine if the project involves an historic property that may qualify for the Register, and if so, if the project may affect those resources in an adverse way.

Sincerely,

Franklin Maggi, Architectural Historian

APPENDIX D Preliminary Biological Review

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Denise Duffy & Associates, Inc.
PLANNING AND ENVIRONMENTAL CONSULTING

July 23, 2013

James M. Brezack
Brezack & Associates Planning
3000 Citrus Circle, Suite 210
Walnut Creek, CA 94598

RE: Pacific Grove Local Water Project

Dear Mr. Brezack,

DENISE DUFFY & ASSOCIATES, Inc. (DD&A) was contracted by Brezack & Associates Planning perform an initial reconnaissance survey and analysis of existing biological occurrence databases to determine the potential for presence of special-status plants and animals or sensitive habitats within the boundaries of the Pacific Grove Local Water Project (Project). Specifically, the Project site has been defined to include the fenced area located along Ocean View Boulevard in the City of Pacific Grove; adjacent to the Pacific Grove Golf Links and Pt. Pinos (APN 007-011-003) (Figure 1).

The emphasis of this study is to describe the existing biological resources within the Project site, and identify potential constraints that may occur to special-status botanical and wildlife species and sensitive habitats.

METHODS

A biological survey was conducted by DD&A Associate Environmental Scientist, Matthew Johnson, on July 18, 2013. Prior to the site visit, special-status plant and wildlife species occurrence records in the United States Geological Survey (USGS) Monterey quadrangle and four surrounding quadrangles (Marina, Mt. Carmel, Seaside, and Soberanes Pt.) from the California Natural Diversity Data Base (CNDDB) and other materials referenced below were reviewed to create a list of special-status plant and wildlife species known or with the potential to occur in the vicinity of the Project (see attached). Habitats within the Project site were characterized in the field to assess potential project-related impacts to wildlife and wildlife habitats and for potential occurrences of special-status plant and wildlife species.

RESULTS

The Project site is located on a heavily disturbed lot adjacent to the Pacific Grove Golf Links and Ocean View Boulevard. The City of Pacific Grove operates this lot as a corps yard and water facility. Two structures remain from the former Pt. Pinos Wastewater Treatment Plant (a clarifier/administrative office and a sludge digester) and heavily traveled dirt driveways dominate the lot. Construction materials and debris are littered around the driveways and fill material is stockpiled in the northwestern corner of the site. The entire site is surrounded, along the fence line, by Monterey cypress (*Hesperocyparis macrocarpa*). The disturbance associated with the use of the site prohibits vegetation from emerging and therefore a majority of the site is bare ground. Areas of the Project site that are not bare ground would be classified as ruderal/disturbed. This habitat type is dominated by non-native species such as slender oat (*Avena barbata*), ripgut brome (*Bromus diandrus*), yellow star thistle (*Centaurea solstitialis*), iceplant (*Carpobrotus edulis*), and wild radish (*Raphanus sativus*). Additional species present within the Project site include rabbit-foot grass (*Polypogon monspessulana*), coyote bush (*Baccharis pilularis*), poison hemlock (*Conium maculatum*), Pride of Madeira (*Echium candicans*), bull thistle (*Cirsium vulgare*), and

Italian rye grass (*Festuca perennis*). Wildlife species that may inhabit this habitat include those that are adept at surviving in urban environments, including skunks (*Mephitidae* sp.), California ground squirrels (*Otospermophilus beecheyi*), and raccoons (*Procyon lotor*). Black-tailed deer (*Odocoileus hemionus columbianus*) have also been observed frequently at the Project site by City employees. (Avian species may use the Monterey Cypress surrounding the Project site as nesting habitat.

No special-status plant or wildlife species were identified within the Project site. No special-status plant species are expected to occur based on the disturbance/maintenance regime and lack of suitable habitat. Some nesting avian species, including raptors, are afforded protection under the California Department of Fish and Game Code and the Migratory Bird Treaty Act. Monterey cypress surrounding the Project site could provide nesting habitat for avian species. No other special-status wildlife species are expected to occur within the Project site based on the lack of suitable habitat.

CONCLUSION

No special-status wildlife species were observed within the Project site during the field survey. Raptors and other avian species, protected under the MBTA and Fish and Game Code, have the potential to nest within the Monterey cypress surrounding the Project site. Impacts to nesting raptors and migratory birds may result from construction activities and removal of trees, and may be considered a significant impact under the California Environmental Quality Act (CEQA). These impacts can be reduced to a less-than-significant level with the implementation of the mitigation provided below:

> *To avoid and reduce impacts to nesting raptors and other protected nesting avian species, construction activities can be timed to avoid the nesting season period (February 1 to August 31). Alternatively, if avoidance of the nesting period is not feasible, pre-construction surveys shall be conducted for nesting raptors and other protected nesting avian species within and immediately adjacent to proposed construction activities if construction is to be initiated between February 1 and August 31. Pre-construction surveys shall be conducted no more than 30 days prior to the start of construction. If nesting raptors and/or other nesting avian species are identified during the pre-construction surveys an appropriate no-disturbance buffer imposed within which no construction activities or disturbance shall take place (generally 300 feet in all directions) until the young of the year have fledged and are no longer reliant upon the nest or parental care for survival, as determined by a qualified biologist.*

No special-status plant species were observed within the Project site during the field survey and none are expected to occur. Therefore, the Project will not result in impacts to special-status plant species.

No sensitive habitats were observed within the Project site during the field survey and none are expected to occur. Therefore, the Project will not result in impacts to sensitive habitats.

If you have any questions of comments please feel free to contact me by phone: (831) 373-4341 or email: mjohnson@ddaplanning.com.

Sincerely,

Matthew Johnson
Associate Environmental Scientist

Title: Pacific Grove Local Water Project Vicinity Map

File: C:\GIS\GIS_Projects\2013-42 PG Local Water\Final Products\Vicinity Map.mxd

Date: 7/18/2013

Scale: 1 inch = 0.02 miles

Project: 2013-42

Monterey | Truckee | San Jose
Denise Duffy and Associates, Inc.
Environmental Consultants Resource Planners
947 Cass Street, Suite 5
Monterey, CA 93940
(831) 373-4341

Figure 1

CALIFORNIA DEPARTMENT OF FISH and WILDLIFE

Quad is (Monterey (3612158) or Marina (3612167) or Seaside (3612157) or Mt. Carmel (3612147) or Soberanes Point (3612148))

CNDDB Element Query Results

ScientificName	CommonName	ElementCode	OccCount	GlobalRank	StateRank	FederalListingStatus	StateListingStatus	CNPSList	OtherStatus	Habitat
Agelaius tricolor	tricolored blackbird	ABPBXB0020	428	G2G3	S2	None	None		ABC_WLBCC-Watch List of Birds of Conservation Concern | BLM_S-Sensitive | CDFW_SSC-Species of Special Concern | IUCN_EN-Endangered | USFWS_BCC-Birds of Conservation Concern	Freshwater marsh | Marsh & swamp | Swamp | Wetland
Allium hickmanii	Hickman's onion	PMLIL02140	26	G2	S2	None	None	1B.2	BLM_S-Sensitive | USFS_S-Sensitive	Chaparral | Cismontane woodland | Closed-cone coniferous forest | Coastal scrub | Valley & foothill grassland
Ambystoma californiense	California tiger salamander	AAAAA01180	1067	G2G3	S2S3	Threatened	Threatened		CDFW_SSC-Species of Special Concern | IUCN_VU-Vulnerable	Cismontane woodland | Meadow & seep | Riparian woodland | Valley & foothill grassland | Vernal pool | Wetland
Anniella pulchra nigra	black legless lizard	ARACC01011	39	G3G4T2T3Q	S2	None	None		CDFW_SSC-Species of Special Concern | USFS_S-Sensitive	Chaparral | Coastal dunes | Coastal scrub
Anniella pulchra pulchra	silvery legless lizard	ARACC01012	91	G3G4T3T4Q	S3	None	None		CDFW_SSC-Species of Special Concern | USFS_S-Sensitive	Chaparral | Coastal dunes | Coastal scrub
Arctostaphylos edmundsii	Little Sur manzanita	PDERI04260	8	G2	S2.2	None	None	1B.2	USFS_S-Sensitive	Chaparral | Coastal bluff scrub
Arctostaphylos hookeri ssp. hookeri	Hooker's manzanita	PDERI040J1	18	G3T2?	S2?	None	None	1B.2	BLM_S-Sensitive	Chaparral | Cismontane woodland | Closed-cone coniferous forest | Coastal scrub
Arctostaphylos montereyensis	Toro manzanita	PDERI040R0	15	G2	S2.1	None	None	1B.2	BLM_S-Sensitive	Chaparral | Cismontane woodland | Coastal scrub
Arctostaphylos pajaroensis	Pajaro manzanita	PDERI04100	19	G2	S2.1	None	None	1B.1	BLM_S-Sensitive	Chaparral
Arctostaphylos pumila	sandmat manzanita	PDERI04180	12	G2	S2.2	None	None	1B.2	BLM_S-Sensitive	Chaparral | Cismontane woodland | Closed-cone coniferous forest | Coastal dunes | Coastal scrub
Astragalus tener var. titi	coastal dunes milk-vetch	PDFAB0F8R2	6	G1T1	S1	Endangered	Endangered	1B.1		Coastal bluff scrub | Coastal

										dunes
Athene cunicularia	burrowing owl	ABNSB10010	1832	G4	S2	None	None		BLM_S-Sensitive | CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern | USFWS_BCC-Birds of Conservation Concern	Coastal prairie | Coastal scrub | Great Basin grassland | Great Basin scrub | Mojavean desert scrub | Sonoran desert scrub | Valley & foothill grassland
Buteo regalis	ferruginous hawk	ABNKC19120	96	G4	S3S4	None	None		CDFW_WL-Watch List | IUCN_LC-Least Concern | USFWS_BCC-Birds of Conservation Concern	Great Basin grassland | Great Basin scrub | Pinon & juniper woodlands | Valley & foothill grassland
Castilleja ambigua var. insalutata	pink Johnny-nip	PDSCR0D403	13	G4T1	S1	None	None	1B.1		Coastal bluff scrub | Coastal prairie
Central Dune Scrub	Central Dune Scrub	CTT21320CA	24	G2	S2.2	None	None			Coastal dunes
Central Maritime Chaparral	Central Maritime Chaparral	CTT37C20CA	19	G2	S2.2	None	None			Chaparral
Centromadia parryi ssp. congdonii	Congdon's tarplant	PDAST4R0P1	91	G4T2	S2	None	None	1B.1	BLM_S-Sensitive	Valley & foothill grassland
Charadrius alexandrinus nivosus	western snowy plover	ABNNB03031	120	G3T3	S2	Threatened	None		ABC_WLBCC-Watch List of Birds of Conservation Concern | CDFW_SSC-Species of Special Concern | USFWS_BCC-Birds of Conservation Concern	Great Basin standing waters | Sand shore | Wetland
Chorizanthe pungens var. pungens	Monterey spineflower	PDPGN040M2	31	G2T2	S2	Threatened	None	1B.2		Chaparral | Cismontane woodland | Coastal dunes | Coastal scrub
Chorizanthe robusta var. robusta	robust spineflower	PDPGN040Q2	22	G2T1	S1	Endangered	None	1B.1	BLM_S-Sensitive	Cismontane woodland | Coastal bluff scrub | Coastal dunes
Clarkia jolonensis	Jolon clarkia	PDONA050L0	21	G2	S2.2	None	None	1B.2	USFS_S-Sensitive	Cismontane woodland
Coelus globosus	globose dune beetle	IICOL4A010	49	G1	S1	None	None		IUCN_VU-Vulnerable	Coastal dunes
Collinsia multicolor	San Francisco collinsia	PDSCR0H0B0	25	G2	S2.2	None	None	1B.2		Closed-cone coniferous forest | Coastal scrub
Cordylanthus rigidus ssp. littoralis	seaside bird's-beak	PDSCR0J0P2	33	G5T2	S2	None	Endangered	1B.1	BLM_S-Sensitive	Chaparral | Cismontane woodland | Closed-cone coniferous forest | Coastal dunes | Coastal scrub
Cypseloides niger	black swift	ABNUA01010	46	G4	S2	None	None		ABC_WLBCC-Watch List of Birds of Conservation Concern | CDFW_SSC-Species of Special Concern | IUCN_LC-	

									Least Concern | USFWS_BCC-Birds of Conservation Concern	
Danaus plexippus	monarch butterfly	IILEPP2010	334	G5	S3	None	None			Closed-cone coniferous forest
Delphinium californicum ssp. interius	Hospital Canyon larkspur	PDRAN0B0A2	18	G3T2?	S2?	None	None	1B.2		Chaparral | Cismontane woodland | Meadow & seep
Delphinium hutchinsoniae	Hutchinson's larkspur	PDRAN0B0V0	23	G2	S2.1	None	None	1B.2	USFS_S-Sensitive	Broadleaved upland forest | Chaparral | Coastal prairie | Coastal scrub
Emys marmorata	western pond turtle	ARAAD02030	1135	G3G4	S3	None	None		BLM_S-Sensitive | CDFW_SSC-Species of Special Concern | IUCN_VU-Vulnerable | USFS_S-Sensitive	Aquatic | Artificial flowing waters | Klamath/North coast flowing waters | Klamath/North coast standing waters | Marsh & swamp | Sacramento/San Joaquin flowing waters | Sacramento/San Joaquin standing waters | South coast flowing waters | South coast standing waters | Wetland
Eremophila alpestris actia	California horned lark	ABPAT02011	77	G5T3Q	S3	None	None		CDFW_WL-Watch List | IUCN_LC-Least Concern	Marine intertidal & splash zone communities | Meadow & seep
Ericameria fasciculata	Eastwood's goldenbush	PDAST3L080	17	G2	S2.1	None	None	1B.1	BLM_S-Sensitive	Chaparral | Closed-cone coniferous forest | Coastal dunes | Coastal scrub
Eriogonum nortonii	Pinnacles buckwheat	PDPGN08470	24	G2	S2.3	None	None	1B.3		Chaparral | Valley & foothill grassland
Erysimum ammophilum	sand-loving wallflower	PDBRA16010	22	G2	S2.2	None	None	1B.2	BLM_S-Sensitive	Chaparral | Coastal dunes | Coastal scrub
Erysimum menziesii	Menzies' wallflower	PDBRA160R0	19	G2	S2	Endangered	Endangered	1B.1		Coastal dunes
Eucyclogobius newberryi	tidewater goby	AFCQN04010	117	G3	S2S3	Endangered	None		AFS_EN-Endangered | CDFW_SSC-Species of Special Concern | IUCN_VU-Vulnerable	Aquatic | Klamath/North coast flowing waters | Sacramento/San Joaquin flowing waters | South coast flowing waters
Euphilotes enoptes smithi	Smith's blue butterfly	IILEPG2026	66	G5T1T2	S1S2	Endangered	None		XERCES_CI-Critically Imperiled	Coastal dunes | Coastal scrub
Fritillaria liliacea	fragrant fritillary	PMLIL0V0C0	69	G2	S2	None	None	1B.2	USFS_S-Sensitive	Coastal prairie | Coastal scrub | Ultramafic | Valley & foothill grassland
Gilia tenuiflora ssp. arenaria	sand gilia	PDPLM041P2	29	G3G4T2	S2	Endangered	Threatened	1B.2		Chaparral | Cismontane woodland | Coastal dunes | Coastal scrub
Hesperocyparis goveniana	Gowen cypress	PGCUP04031	4	G1	S1	Threatened	None	1B.2		Chaparral | Closed-cone coniferous forest

Hesperocyparis macrocarpa	Monterey cypress	PGCUP04060	2	G1	S1	None	None	1B.2		Closed-cone coniferous forest
Horkelia cuneata var. sericea	Kellogg's horkelia	PDROS0W043	38	G4T2	S2?	None	None	1B.1	USFS_S-Sensitive	Chaparral | Closed-cone coniferous forest | Coastal dunes | Coastal scrub
Lasiurus cinereus	hoary bat	AMACC05030	235	G5	S4?	None	None		IUCN_LC-Least Concern | WBWG_M-Medium Priority	Broadleaved upland forest | Cismontane woodland | Lower montane coniferous forest | North coast coniferous forest
Lasthenia conjugens	Contra Costa goldfields	PDAST5L040	33	G1	S1	Endangered	None	1B.1		Alkali playa | Cismontane woodland | Valley & foothill grassland | Vernal pool | Wetland
Layia carnosa	beach layia	PDAST5N010	22	G2	S2	Endangered	Endangered	1B.1		Coastal dunes | Coastal scrub
Linderiella occidentalis	California linderiella	ICBRA06010	382	G3	S2S3	None	None		IUCN_NT-Near Threatened	Vernal pool
Lupinus tidestromii	Tidestrom's lupine	PDFAB2B3Y0	21	G1	S1	Endangered	Endangered	1B.1		Coastal dunes
Malacothamnus palmeri var. involucratus	Carmel Valley bush-mallow	PDMAL0Q0B1	32	G3T2Q	S2.2	None	None	1B.2	BLM_S-Sensitive | USFS_S-Sensitive	Chaparral | Cismontane woodland | Ultramafic
Malacothamnus palmeri var. palmeri	Santa Lucia bush-mallow	PDMAL0Q0B5	9	G3T2Q	S2.2	None	None	1B.2	USFS_S-Sensitive	Chaparral
Malacothrix saxatilis var. arachnoidea	Carmel Valley malacothrix	PDAST660C2	17	G5T2	S2	None	None	1B.2	BLM_S-Sensitive | USFS_S-Sensitive	Chaparral | Coastal scrub
Microseris paludosa	marsh microseris	PDAST6E0D0	31	G2	S2.2	None	None	1B.2		Cismontane woodland | Closed-cone coniferous forest | Coastal scrub | Valley & foothill grassland
Monolopia gracilens	woodland woollythreads	PDAST6G010	45	G2G3	S2S3	None	None	1B.2		Broadleaved upland forest | Chaparral | Cismontane woodland | North coast coniferous forest | Ultramafic | Valley & foothill grassland
Monterey Cypress Forest	Monterey Cypress Forest	CTT83150CA	2	G1	S1.2	None	None			Closed-cone coniferous forest
Monterey Pine Forest	Monterey Pine Forest	CTT83130CA	11	G1	S1.1	None	None			Closed-cone coniferous forest
Monterey Pygmy Cypress Forest	Monterey Pygmy Cypress Forest	CTT83162CA	2	G1	S1.1	None	None			Closed-cone coniferous forest
Northern Bishop Pine Forest	Northern Bishop Pine Forest	CTT83121CA	1	G2	S2.2	None	None			Closed-cone coniferous forest
Northern Coastal Salt Marsh	Northern Coastal Salt Marsh	CTT52110CA	53	G3	S3.2	None	None			Marsh & swamp | Wetland
Oceanodroma homochroa	ashy storm-petrel	ABNDC04030	21	G2	S2	None	None		ABC_WLBCC-Watch List of Birds of Conservation Concern | BLM_S-Sensitive | CDFW_SSC-Species of Special Concern |	Protected deepwater coastal communities

									IUCN_EN-Endangered | USFWS_BCC-Birds of Conservation Concern	
Oncorhynchus mykiss irideus	steelhead - south/central California coast DPS	AFCHA0209H	32	G5T2Q	S2	Threatened	None		AFS_TH-Threatened | CDFW_SSC-Species of Special Concern	Aquatic | Sacramento/San Joaquin flowing waters | South coast flowing waters
Pelecanus occidentalis californicus	California brown pelican	ABNFC01021	19	G4T3	S1S2	Delisted	Delisted		BLM_S-Sensitive | CDFW_FP-Fully Protected	
Phrynosoma blainvillii	coast horned lizard	ARACF12100	677	G4G5	S3S4	None	None		BLM_S-Sensitive | CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern | USFS_S-Sensitive	Chaparral | Cismontane woodland | Coastal bluff scrub | Coastal scrub | Desert wash | Pinon & juniper woodlands | Riparian scrub | Riparian woodland | Valley & foothill grassland
Pinus radiata	Monterey pine	PGPIN040V0	5	G1	S1	None	None	1B.1		Cismontane woodland | Closed-cone coniferous forest
Piperia yadonii	Yadon's rein orchid	PMORC1X070	29	G2	S2	Endangered	None	1B.1		Chaparral | Closed-cone coniferous forest | Coastal bluff scrub
Plagiobothrys uncinatus	hooked popcornflower	PDBOR0V170	14	G2	S2	None	None	1B.2	BLM_S-Sensitive | USFS_S-Sensitive	Chaparral | Cismontane woodland | Valley & foothill grassland
Potentilla hickmanii	Hickman's cinquefoil	PDROS1B0U0	5	G1	S1	Endangered	Endangered	1B.1		Closed-cone coniferous forest | Coastal bluff scrub | Freshwater marsh | Marsh & swamp | Meadow & seep | Wetland
Rana draytonii	California red-legged frog	AAABH01022	1338	G4T2T3	S2S3	Threatened	None		CDFW_SSC-Species of Special Concern | IUCN_VU-Vulnerable	Aquatic | Artificial flowing waters | Artificial standing waters | Freshwater marsh | Marsh & swamp | Riparian forest | Riparian scrub | Riparian woodland | Sacramento/San Joaquin flowing waters | Sacramento/San Joaquin standing waters | South coast flowing waters | South coast standing waters | Wetland
Reithrodontomys megalotis distichlis	Salinas harvest mouse	AMAFF02032	7	G5T1	S1	None	None			Marsh & swamp | Wetland
Riparia riparia	bank swallow	ABPAU08010	282	G5	S2S3	None	Threatened		BLM_S-Sensitive | IUCN_LC-Least Concern	Riparian scrub | Riparian woodland

Rosa pinetorum	pine rose	PDROS1J0W0	11	G2Q	S2.2	None	None	1B.2		Closed-cone coniferous forest
Sidalcea malachroides	maple-leaved checkerbloom	PDMAL110E0	136	G3G4	S3S4.2	None	None	4.2		Broadleaved upland forest | Coastal prairie | Coastal scrub | North coast coniferous forest
Stebbinsoseris decipiens	Santa Cruz microseris	PDAST6E050	16	G2	S2.2	None	None	1B.2		Broadleaved upland forest | Chaparral | Closed-cone coniferous forest | Coastal prairie | Coastal scrub | Ultramafic
Taxidea taxus	American badger	AMAJF04010	470	G5	S4	None	None		CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern	Alkali marsh | Alkali playa | Alpine | Alpine dwarf scrub | Bog & fen | Brackish marsh | Broadleaved upland forest | Chaparral | Chenopod scrub | Cismontane woodland | Closed-cone coniferous forest | Coastal bluff scrub | Coastal dunes | Coastal prairie | Coastal scrub | Desert dunes | Desert wash | Freshwater marsh | Great Basin grassland | Great Basin scrub | Interior dunes | Ione formation | Joshua tree woodland | Limestone | Lower montane coniferous forest | Marsh & swamp | Meadow & seep | Mojavean desert scrub | Montane dwarf scrub | North coast coniferous forest | Oldgrowth | Pavement plain | Redwood | Riparian forest | Riparian scrub | Riparian woodland | Salt marsh | Sonoran desert scrub | Sonoran thorn woodland | Ultramafic | Upper montane coniferous forest | Upper Sonoran scrub | Valley & foothill grassland
Tortula californica	California screw moss	NBMUS7L090	10	G2?	S2	None	None	1B.2	BLM_S-Sensitive	Chenopod scrub | Valley & foothill grassland
Trifolium buckwestiorum	Santa Cruz clover	PDFAB402W0	23	G2	S2	None	None	1B.1	BLM_S-Sensitive	Broadleaved upland forest | Cismontane woodland | Coastal prairie

Trifolium hydrophilum	saline clover	PDFAB400R5	44	G2	S2	None	None	1B.2		Marsh & swamp | Valley & foothill grassland | Vernal pool | Wetland
Trifolium polyodon	Pacific Grove clover	PDFAB402H0	12	G1	S1	None	Rare	1B.1	BLM_S-Sensitive	Closed-cone coniferous forest | Coastal prairie | Meadow & seep | Valley & foothill grassland | Wetland
Trifolium trichocalyx	Monterey clover	PDFAB402J0	3	G1	S1	Endangered	Endangered	1B.1		Closed-cone coniferous forest
Valley Needlegrass Grassland	Valley Needlegrass Grassland	CTT42110CA	45	G3	S3.1	None	None			Valley & foothill grassland

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APPENDIX E Preliminary Geological Review

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GEOTECHNICAL INVESTIGATION
PACIFC GROVE ASBS STORMWATER MANAGEMENT PROJECT
CITIES OF MONTEREY AND PACIFIC GROVE, CALIFORNIA

PROJECT 2013.0031

For

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Figure 4 - Overall Site Plan
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APPENDIX A

Keys to Soil Classification (Fine and Coarse Grained Soils)
Key to Rock Classification
Log of Exploratory Drill Holes (DH-1 through DH-6)

GEOTECHNICAL INVESTIGATION
PACIFC GROVE ASBS STORMWATER MANAGEMENT PROJECT
CITIES OF MONTEREY AND PACIFIC GROVE, CALIFORNIA

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical investigation for proposed improvements associated with the Pacific Grove ASBS Stormwater Management Project, in Pacific Grove, California. The location of the project is shown on our Geologic Index Map (Figure 1), and features in the project vicinity are shown on the Treatment Plant Site Plan (Figure 5) of this report. For purposes of this report "site" refers to the Pacific Grove Water Treatment Plant (PGWTP), the Crespi Pond area and the area of the proposed wetland.

1.2 PROJECT DESCRIPTION

As outlined in the Draft Engineering Report prepared by Fall Creek Engineering, the Pacific Grove ASBS stormwater management project is designed to improve stormwater quality prior to discharge to the "Area of Special Biological Significance" (ASBS) designated along the Pacific Grove coastline. The goal of the project is to achieve a 90 percent reduction in the pollutants that are discharged into the bay by seasonal stormwater discharges. The portions of the project that are addressed by this geotechnical investigation consist of the following:

- Reuse or reconstruction of the existing two tanks at the abandoned Pacific Grove Water Treatment Plant (PGWTP): the two existing tanks at this site are being evaluated for their structural integrity and are planned for reuse for stormwater storage/treatment.

- Expansion of Crespi Pond: the existing pond will be expanded by deepening it up to 5 feet (it's present maximum depth is about 5 feet and proposed maximum depth is about 10 feet), and by extending it approximately 120 feet south and 40 feet west of its existing limits.

- Creation of wetlands: a wetland is proposed for construction about 750 south of Crespi Pond. This wetland will extend about 5 feet below existing grade.

- Installation of utility lines: stormwater pipes will be installed to connect the new wetland, Crespi Pond and the PGWTP site. Utility trenches proposed in other areas of the site are beyond our present scope of work.

Originally, our scope also included expansion of a cistern near the intersection of Del Monte Boulevard and Egan Avenue. We understand this portion of the project is no longer being pursued.

1.3 OBJECTIVE AND SCOPE OF INVESTIGATION

The objective of this investigation was to explore subsurface conditions in the above mentioned project areas; provide geotechnical information to assist in the preliminary design and

evaluation of the proposed improvements; and to prepare geotechnical recommendations for their design and construction.

The following services were performed for our investigation.

1. Reconnaissance of the project areas to observe surface conditions and mark locations for our subsurface exploration.

2. Coordination of our drilling with Underground Service Alert and the City of Pacific Grove.

3. Research of existing regional geologic information including geologic hazards pertinent to the site.

4. Exploration, sampling, and classification of subsurface soils at selected locations by means of six exploratory drill holes.

5. Laboratory testing of selected soil samples recovered from our drill holes.

6. Engineering analysis of the above field and laboratory data and formulation of conclusions and recommendations for the project.

7. Preparation of this report summarizing our findings, conclusions and recommendations.

1.4 INFORMATION PROVIDED

For this investigation, the following was provided to us and used during our study.

- A 6-page set of plans titled "15% Design Plans, Pacific Grove ASBS," prepared by Fall Creek Engineering and dated June 2013.
- A report titled, "Draft Engineering Report: Preliminary Hydrology Analysis and David Avenue Reservoir Design Alternatives Summary, Pacific Grove Area of Special Biological Significance (ASBS) Stormwater Management Project", prepared by Fall Creek Engineering and dated June 20, 2013.
- Design plans for the existing PGWTP tanks consisting of Sheets 2, 7, 9, 10 and 14 of a 23-page set of plans titled "City of Pacific Grove Sewage Pumping and Treatment Works", prepared by Alfred D. Coons, City Manager and Engineer, dated January 1952.
- Base maps for our Figure 4 and 5 provided by Fall Creek Engineering via email and dated 8/5/13.

2. SITE INVESTIGATION

2.1 SUBSURFACE EXPLORATION

The subsurface exploration program included six drill holes (DH-1 through DH-6). The drill holes were located in the field by referencing to existing site features and pacing; therefore, locations should be considered approximate. The approximate locations of the drill holes are shown on Figure 4, with a more detailed map of the PGWTP tank area in Figure 5.

Drill holes DH-1 through DH-6 were advanced on June 4, 2013, to depths between 9 and 24 feet below the ground surface using a Mobile B-53 drilling rig equipped with an 8-inch diameter hollow stem auger.

In the field, our personnel visually classified the materials encountered in the drill holes and maintained a log of each drill hole. Samples were obtained from the drill holes by driving a 2½-inch inside diameter split spoon or a 2-inch outside diameter (1⅜ inch inside diameter) Standard Penetration Test (SPT) sampler up to a depth of 18 inches into the earth material using a 140-pound hammer falling 30 inches. The number of blows required to drive the samplers was recorded for each 6-inch penetration interval. The number of blows required to drive the sampler the last 12 inches, or the penetration interval indicated on the log where harder material was encountered, was shown as blows per foot on the drill hole logs. The hammer was operated by a hydraulic winch and pulley system.

Soil samples were collected from the drill holes at approximately 5-foot vertical intervals. Soil samples were sealed in the field and transported to our laboratory for further evaluation and testing. Visual classification of soils encountered in our drill holes was made in general accordance with the Unified Soil Classification System (ASTM D2487 and D2488). The laboratory test results were used to refine our field classifications. Two Keys to Soil Classification, one for fine grained soils and one for coarse grained soils, and one key for Rock Classification are included in Appendix A together with the logs of the drill holes.

2.2 LABORATORY TESTING

Laboratory tests were performed on selected soil samples. These tests included water content, dry density and percent passing a No. 200 sieve. The laboratory test results are presented on the drill hole logs at the corresponding sample depths.

3. FINDINGS

3.1 GEOLOGIC SETTING

Regional geologic mapping by Clark, Dupre and Rosenberg (1997; Clark and others hereafter for brevity) provides the best available regional-scale geologic mapping for the project area. Our Geologic Index Map (Figure 1) is an excerpt from Clark and others (1997).

The geology of the site vicinity, broadly speaking, is that of an elevated marine terrace cut across granitic bedrock, overlain with a thin mantle of terrace lag deposits and local dune sands.

As mapped by Clark and others (1997), bedrock in the site vicinity is mapped as "porphyritic granodiorite of Monterey of Ross" (map unit Kgdp), which can be thought of as granitic rock.

As relative sea level dropped, a marine (coastal) terrace was planed across the granitic bedrock, with Pleistocene-age (within the last 2 million years) marine terrace deposits deposited across this surface. These deposits ("Peninsula College coastal terrace deposits;" [map unit Qctp] are preserved on high ground about 1500 feet south of the site (see Fig. 1).

As relative sea level dropped further, another marine terrace was planed across the bedrock, leaving the "Ocean View coastal terrace deposits" (map unit Qcto) mapped as fringing the coastline near the site, and underlying the site. Texturally, these deposits are described as consisting of "semi-consolidated, moderately well-sorted marine sand containing thin, discontinuous gravel-rich layers."

Dune sand deposits of Pleistocene age (map unit Qod1) and Holocene age (map unit Qd) have been deposited by the wind in the areas shown on Figure 1 – generally south of the site. The younger (Holocene, map unit Qd) dune sand deposits are described as "unconsolidated, well-sorted, fine- to medium-grained sand." The older (Pleistocene, map unit Qod1) dune sand deposits are described as texturally the same as the younger deposits, and "weakly consolidated."

Approximately 300 to 500 feet east of the PGWTP tanks, Crespi Pond (see Figure 1 and Figure 4) occupies a topographic swale that is mapped as infilled with younger (Holocene age) alluvium. This map unit (Qal) is described as consisting of "unconsolidated, heterogeneous, moderately sorted silt and sand with discontinuous lenses of clay and silty clay". The topographic swale occupied by Crespi Pond likely marks the location of a now-buried stream course that is incised into the top-of-bedrock surface.

Rosenberg (2001) compiled previous and independent geologic mapping for Monterey County that incorporated the geologic mapping of Clark and others (1997), of which he was a co-author. The linework of this compilation is more generalized than that of Clark and others, due to map scale. No significant differences in geologic mapping as it affects the site vicinity are reflected in Rosenberg (2001).

Wagner and others (2002) prepared a regional geologic compilation map that encompasses the site, also at a more generalized scale than that of Clark and others (1997). Wagner and others (2002) drew on both Clark and others (1997) and Rosenberg (2001), and no significant differences in geologic interpretation are reflected in their mapping.

3.2 GEOHAZARDS MAPPING

Rosenberg (2001) prepared a County-wide map of liquefaction susceptibility, as a derivative map associated with the geologic mapping described above. An excerpt of Rosenberg's Liquefaction Susceptibility Map is presented as our Liquefaction Map (Figure 2). Rosenberg's classification ranged across four liquefaction susceptibility classes (Low, Moderate, and High, with a fourth "variable" class used in areas of significant grading). While this map is necessarily generalized, it maps the older marine terrace deposits (map units Qctp and Qcto underlying the PGWTP tank site and the proposed wetland area) and older dune deposits (map unit Qod1), as having a low liquefaction susceptibility. The younger dune deposits (map unit Qd) mapped south of the PGWTP tank site, and the alluvium filling the topographic swale (underlying Crespi Pond), were considered to have a high liquefaction susceptibility. Bedrock and upland areas are mapped as having a "low" liquefaction susceptibility.

There are no known historic liquefaction sites from the 1906 or 1989 earthquakes in the PGWTP site or vicinity.

The PGWTP site is mapped as lying within a State of California "tsunami inundation area" which fringes the coastline as shown in Figure 3 of this report (State of California Emergency Management Agency, 2009). Both the PGWTP site and Crespi pond are within the designated tsunami inundation area. The shoreward limit of inundation is shown as lying at approximately the southern end of the PGWTP site and Crespi Pond, and runs approximately along contour eastward and westward around the end of Point Pinos.

3.3 EARTHQUAKE FAULTING

No active faults are mapped in the project vicinity (Wagner and others, 2002). Faults associated with the Monterey Bay fault zone are mapped east of the site, and the San Gregorio fault west of the site (see Table 1 of seismic sources below).

The greater San Francisco/Monterey Bay Area is seismically dominated by the active San Andreas Fault system, the tectonic boundary between the northward moving Pacific Plate (west of the fault) and the North American Plate (east of the fault). This movement is distributed across a complex system of generally strike-slip, right-lateral and subparallel faults

Regional faults that have a potential to generate large magnitude earthquakes and significant ground shaking at the site are listed in Table 1. Map distances are derived from the USGS Quaternary Fault and Fold database (http://earthquake.usgs.gov/regional/qfaults/), based on a latitude of 36.636513 and a longtitude of -121.934629.

Table 1. Significant Seismic Sources within Project Vicinity

Fault	Approximate Distance	Direction from Project Site to Fault
Monterey Bay/Tularcitos	2.7 km	Northeast
San Gregorio	10.1 km	West
Reliz	11.7 km	Northeast
Zayante-Vergeles	35.6 km	Northeast
San Andreas	41.5 km	Northeast

3.4 SEISMICITY

The Working Group on California Earthquake Probabilities (WGCEP) estimates the probabilities of major earthquakes are now in their fourth iteration. The greatest changes in approach from the first to the fourth iteration are; 1) the treatment of major faults as either segmented, unsegmented or capable of different rupture scenarios; 2) the progressive consideration of more potential seismic sources, and 3) the use of time-independent versus time-dependent models. Current estimates (WGCEP, 2003, 2008) are most detailed for the greater San Francisco Bay Area; WGCEP (2008) estimated a 63% probability of a large (magnitude 6.7 or greater) earthquake in the San Francisco Bay area as a whole over a 30-year period; this overall probability differed only slightly from the previous (WGCEP, 2003) probability of 62%. The current estimate for the Calaveras fault alone is 7% (revised down from the 11% presented by WGCEP, 2003); for the (northern) San Andreas fault alone, 21%; and for the Hayward fault, 31% (revised upward from the WGCEP (2003) value of 27%).

3.5 SITE COEFFICIENTS AND SEISMIC GROUND MOTION VALUES

The site coefficients and seismic ground motion values in Table 2 were developed using the USGS Seismic Design Maps (http://earthquake.usgs.gov/hazards/designmaps/usdesign.php), incorporating both the ASCE 7-05 and ASCE 7-10 codes, and the project site location (latitude 36.636513N, longitude -121.934629W).

Table 2. Seismic Design Parameters

Parameter	ASCE 7-05 Values	ASCE 7-10 Values
Site Class	B	B
Site Coefficient F_a	1.0	1.0
Site Coefficient F_v	1.0	1.0
S_s	1.473	1.549g
S_1	0.614	0.569g
S_{Ms}	1.473	1.549g
S_{M1}	0.614	0.569g
S_{Ds}	0.982	1.033g
S_{D1}	0.409	0.379g

The design peak ground acceleration (PGA) can be taken as the lesser of the values developed from probabilistic approach and deterministic approach. Using the USGS Seismic Design Maps and incorporating both ASCE 7-05 and ASCE 7-10, the PGA value at the site is 0.62g for the Maximum Considered Earthquake (MCE) and 0.41g for the Design Earthquake (DE). MCE corresponds to a 2% probability of exceedance in a 50-year period. Studies have shown that, for the San Francisco Bay Area, DE roughly corresponds to a 10% probability of exceedance in a 50-year period.

3.6 SURFACE CONDITIONS

The PGWTP and Crespi Pond site is located on Point Pinos, at the northern tip of the City of Pacific Grove. The area includes the Pacific Grove golf Links and is bordered by Sunset Drive

and the Pacific Ocean on the north and west, by Asilomar Avenue to the east and by Lighthouse Avenue to the south.

As mentioned above, the proposed development within the area of DH-6 (near the intersection of Del Monte Boulevard and Egan Avenue) was abandoned and is not addressed in this section.

3.6.1 PGWTP Tank Site

The existing ground surface at the tank site slopes gently towards the north at a gradient of about 10:1 (horizontal:vertical), steepening south of the site, and flattening to the north. Past grading for the tank pad appears to have consisted of cuts of 3 to 5 feet in height on the south and west sides of the tanks. There was no evidence of significant fill in the immediate vicinity of the tanks, although the 1952 project plans indicate general fill placement on the east side of the site.

We understand that the existing tanks are also being evaluated for reuse by a structural engineer, Harper and Associates. Based on the information provided in the 1952 design plans, supplemented by information provided to us from Harper and Associates, both tanks are about 57 feet in diameter, 30 to 33 feet in height and are buried 10 to 16 feet below grade. The "clarifier" on the east side, has a sloping base that extends between 13 to 16.5 feet below grade and the "digester" on the west side, has a flat base that extends about 10 feet below existing grade.

3.6.2 Crespi Pond and Proposed Wetland Site

The dune sands that comprise the majority of the golf course form a subtle, roughly north-south trending ridge which forms the eastern border of the topographic swale that terminates at Crespi Pond. The ground surface on the margins of the pond is level to very slightly sloping towards the north. We understand that the existing depth of the pond is about 5 feet, and the entire pond is bordered by the golf course fairway.

The area about 750 feet south of Crespi Pond that is proposed for a new wetland is also located in the topographic swale that borders the dune sand ridge. This area occupies a topographic low with very mild gradients and is also within the golf course.

3.7 SUBSURFACE CONDITIONS

A brief description of the materials encountered in each boring is presented below. For a more detailed description of the soil conditions encountered in our drill holes, refer to the drill hole logs in Appendix A.

DH-1 and DH-2 were located at the PGWTP tank site and extended between 19.5 and 24 feet below ground surface. These boring encountered dune deposits underlain by granite bedrock. The dune deposits consist of Poorly Graded Sand with Clay and are medium dense in the upper two feet, and variably looser in density at variable intervals between about 3 and 12 feet below ground surface. The density increases below about 9 to 12 feet, with granite bedrock located at about 16 feet below ground surface. The granite is severely weathered in the upper portion and increases in density/strength with depth.

DH-3 and DH-4 were located on the northwest and southwest sides of Crespi Pond in the areas of its proposed expansion. Both encountered dune deposits overlying granite. In this

topographic swale, the dune deposits have greater fine grained material and consist of medium dense to loose Poorly Graded Sand with Clay to Clayey Sand. Peat rich sand was encountered just above the bedrock in DH-4. Granite bedrock was encountered in both borings at 3.5 feet (DH-3) and 7.5 feet (DH-4) below ground surface. In DH-3 the field measured blow counts were high, indicating dense granite bedrock at 5 feet below ground surface. In DH-4 the granite appeared relatively soft in rock hardness from 7.5 to 12 feet below ground surface and then became denser/stronger at 12 feet below ground surface.

DH- 5 was located in the area of the proposed wetland/pond. It encountered 12 feet of Poorly Graded Sand with Clay underlain by granite at 12.5 feet below ground surface, both of which displayed similar composition and to the other drill holes.

DH-6 was located near the intersection of Del Monte Boulevard and Egan Avenue. This drill hole encountered 2 feet of older dune deposits consisting of a medium dense Clayey Sand. Weathered granite was encountered at 2 feet below ground surface and denser granite at 7 feet below ground surface.

3.8 GROUNDWATER

Groundwater was not encountered in any of our borings (DH-1 through DH-6). These conditions likely do not reflect stabilized groundwater depths, and are likely variable. Based on the site geology we interpret that groundwater will locally pond on the granite bedrock surface after heavy rainfall and then drain outwards towards the ocean. In the area of the PGWTP tanks, subsurface drainage is expected to occur relatively quickly and to flow radially outwards as the water is released along the Point Pinos bluffs. In the area around Crespi Pond, subsurface drainage is likely slower and focused northward by the topographic and bedrock swale.

Golf course maintenance personnel report that even in the topographic low areas the fairway is drivable relatively quickly after rains, indicating that drainage of perched water is fairly rapid.

Groundwater depth is subject to fluctuations depending on rainfall, golf course irrigation, pumping in local wells, or other factors that may not be evident at the time of our investigation.

3.9 TOP OF BEDROCK SURFACE

The site is located on a marine terrace surface. Geomorphically, these surfaces are cut by wave action and therefore tend to be quite planar, and nearly level when formed. Our borings are consistent with this, encountering top-of-bedrock at an approximate elevation of 7 feet in DH-2, and an elevation of 5 feet in DH-1, a difference in elevation of 2 feet across a distance of over 100 feet. In general, we expect that most of the top-of-bedrock surface would be similarly planar. Locally incised and buried drainageways may exist (such as that occupied by Crespi Pond), and bedrock would be encountered at greater depths in these areas.

Bedrock encountered at the maximum depth of our drill holes was soft in rock hardness and crumbled to sand size material in the samplers, even when the SPT blow counts were very high. Based on this we infer that material will be excavatable with conventional equipment, but extra time and horsepower will likely be required. Generally speaking, rock quality is expected to improve with depth.

Based on our borings and the topographic maps that were provided, the depth to bedrock, dense bedrock and the elevation of dense bedrock is estimated Table 3. Elevations are based on the datum provided to us by Fall Creek Engineering as shown in Figure 5:

Table 3. Summary of Bedrock Depth and Elevation

Location	Depth Below Ground Surface to Top of Bedrock (feet)	Depth Below Ground Surface to Dense Bedrock (feet)	Elevation of Dense Bedrock (feet)
PGWTP Site (DH-1 and DH-2)	16 to 16.5	16 to 16.5	Elev. 5 to 7
Crespi Pond (DH-3 and DH-4)	3.5 to 7.5	5 to 12	Elev. 10 to 12
Proposed Wetland (DH-5)	12.5	12.5	Elev. 26

3.10 VARIATIONS IN SUBSURFACE CONDITIONS

Our interpretations of soil, bedrock and groundwater conditions, as described in this report, are based on data obtained from subsurface exploration and laboratory testing for this study, and from subsurface data obtained by others. Our conclusions and recommendations are based on these interpretations. The project area has undergone different phases of land usage, with associated grading. Therefore, it is likely that undisclosed variations in subsurface conditions exist within the project area, such as old foundations, abandoned utilities and localized fill deposits of unknown character. Additionally, the hardness of granite bedrock will be locally variable.

We recommend that careful observations be made during construction to verify our interpretations. Should variations from our interpretations be found, we should be notified to evaluate whether any revisions should be made to our recommendations.

4. DISCUSSION AND CONCLUSIONS

4.1 GENERAL

Based on the results of our investigation, we conclude that the site is geotechnically suitable for the proposed improvements, provided the recommendations presented in this report are followed. A review of our conclusions with respect to various hazards is presented below. Detailed recommendations are presented in Section 5.

4.2 SURFACE RUPTURE AND SEISMIC GROUND SHAKING

Because the project area is not located within a State of California Earthquake Fault Zone and no mapped active faults are known to cross the project area, the probability of ground surface rupture at the project area due to displacement along a fault is remote.

The project area is in a region of high seismicity. Based on general knowledge of the local seismicity, it should be anticipated that, during its useful life, the project area will be subject to strong ground shaking. It is also anticipated that the project area will periodically experience small to moderate magnitude earthquakes. Proposed improvements should be designed accordingly.

4.3 SHALLOW BEDROCK AND EXCAVATABILTY

Shallow granite bedrock exists at variable elevations across the site. Granite bedrock, depending on the degree of weathering, may be very difficult to excavate. Approximate depth to dense bedrock as encountered in our borings is summarized in Section 3.9.

Based on DH-3 and DH-4, it appears that hard rock could be encountered at shallow depths below Crespi Pond water elevation and that excavating up to 10 feet below the pond water elevation may be difficult. However, the bedrock surface may dive deeper as one approaches the centerline of the topographic swale in this area, allowing greater excavatability.

Underground contractors should be aware of the presence of shallow bedrock and employ suitable equipment for these conditions. Heavy ripping, jack hammering, and other appropriate means may be required.

4.4 LIQUEFACTION AND LATERAL SPREADING

Soil liquefaction is a phenomenon in which saturated granular soils, and certain fine-grained soils, lose their strength due to the build-up of excess pore water pressure during cyclic loading, such as that induced by earthquakes. Soils most susceptible to liquefaction are saturated, clean, loose, fine-grained sands and non-plastic silts. Certain gravels, plastic silts, and clays are also susceptible to liquefaction. The primary factors affecting soil liquefaction include: 1) intensity and duration of seismic shaking; 2) soil type; 3) relative density of granular soils; 4) moisture content and plasticity of fine-grained soils; 5) overburden pressure; and 6) depth to groundwater.

The regional liquefaction susceptibility mapping reviewed in Section 4.4 considers the marine terrace deposits underlying the PGWTP tank site and the wetland area to have a low liquefaction susceptibility. The alluvial deposits that are mapped to underlay Crespi Pond are mapped as having a high liquefaction potential. Our borings encountered materials we classified as dune deposits, because they are sand-sizes or finer, with fairly uniform grain size, and no large clasts. The dune sand deposits are relatively clean with low fines content and are potentially liquefiable depending on their density and the depth of groundwater. At the PGWTP tank site potentially liquefiable soils were encountered in isolated zones between about 3 and 12 feet below ground surface.

The setting of the PGWTP tank site is such that groundwater generated from rainfall reaches the top of bedrock, and rather than perch on top of the bedrock, it tends to drain away relatively rapidly. This is due to the site being located near the northern end of a bedrock peninsula with virtually no contributing watershed, and the existence of free-draining faces along the bluff margins. None of our borings at the site encountered groundwater during drilling. From the groundwater data we were able to obtain in this investigation (see Section 3.8), we infer that for the majority of the year groundwater does not saturate the 16 feet of soil that mantles the bedrock at the PGWTP site. Therefore, the probability that temporarily perched groundwater would occur at the same time as a major earthquake is low. With this condition, in our opinion the hazard of liquefaction at the site is low.

Because there is a low potential for liquefaction at the PGWTP tanks site, there is a correspondingly a low potential of lateral spreading in this area of the site.

Crespi Pond and the site for a future wetlands are located in a topographic low. Our borings did not encounter ground water in these areas either, but based on the site geology there is a greater likelihood that perched groundwater may remain trapped in these areas for longer periods of time. Also, use of the area as wetlands may result in raising the groundwater elevation. We analyzed the liquefaction potential in these areas based on a PGA value of 0.41g (see Section 3.3), an earthquake moment magnitude of 7.3, and a perched groundwater depth of 5 feet below ground surface.

The results of our liquefaction analysis suggest that the sand layers from 5 to 7 feet in DH-3 and from 5 to 8 feet in DH-4 are potentially liquefiable. Estimated liquefaction-induced ground settlements for these layers are 1/4 inch to 1/3 inch respectively. Case histories have shown that actual liquefaction-induced settlements could be 50 to 200 percent of the estimated values.

4.5 SETTLEMENT OF WATER TANK FOUNDATIONS

Seismic and static settlement of the 0 to 3.5 foot thick soil layer between the bottom of the tanks and the underlying bedrock is a potential issue. During construction of the existing tanks, it is possible that the soil layer that exists between the bottom of the tanks and the bedrock surface was subexcavated and recompacted in place, thus reducing the magnitude of seismic and static settlement of this layer.

The information from our surrounding drill holes may not be representative of the soils beneath the tank foundations, but we judge that they represent a "worst case" condition. Assuming this worst case condition the seismically induced settlement of this area is judged to be less than about ½ inch.

As long as the loads within the tanks (the maximum water level) are similar to the loads they experienced when they were in service, additional static settlement should be minor. Due to the age of the tank it is likely that static settlement occurred years ago.

4.6 EXCAVATIONS AND DEWATERING

Proposed excavations within the Crespi Pond area are planned to be 5 to 10 feet below existing ground surface. Excavation depths for utilities are not presently known. Excavations within the dune sand deposits will encounter cohesionless materials that are subject to collapse and will require shoring or sloping the excavation sidewalls. Detailed recommendations are provided in Section 5.2.

Depending on the time of year of construction, if groundwater is encountered during construction, dewatering may also be required to allow construction to proceed in a "dry" condition.

4.7 EXPANSION POTENTIAL OF NEAR-SURFACE SOILS

The near-surface soils are generally sands with a low percentage of fines. These types of soil generally have low expansion potential.

5. RECOMMENDATIONS

5.1 GENERAL

Recommendations are provided in this section for expansion of the Crespi Pond and the wetland area, for assessment of the existing PGWTP tanks and for construction of utility trenches. General recommendations are provided for other improvements in the area. If new tanks or other improvements are proposed, we request the opportunity to review them to evaluate if our recommendations are suitable.

5.2 EARTHWORK

5.2.1 Clearing and Grubbing

Clearing and grubbing should be performed in areas proposed for earthwork, concrete slabs-on-grade or other development. Clearing and grubbing should include clearing of existing structures, utility lines to be abandoned, deleterious materials, debris, obstructions, and stumps and primary roots of trees and brush (roots over 1 inch in diameter or longer than about 3 feet in length). Depressions, voids and holes that extend below the proposed finish grade should be cleaned and backfilled with engineered fill.

Surface vegetation and organic laden soils should be stripped. Organic laden soils are defined as soils with more than 3 percent by weight of organic content. The required stripping depth should be determined in the field by the Engineer at the time of construction. Stripped material may be stockpiled for use in landscape areas if approved by the project landscape architect, or otherwise removed from the site.

5.2.2 Excavations, Shoring and Dewatering

Excavations up to 10 feet are anticipated for expansion of the Crespi Pond and the new wetland area. Excavations of unknown depth are anticipated for utility lines. Excavations may encounter hard granite bedrock conditions (see Section 3.9 for approximate depth to dense rock encountered in our drill holes). Based on the materials encountered in our borings we infer that excavations can be accomplished with conventional equipment, supplemented by heavy rippers. However, jack hammers in hard granite may be necessary. All underground contractors should be prepared for hard shallow rock conditions.

The contractor is responsible for the design, installation, maintenance and removal of temporary shoring and bracing systems. The presence of nearby existing structures, pavements, and underground utilities must be incorporated in the design of the shoring and bracing systems. The presence of relatively clean sandy soils that are subject to sudden collapse should be taken into consideration in design and construction.

Groundwater was not encountered in any of our drill holes but is expected to seasonally pond on the bedrock surface for short periods of time. Dewatering systems may be necessary. The design, installation, permitting, maintenance and removal of dewatering systems are the responsibility of the contractor.

Excavations adjacent to existing or proposed foundations should be above an imaginary plane having an inclination of 1½:1 (horizontal to vertical) extending down from the top of the

foundations. Otherwise, the effect of the adjacent foundations should be incorporated in the design and construction of the excavations and improvements.

5.2.3 Subgrade Preparation

Subgrade preparation is recommended in areas to receive engineered fill, or to support improvements such as pavements, concrete slabs, etc. Where subgrade preparation is required, the subgrade should be compacted to the recommendations given under Section 5.2.5. "Engineered Fill Placement and Compaction."

Soil with moisture content above optimum value should be anticipated during and shortly after rainy seasons, or for soils below the groundwater level. Where unstable, wet or soft soil is encountered, the soil will require processing before compaction can be achieved. When construction schedule does not allow air-drying, other means such as lime treatment of the soil or excavation and replacement may be considered. Geotextile fabrics may also be used to help stabilize the subgrade. The method to be used should be determined at the time of construction based on the actual site conditions. We recommend obtaining unit prices for subgrade stabilization during the construction bid process.

5.2.4 Material for Engineered Fill

In general, on-site soils with an organic content of less than 3 percent by weight, free of any hazardous or deleterious materials, and meeting the gradation requirements below may be used as general engineered fill to achieve project grades, except when special material is required.

In general, engineered fill material should not contain rocks or lumps larger than 3 inches in greatest dimension, should not contain more than 15 percent of the material larger than 1½ inches, and should contain at least 10 percent passing the No. 200 sieve. In addition to these requirements, import fill should have a low expansion potential as indicated by Plasticity Index of 12 or less, or Expansion Index of less than 20.

All import fills should be approved by the project geotechnical engineer prior to delivery to the site. At least five (5) working days prior to importing to the site, a representative sample of the proposed import fill should be delivered to our laboratory for evaluation.

5.2.5 Engineered Fill Placement and Compaction

Engineered fill should be placed in horizontal lifts each not exceeding 8 inches in thickness, moisture conditioned to the required moisture content, and mechanically compacted. Relative compaction or compaction is defined as the in-place dry density of the compacted soil divided by the laboratory maximum dry density as determined by ASTM Test Method D1557, latest edition, expressed as a percentage.

Moisture conditioning of soils should consist of adding water to the soils if they are too dry and allowing the soils to dry if they are too wet.

Engineered fills consisting of on-site or imported soils should be compacted to a minimum of 90 percent relative compaction. The moisture content of the material should be brought to between 1 and 3 percent above the laboratory optimum value before compaction is performed. In pavement areas, the upper 8 inches of soil should be compacted to a minimum of 95 percent relative compaction.

5.2.6 Cut and Fill Slopes

Generally, cut and fill slopes in sandy soil should be constructed at inclinations no steeper than 2.5:1 (horizontal:vertical). Permanent cut slopes within the metamorphic rock may be constructed at inclinations as steep as 1:1 (horizontal:vertical).

All pavements and concrete slabs-on-grade should be set back at least 5 feet horizontally from the crests of cut or fill slopes.

It may be desirable to lay back cut slopes in sand to as flat as 3:1 on the margins of Crespi Pond and the proposed wetland area. The stability of saturated slopes on the pond margins will be dependent on the percentage of fines within the material and to what degree vegetation is established.

5.2.7 Utility Trench Excavation and Backfill

Trench excavation, bedding and backfill should conform to the City of Pacific Grove Standard Specifications. Construction, shoring, and bracing of excavations should comply with the current CAL-OSHA safety standards and local jurisdiction. The stability and safety of excavations, braced or unbraced, is the responsibility of the contractor.

5.2.8 Wet Weather Construction

If site grading and construction is to be performed during the winter rainy months, the owner and contractors should be fully aware of the potential impact of wet weather. Rainstorms can cause delay to construction and damage to previously completed work by saturating compacted pads or subgrades, or flooding excavations.

Earthwork during rainy months will require extra effort and caution by the contractors. The contractor is solely responsible to protect his work to avoid damage by rainwater. Standing pools of water should be pumped out immediately. Construction during wet weather conditions should be addressed in the project construction bid documents and/or specifications. We recommend the grading contractor submit a wet weather construction plan outlining procedures they will employ to protect their work and to minimize damage to their work by rainstorms.

5.3 WATER TANK FOUNDATIONS

Based on the information provided to us, we understand that the eastern tank (the clarifier) has a base foundation consisting of a 14-inch thick concrete mat that slopes from 13 feet at the edges to 16.5 feet below ground surface at the center. The western tank (the digester) has a flat, 18-inch thick concrete mat that is founded 10 feet below ground surface.

For evaluation of these two tanks we recommend a net allowable bearing capacity of 2500 pounds per square foot on the underlying soils when considering dead plus normal live loading. This allowable foundation soil pressure may be increased by one-third when considering short-term wind or seismic loading. This assumes the existing embedment depths as noted above. Static settlement of the tanks is expected to have already occurred. Total settlement due to seismic shaking may be on the order of ½ inch .

Soil resistance to lateral loads will be provided by a combination of frictional resistance between the bottom of the mat foundations and underlying soils and by passive pressures acting against the embedded sides of the tanks. For frictional resistance at the base of the tanks, an ultimate

coefficient of friction of 0.3 may be used for design. In addition, an allowable passive lateral bearing pressure equal to an equivalent fluid pressure of 300 pounds per cubic foot (pcf) may be used. These values may be used in combination without reduction. This passive pressure can be assumed to act from 2 feet below grade and downward.

The side walls of the tanks should be designed to retain the surrounding soil. We infer that at-rest soil pressures are applicable for the tank walls as they are restrained from deflecting at the top. Assuming drained backfill conditions, the tank walls should be designed to resist an equivalent fluid pressure of 55 pcf.

If the structural engineer wishes to include seismic forces in the design of tank walls, the walls may be evaluated using the above at-rest soil pressure plus a horizontal seismic line force of $10H^2$ pounds per lineal foot (where H is the height of the vertical design plane from the wall base to the ground surface above). The resultant of the seismic force should be applied at 2/3H above the wall base. A reduced factor of safety for overturning and sliding may be used in seismic design as determined by the structural designer.

5.4 CONCRETE SLABS-ON-GRADE

No specific exterior concrete slabs-on-grade are presently proposed. The following recommendations are for exterior slabs in general. Preparation of subgrade soil and placement and compaction of engineered fill for concrete slabs-on-grade should be as outlined in Section 5.2, the "Earthwork" section of this report.

Exterior concrete slabs that are not sensitive to moisture transmission through the slabs, such as exterior flatwork may be constructed directly on properly prepared soil subgrades. Design of reinforcement, joint spacing, etc. is the responsibility of the design engineer.

Exterior concrete slabs-on-grade should be cast free from adjacent foundations or other non-heaving edge restraints. This may be accomplished by using a strip of 1/2-inch asphalt-impregnated felt divider material between the slab edges and the adjacent structure.

5.5 SURFACE DRAINAGE

Engineering design of grading and drainage at the site is the responsibility of the project Civil Engineer. We recommend the following be considered by the project Civil Engineer and incorporated into the project plans where appropriate.

Sufficient surface drainage should be provided to direct runoff away from building foundations, concrete slabs-on-grade and pavements, and towards suitable collection and discharge facilities. Ponding of surface water should be avoided by establishing positive drainage away from all improvements. Water collected from roof downspouts should be discharged into a closed pipe or towards drainage structures, and the water carried to a suitable discharge point.

The dune sand deposits are highly erodible and care should be taken to provide erosion protection where water is discharged and to plant and mulch all disturbed surfaces, establishing vegetation as appropriate, prior to the winter rains.

6. PLAN REVIEW, EARTHWORK AND FOUNDATION OBSERVATION

Post-report geotechnical services by Pacific Geotechnical Engineering (PGE), typically consisting of pre-construction design consultations and reviews, construction observation and testing services, are necessary for PGE to confirm the recommendations contained in this report. This report is based on limited sampling and investigation, and by those constraints may not have discovered local anomalies or other varying conditions that may exist on the project site. Therefore, this report is only preliminary until PGE can confirm that actual conditions in the ground conform to those anticipated in the report. Accordingly, as an integral part of this report, PGE recommends post-report geotechnical services to assist the project team during design and construction of the project. PGE requires that it perform these services if it is to remain as the project geotechnical engineer-of-record.

During design, PGE can provide consultation and supplemental recommendations to assist the project team in design and value engineering, especially if the project design has been modified after completion of our report. It is impossible for us to anticipate every design scenario and use of construction materials during preparation of our report. Therefore, retaining PGE to provide post-report consultation will help address design changes, answer questions and evaluate alternatives proposed by the project designers and contractors.

Prior to issuing project plans and specifications for construction bidding purposes, PGE should review the grading, drainage and foundation plans and the project specifications to determine if the intent of our recommendations has been incorporated in these documents. We have found that such a review process will help reduce the likelihood of misinterpretation of our recommendations which may cause construction delay and additional cost.

Construction phase services can include, among other things, the observation and testing during site clearing, stripping, excavation, mass grading, subgrade preparation, fill placement and compaction, backfill compaction, foundation construction and pavement construction activities.

Pacific Geotechnical Engineering would be pleased to provide cost proposals for follow-up geotechnical services. Post-report geotechnical services may include additional field and laboratory services.

7. LIMITATIONS

In preparing the feasibility-level findings and professional opinions presented in this report, we have endeavored to follow generally accepted principles and practices of the engineering geologic and geotechnical engineering professions in the area and at the time our services were provided. No warranty, express or implied, is provided.

The preliminary recommendations contained in this report are based, in part, on information that has been provided to us. In the event that the general development concept or general location and type of structures are modified, our preliminary conclusions and recommendations shall not be considered valid unless we are retained to review such changes and to make any necessary additions or changes to our recommendations. For Pacific Geotechnical Engineering to remain the geotechnical consultant of record for the proposed project, we must provide supplemental geotechnical services during final design phase, plan review and construction observation services, as outlined above under the Plan Review, Earthwork and Foundation Observation section of this report.

Subsurface exploration is necessarily confined to selected locations and conditions may, and often do, vary between these locations. Should conditions different from those assumed in this report be encountered during project development, additional exploration, testing, and analysis may be required.

Should persons concerned with this project observe geotechnical features or conditions at the site or surrounding areas which are different from those described in this report, those observations should be reported immediately to Pacific Geotechnical Engineering for evaluation.

It is important for project performance that the preliminary recommendations given in this report are made known to the design professionals involved with the project, that they be incorporated into project drawings and documents, and that the preliminary recommendations be validated and/or supplemented by a design level geotechnical investigation.

Report prepared by,

PACIFIC GEOTECHNICAL ENGINEERING

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GE 2252

G. Reid Fisher PhD
CEG 1858

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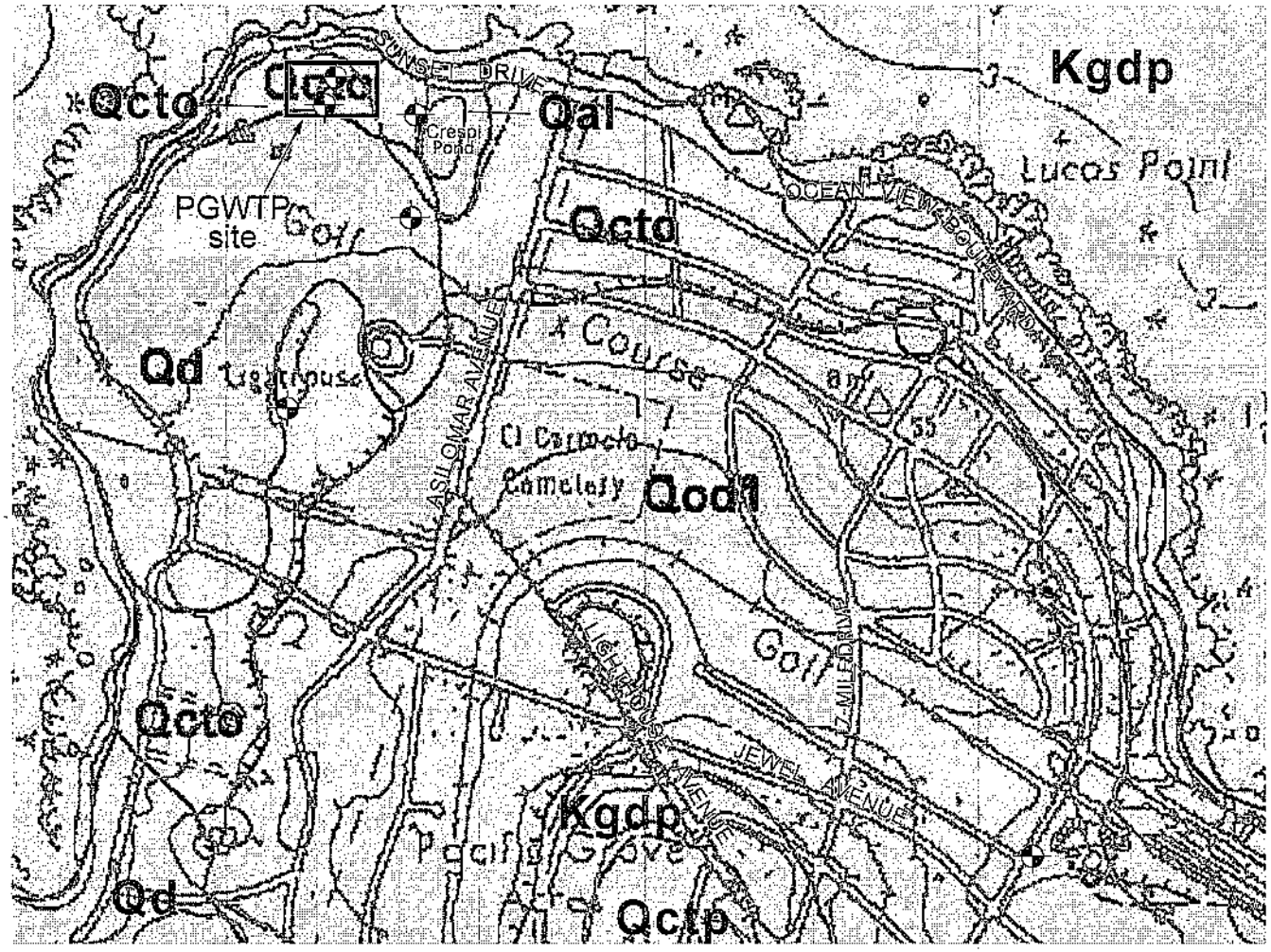
FIGURES



EXPLANATION

Qd	Dune sand deposits (Holocene)
Qal	Alluvial deposits (Holocene)
Qod1	Younger coastal dune deposits (Pleistocene)
Qcto	Ocean view coastal terrace (Pleistocene)
Qctl	Lighthouse coastal terrace (Pleistocene)
Qctp	Peninsula College coastal terrace (Pleistocene)
Kgdp	Porphyritic granodiorite of Monterey of Ross (Cretaceous)
⊕	Drill hole location

N

0 500 ft

NOTES:
1. BASE MAP: Geologic Map of the Monterey and Seaside 7.5-Minute Quadrangles (J.C. Clark and others, 1997).
2. Drill hole locations are shown on this figure to illustrate the overall distribution of exploration. See Figures 4 and 5 for specific locations of drill holes.

PACIFIC GEOTECHNICAL ENGINEERING

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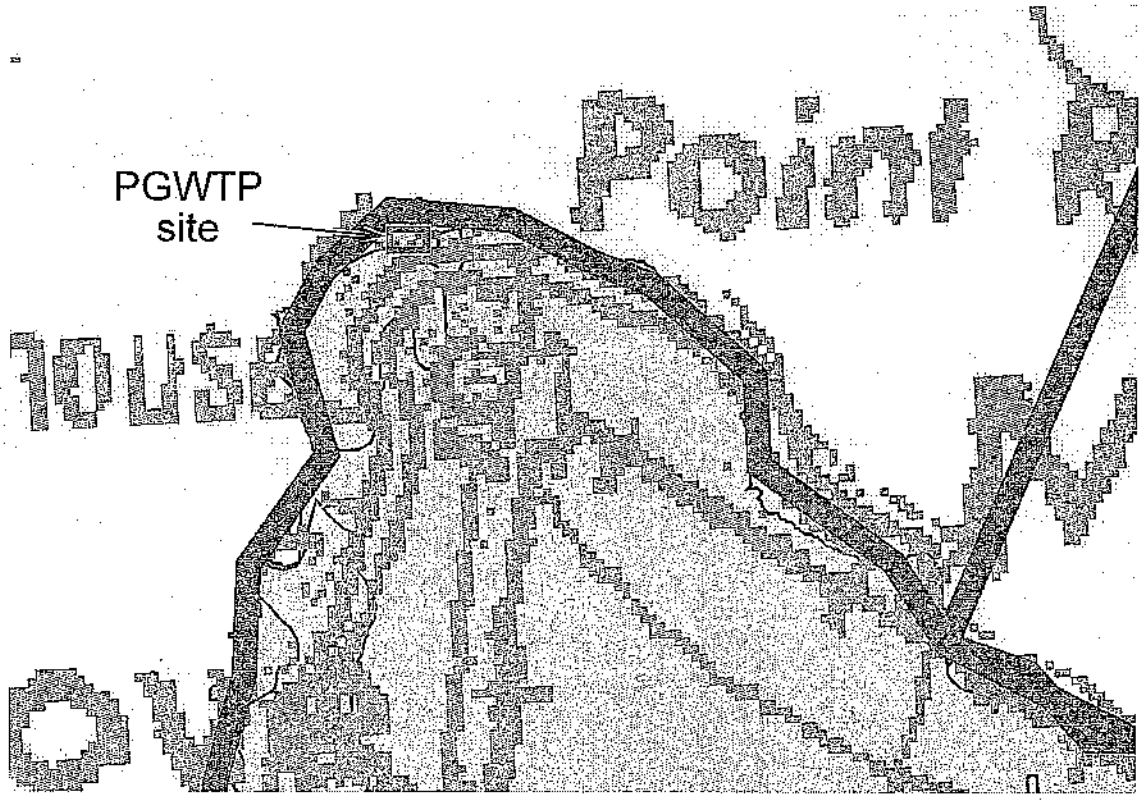
DATE:	AUGUST 2013
CHECED BY:	
REVISION:	

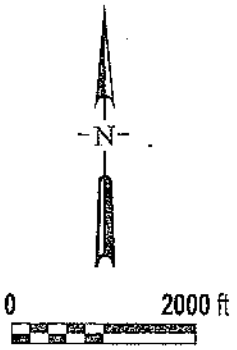
GEOLOGIC INDEX MAP

PACIFIC GROVE ASBS STORMWATER MANAGEMENT PROJECT
MONTEREY and PACIFIC GROVE, CALIFORNIA

FIGURE 1

PROJECT 2013.0031





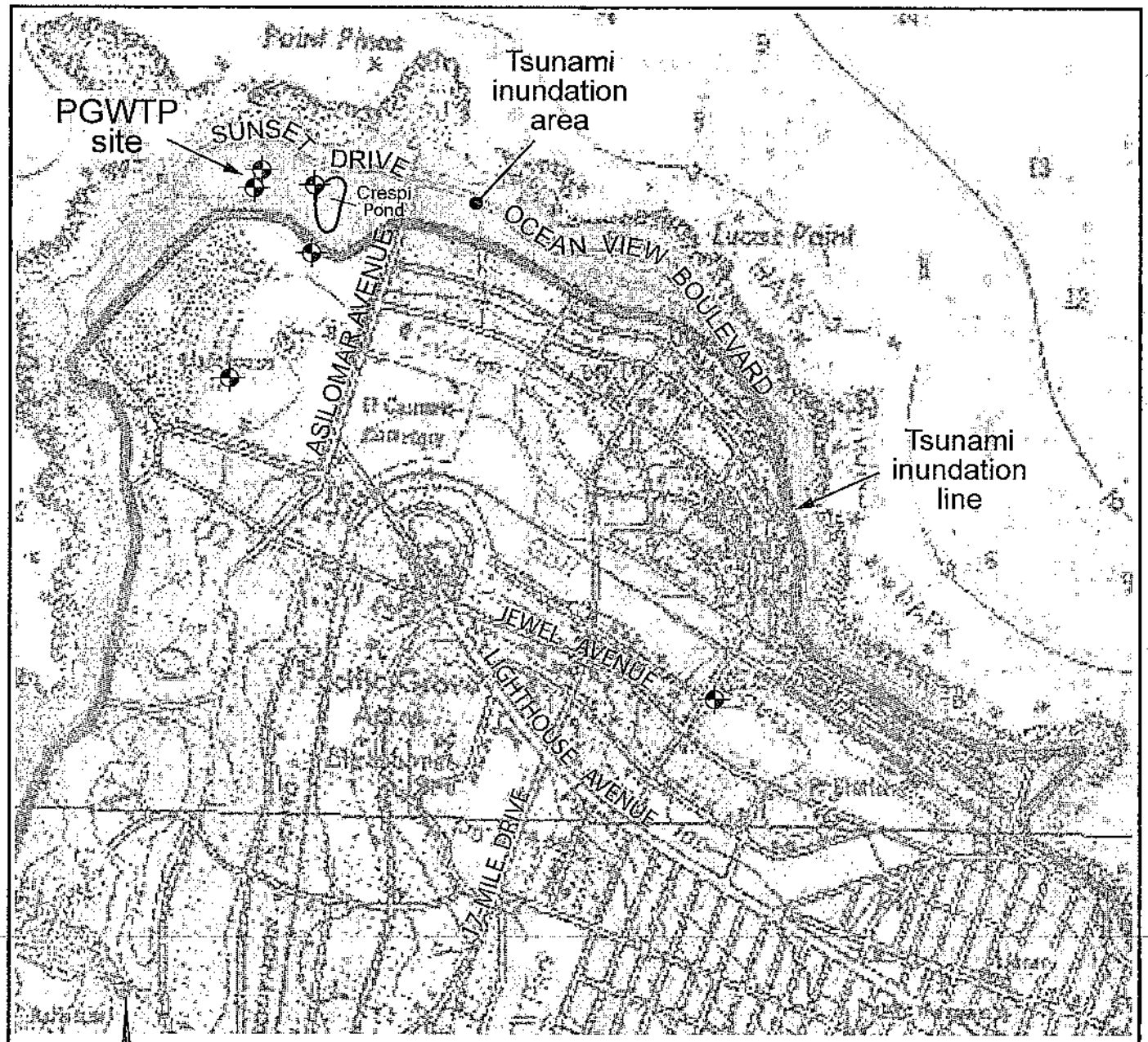
EXPLANATION

High liquefaction susceptibility

Low liquefaction susceptibility

BASE MAP: Digital Map Showing Relative Liquefaction Susceptibility of Monterey County, California (L.I. Rosenberg, 2001).

PACIFIC GEOTECHNICAL ENGINEERING	DRAFTED BY: CSS	**LIQUEFACTION MAP**	**FIGURE** 2
	DATE: AUGUST 2013	**PACIFIC GROVE ASBS STORMWATER MANAGEMENT PROJECT MONTEREY and PACIFIC GROVE, CALIFORNIA**	
	CHECED BY:		**PROJECT** 2013.0031
	REVISION:		



BASE MAP: Tsunami Inundation Map for Emergency Planning, Monterey Quadrangle (California Emergency Management Agency and others, 2009).

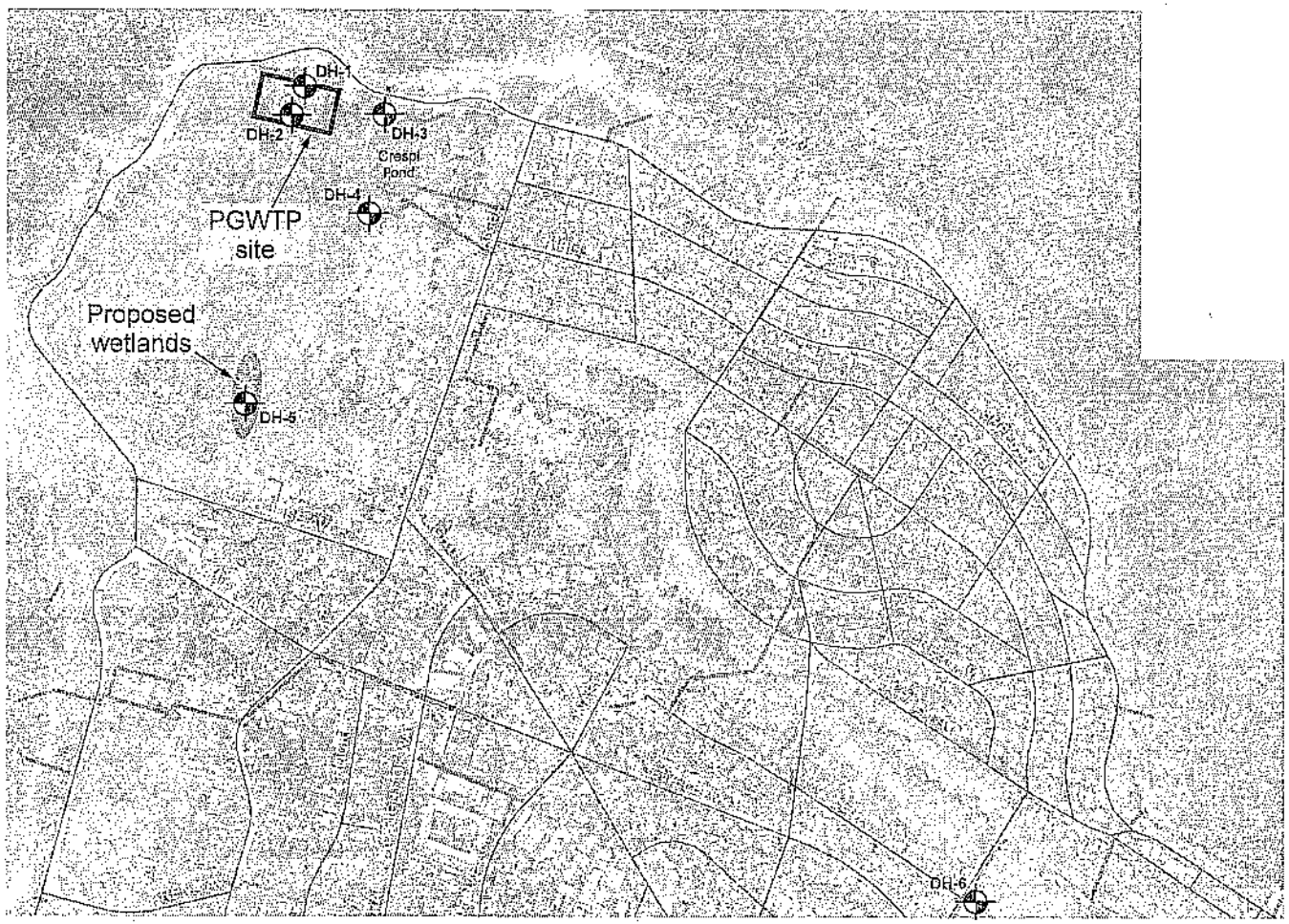
-N-

0 1000 ft

EXPLANATION

Drill hole location

PACIFIC GEOTECHNICAL ENGINEERING	DRAFTED BY: CSS	**TSUNAMI INUNDATION MAP**	**FIGURE** 3
	DATE: AUGUST 2013	**PACIFIC GROVE ASBS STORMWATER MANAGEMENT PROJECT MONTEREY and PACIFIC GROVE, CALIFORNIA**	
	CHECED BY:		**PROJECT** 2013.0031
	REVISION:		



EXPLANATION

DH-6 Drill hole location

Existing storm drain

N

0 500 ft

BASE MAP: "Pacific Grove Water Treatment Plant Vicinity, Pacific Grove ASBS Stormwater Management Plan," by Fall Creek Engineering, Inc., received electronically on 8/5/13.

PACIFIC GEOTECHNICAL ENGINEERING

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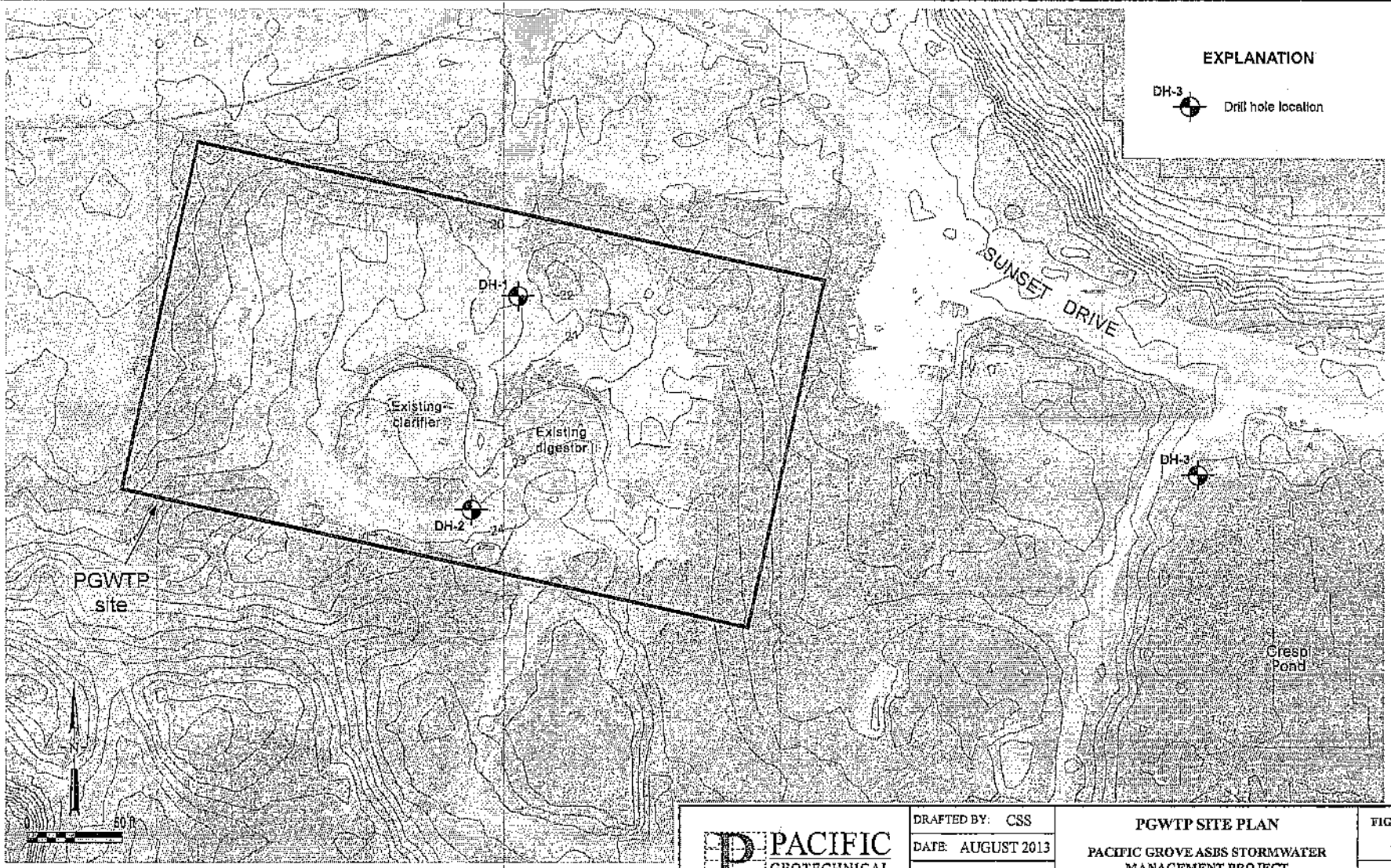
OVERALL SITE PLAN

PACIFIC GROVE ASBS STORMWATER MANAGEMENT PROJECT
MONTEREY and PACIFIC GROVE, CALIFORNIA

FIGURE 4

PROJECT 2013.0031



BASE MAP: "Pacific Grove Water Treatment Plant Contour Data, Pacific Grove ASBS Stormwater Management Plan," by Fall Creek Engineering, Inc., received electronically on 8/5/13.

PACIFIC GEOTECHNICAL ENGINEERING

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PGWTP SITE PLAN

PACIFIC GROVE ASBS STORMWATER MANAGEMENT PROJECT
MONTEREY and PACIFIC GROVE, CALIFORNIA

FIGURE 5

PROJECT 2013.0031

APPENDIX A

KEY TO SOIL CLASSIFICATION - FINE GRAINED SOILS

(50% OR MORE IS SMALLER THAN NO. 200 SIEVE SIZE)

(modified from ASTM D2487 to include fine grained soils with intermediate plasticity)

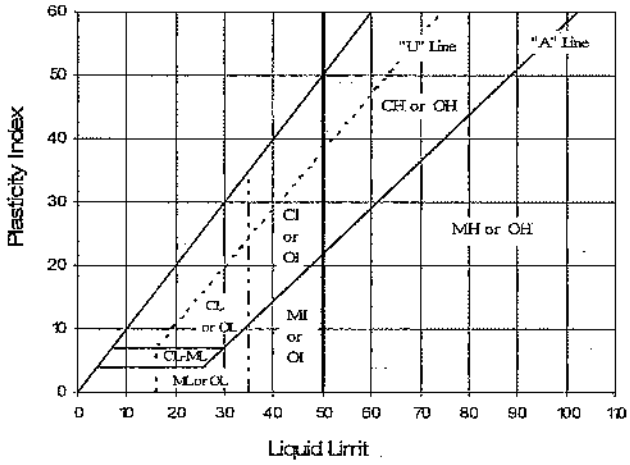
MAJOR DIVISIONS			GROUP SYMBOLS	GROUP NAMES
SILTS AND CLAYS (Liquid Limit less than 35) Low Plasticity	Inorganic	PI < 4 or plots below "A" line	ML	Silt, Silt with Sand or Gravel, Sandy or Gravelly Silt, Sandy or Gravelly Silt with Sand or Gravel
	Inorganic	PI > 7 or plots on or above "A" line	CL	Lean Clay, Lean Clay with Sand or Gravel, Sandy or Gravelly Lean Clay, Sandy or Gravelly Lean Clay with Sand or Gravel
	Inorganic	PI between 4 and 7	CL-ML	Silty Clay, Silty Clay with Sand or Gravel, Sandy or Gravelly Silty Clay, Sandy or Gravelly Silty Clay with Sand or Gravel
	Organic	See footnote 3	OL	Organic Silt (below "A" Line) or Organic Clay (on or above "A" Line) [1,2]
SILTS AND CLAYS (35 ≤ Liquid Limit < 50) Intermediate Plasticity	Inorganic	PI < 4 or plots below "A" line	MI	Silt, Silt with Sand or Gravel, Sandy or Gravelly Silt, Sandy or Gravelly Silt with Sand or Gravel
	Inorganic	PI > 7 or plots on or above "A" line	CI	Clay, Clay with Sand or Gravel, Sandy or Gravelly Clay, Sandy or Gravelly Clay with Sand or Gravel
	Organic	See footnote 3	OI	Organic Silt (below "A" Line) or Organic Clay (on or above "A" Line) [1,2]
SILTS AND CLAYS (Liquid Limit 50 or greater) High Plasticity	Inorganic	PI plots below "A" line	MH	Elastic Silt, Elastic Silt with Sand or Gravel, Sandy or Gravelly Elastic Silt, Sandy or Gravelly Elastic Silt with Sand or Gravel
	Inorganic	PI plots on or above "A" line	CH	Fat Clay, Fat Clay with Sand or Gravel, Sandy or Gravelly Fat Clay, Sandy or Gravelly Fat Clay with Sand or Gravel
	Organic	See note 3 below	OH	Organic Silt (below "A" Line) or Organic Clay (on or above "A" Line) [1,2]

1. If soil contains 15% to 29% plus No. 200 material, include "with sand" or "with gravel" to group name, whichever is predominant.
2. If soil contains ≥30% plus No. 200 material, include "sandy" or "gravelly" to group name, whichever is predominant. If soil contains ≥15% of sand or gravel sized material, add "with sand" or "with gravel" to group name.
3. Ratio of liquid limit of oven dried sample to liquid limit of not dried sample is less than 0.75.

CONSISTENCY	UNCONFINED SHEAR STRENGTH (KSF)	STANDARD PENETRATION (BLOWS/FOOT)
VERY SOFT	< 0.25	< 2
SOFT	0.25 – 0.5	2 – 4
FIRM	0.5 – 1.0	5 – 8
STIFF	1.0 – 2.0	9 – 15
VERY STIFF	2.0 – 4.0	16 – 30
HARD	> 4.0	> 30

MOISTURE	CRITERIA
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below the water table

Plasticity Chart



PACIFIC GEOTECHNICAL ENGINEERING

KEY TO SOIL CLASSIFICATION – COARSE GRAINED SOILS
(MORE THAN 50% IS LARGER THAN NO. 200 SIEVE SIZE)
(modified from ASTM D2487 to include fines with intermediate plasticity)

MAJOR DIVISIONS			GROUP SYMBOLS	GROUP NAMES[1]
GRAVELS (more than 50% of coarse fraction is larger than No. 4 sieve size)	Gravels with less than 5% fines	Cu ≥ 4 and 1 ≤ Cc ≤ 3	GW	Well Graded Gravel, Well Graded Gravel with Sand
		Cu < 4 and/or 1 > Cc > 3	GP	Poorly Graded Gravel, Poorly Graded Gravel with Sand
	Gravels with 5% to 12% fines	ML, MI or MH fines	GW-GM	Well Graded Gravel with Silt, Well Graded Gravel with Silt and Sand
			GP-GM	Poorly Graded Gravel with Silt, Poorly Graded Gravel with Silt and Sand
		CL, CI or CH fines	GW-GC	Well Graded Gravel with Clay, Well Graded Gravel with Clay and Sand
			GP-GC	Poorly Graded Gravel with Clay, Poorly Graded Gravel with Clay and Sand
	Gravels with more than 12% fines	ML, MI or MH fines	GM	Silty Gravel, Silty Gravel with Sand
		CL, CI or CH fines	GC	Clayey Gravel, Clayey Gravel with Sand
		CL-ML fines	GC-GM	Silty Clayey Gravel; Silty, Clayey Gravel with Sand
SANDS (50% or more of coarse fraction is smaller than No. 4 sieve size)	Sands with less than 5% fines	Cu ≥ 6 and 1 ≤ Cc ≤ 3	SW	Well Graded Sand, Well Graded Sand with Gravel
		Cu < 6 and/or 1 > Cc > 3	SP	Poorly Graded Sand, Poorly Graded Sand with Gravel
	Sands with 5% to 12% fines	ML, MI or MH fines	SW-SM	Well Graded Sand with Silt, Well Graded Sand with Silt and Gravel
			SP-SM	Poorly Graded Sand with Silt, Poorly Graded Sand with Silt and Gravel
		CL, CI or CH fines	SW-SC	Well Graded Sand with Clay, Well Graded Sand with Clay and Gravel
			SP-SC	Poorly Graded Sand with Clay, Poorly Graded Sand with Clay and Gravel
	Sands with more than 12% fines	ML, MI or MH fines	SM	Silty Sand, Silty Sand with Gravel
		CL, CI or CH fines	SC	Clayey Sand, Clayey Sand with Gravel
		CL-ML fines	SC-SM	Silty, Clayey Sand; Silty, Clayey Sand with Gravel

US STANDARD SIEVES	3 Inch	¾ Inch	No. 4	No. 10	No. 40	No. 200
	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES & BOULDERS	GRAVELS		SANDS			SILTS AND CLAYS

RELATIVE DENSITY (SANDS AND GRAVELS)	STANDARD PENETRATION (BLOWS/FOOT)
Very Loose	0 - 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 - 50
Very Dense	50+

1. Add "with sand" to group name if material contains 15% or greater of sand-sized particle. Add "with gravel" to group name if material contains 15% or greater of gravel-sized particle.

MOISTURE	CRITERIA
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below the water table

PACIFIC GEOTECHNICAL ENGINEERING

ROCK QUALITY DESCRIPTIONS

HARDNESS**

Very Hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of the geologist's pick
Hard	Can be scratched with knife or pick only with difficulty. Hard blow with hammer required to break sample.
Moderately Hard	Can be scratched with knife or pick. Gouges or grooves to ½ inch can be excavated by hard blow of point of a geologist's pick. Hand specimens broken with moderate blow.
Medium	Can be grooved or gouged 1/16 inch deep by firm pressure on knife or pick point. Can be excavated in small chips about 1 inch maximum in dimension by hard blows of the point of a geologist's pick.
Soft	Can be grooved or gouged readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small pieces can be broken by finger pressure,
Very Soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces one inch or more thickness can be broken with finger pressure. Can be scratched readily by finger nail.

WEATHERING**

Fresh or Unweathered	Rock fresh, crystals bright, few joints and fractures may show slight staining. Rock rings under hammer if crystalline.
Very Slight	Rock generally fresh, fractures and joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints and fractures stained, and discoloration extends into rock up to 1 inch. Joints may contain clay. In granitic rock, some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitic rock, most feldspars are dull and discolored; some show clay. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately Severe	All rock except quartz discolored or stained. In granitic rock, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick. Rock goes "clunk" when struck.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitic rock, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very Severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil." Rock "fabric" not discernible or discernible only in small scattered locations. Quartz may be present as dikes or stringers.

FRACTURE DIMENSIONS*

Fracture	Block Size (or Spacing[1])
Crushed	~5 microns to 0.1 ft
Intensely	0.05 to 0.1 ft
Closely	0.1 to 0.5 ft
Moderately	0.5 to 1.0 ft
Slightly	1.0 to 3.0 ft
Massive	3.0 ft and larger

1 Average distance between adjacent fractures
* Source of data unknown
** Source of data: "Subsurface Investigaiton for Design and Constructio of Foundation Buildings," (1976) American Society of Civil Engineers, Manuals and Reports on Engineering Practice – No. 5

DATE: 6/4/2013	LOG OF EXPLORATORY DRILL HOLE	DH- 1

PROJECT NAME: PGWTP **PROJECT NUMBER:** 2013.0031

DRILL RIG: Mobile B53, 140# downhole hammer & wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** ±21

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
DUNE DEPOSITS: POORLY GRADED SAND WITH CLAY: Very dark brown (10YR 2/2), dry to moist, dense upper, medium dense to loose below; fine sand;	SP-SC	1	S D D	58				3		113		
		2										
		3	S D D	23				4		103		
		4										
		5	S I I	8		10		3				
		6										
		7										
POORLY GRADED SAND WITH CLAY: Brown (7.5YR 4/4), wet, medium dense; fine sand	SP-SC	8										
		9	S I I	17		5		18				
		10										
		11										
		12										
POORLY GRADED SAND WITH CLAY: Light brownish grey (10YR 6/2), wet, very dense; fine sand	SP-SC	13	S I I	72/10"				22				
		14										
		15										
- drilling gets abruptly hard at 16 ft.		16										
BEDROCK: GRANITE: Variable brownish yellow, pale brown, light grey, wet, rock mass is soft due to weathering, individual crystal and fragments are very hard, severely weathered; fracture cannot be determined in samples		17										
		18										
		19	S I I	49								
		20										

DATE: 6/4/2013	LOG OF EXPLORATORY DRILL HOLE	DH- 1

PROJECT NAME: PGWTP **PROJECT NUMBER:** 2013.0031

DRILL RIG: Mobile B53, 140# downhole hammer & wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** ± 21

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
BEDROCK: GRANITE: as above - by 23 ft. weathered such that rock separates into individual crystals; no oxidation color in sample, light grey, black, white quartz-plagioclase biotite granitoid		21										
		22										
		23										
		24	I	50/4"								
BOTTOM OF HOLE = 24 Feet No Groundwater encountered		25										
		26										
		27										
		28										
		29										
		30										
		31										
		32										
		33										
		34										
		35										
		36										
		37										
		38										
		39										
		40										

DATE: 6/4/2013	LOG OF EXPLORATORY DRILL HOLE	DH- 2

PROJECT NAME: PGWTP **PROJECT NUMBER:** 2013.0031

DRILL RIG: Mobile B53, 140# downhole hammer & wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** ± 23

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
PAVEMENT SECTION (4" AC, no Baserock)												
DUNE DEPOSITS: POORLY GRADED SAND WITH CLAY to CLAYEY SAND: Dark brown (10YR 3/3), dry to moist, medium dense; fine sand	SP-SC to SC	1										
		2	SDS	40				4		113		
		3										
POORLY GRADED SAND WITH CLAY: Black (10YR 2/1), dry, medium dense; fine sand	SP-SC	4	SI	12								
		5										
POORLY GRADED SAND with CLAY and GRAVEL: Dark brown (7.5YR 3/3), moist, medium dense; fine to coarse mostly subangular to angular sand; with fine gravel	SP-SC	6	SI	17				20		83		
		7										
		8										
-by 9 ft. dark brown (7.5YR 3/2) - by 9.75 ft. grades to light brownish grey		9	SI	12		10		16				
		10										
		11										
		12										
		13										
-by 14.5 ft. greenish grey (Gley1 6/10Y)		14	SI	24		8		20				
		15										
BEDROCK: GRANITE: Variably colored, brown overall; wet; rock mass soft due to weathering, crystals are hard; severely weathered to clayey sand, fractures cannot be determined in samples		16										
		17										
		18										
BOTTOM OF HOLE = 19.5 Feet No Groundwater Encountered		19	SI	50/5"								
		20										

DATE: 6/4/2013	LOG OF EXPLORATORY DRILL HOLE	DH- 3

PROJECT NAME: PGWTP **PROJECT NUMBER:** 2013.0031

DRILL RIG: Mobile B53, 140# downhole hammer & wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** ± 15

SAMPLER:
D = 3" OD, 2½" ID Split-spoon
X = 2½" OD, 2" ID Split-spoon
I = Standard Penetrometer (2" OD SPT)
S = Slough in sample

GROUND WATER DEPTH: Initial: — Final: —

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
DUNE DEPOSITS: CLAYEY SAND: Very dark brown (10YR 2/2), dry to moist, loose; fine sand	SC	1	S									
		2	D	13								
CLAYEY SAND: Very dark brown (10YR 2/2), moist, medium dense; with fine sand	SC		D			31		18		110		
		3	S									
			D	15								
BEDROCK: (upper 6 in. completely weathered to clayey sand) GRANITE: multi colored grey, white, black with yellowish brown areas from oxidation; dry; rock mass soft due to weathering, crushes into individual crystals		4	D									
		5	S									
		6	D	50/4"		9		9		127		
		7										
		8										
		9	D	50/4"								
BOTTOM OF HOLE = 9 Feet No Groundwater Encountered		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										

DATE: 6/4/2013	LOG OF EXPLORATORY DRILL HOLE	DH- 4

PROJECT NAME: PGWTP **PROJECT NUMBER:** 2013.0031

DRILL RIG: Mobile B53, 140# downhole hammer & wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** ± 23

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: — Final: —

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
DUNE DEPOSITS: POORLY GRADED SAND WITH CLAY: Greyish brown (10YR 5/2), moist, medium dense; fine sand	SP-SC	1										
		2	S D	30	>4.5	15		6		109		
CLAYEY SAND: Very dark grayish brown (10YR 3/2), moist, medium dense; fine sand	SC	3	D S I I	4								
POORLY GRADED SAND WITH CLAY: Grayish brown (10YR 5/2), dry to moist, loose; fine sand	SP-SC	4										
		5	S I I	5								
-peat rich layer begins at ≈ 6.2 ft. ends of sample 6.5 ft.		6										
		7										
WEATHERED BEDROCK: Weathered to CLAYEY SAND: Dark greenish grey (Gley1 4/5GY), moist, medium dense; mostly fine sand.	SC	8										
		9	S I I	10		22		14				
		10										
		11										
BEDROCK: GRANITE: Variable colors but dark yellowish brown over all; moist, rock mass soft due to weathering; crystals are severely weathered; crumbles		12										
		13										
		14	S I	50/6"								
BOTTOM OF HOLE ≈ 14.5 Feet		15										
		16										
		17										
		18										
		19										
		20										

DATE: 6/4/2013	LOG OF EXPLORATORY DRILL HOLE	DH- 5

PROJECT NAME: PGWTP **PROJECT NUMBER:** 2013.0031

DRILL RIG: Mobile B53, 140# downhole hammer & wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** ± 38

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: — Final: —

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
DUNE DEPOSITS: CLAYEY SAND: Greyish brown (10YR 5/2), moist to wet, loose; fine sand	SC	1	S									
		2	D	11								
			D									
		3	S									
-by 3 ft. wet with water in sample liner, medium dense			D	25		13		16		114		
? ? ? ? ? ?		4	D									
-No recovery at 5.0-6.5 ft.	SP-SC	5	S									
POORLY GRADED SAND WITH CLAY: Light brown light grey (10YR 6/2), wet, medium dense		6	I	12								
		7										
		8										
		9	S									
			I	26		6		23				
		10	I									
		11										
-abruptly drilling gets harder		12										
BEDROCK: GRANITE: Variable colored, grey white, black yellowish brown where oxidized; wet; rock mass soft due to weathering; severely weathered rock crumbles into individual rock crystals		13										
		14	S									
			I	50/6"								
		15										
BOTTOM OF HOLE = 14.5 Feet No Groundwater Encountered		16										
		17										
		18										
		19										
		20										

DATE: 6/4/2013	LOG OF EXPLORATORY DRILL HOLE	DH- 6

PROJECT NAME: PGWTP **PROJECT NUMBER:** 2013.0031

DRILL RIG: Mobile B53, 140# downhole hammer & wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** ± 21

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: — Final: —

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
OLDER DUNE DEPOSITS: CLAYEY SAND: Very dark brown (10YR 2/2), dry to moist, medium dense; fine sand; Grades slightly coarser with depth to fine sand with some medium sand	SC	1	S									
		2	D D	28				4		109		
WEATHERED BEDROCK: WEATHERED to a CLAYEY SAND: Very dark grey (10YR 3/1), mottled with strong brown (7.5Y 4/6), wet, medium dense to very dense; mostly fine sand		3	S									
		4	I I	16				15				
		5										
		6	S I	50/5"								
BEDROCK: GRANITE: Variably colored white, grey, black with yellowish brown oxidation; moist; rock mass is soft due to weathering; severely weathered, crumbles to individual hard minerals		7										
		8										
		9	S I	50/4"								
		10										
		11										
		12										
		13										
		14	I	50/4"								
BOTTOM OF HOLE = 14 Feet No Groundwater Encountered		15										
		16										
		17										
		18										
		19										
		20										

APPENDIX F Detailed Opinion of Probable Costs

Draft

Draft

Costs Updated Per new OVIVO provided costs
Plant Design for Peak Flow = 0.28 MGD
Average Flow = 114155 GPD, .114 MGD, 125 AFY

Description of Expense [6]	Total Project Cost	Wastewater Diversion	Wastewater Diversion Pipeline	Admin/Lab/Shop Building (1)	Headworks (2)	Treatment (3)	Disinfection	Truck Fill Station	Demo Existing PS 15.5	Return Solids Pump Station	Return Solids Force Main	Recycled Water Storage [4]	Recycled Water Pump Station	Recycled Water Pipeline (Phase 1)
Concrete	$ 10,700.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 720.00		$ 5,000.00		$ -	$ 5,000.00	$ -
Excavation and Back fill (10%)	$ 1,100.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 72.00		$ 500.00	$ -	$ -	$ 500.00	$ -
Miscellaneous Metals (4%)	$ 4,300.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 288.00		$ 2,000.00	$ -	$ -	$ 2,000.00	$ -
Yard Piping (7%)	$ 800.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 50.40		$ 350.00	$ -	$ -	$ 350.00	$ -
Total Concrete	$ 16,800.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,130.40		$ 7,850.00	$ -	$ -	$ 7,850.00	$ -
Equipment [5]	$ 1,460,000.00	$ 50,000.00	$ 143,000.00	$ -	$ 10,000.00	$ 900,000.00	$ 9,000.00			$ 30,000.00	$ 20,000.00	$ 138,000.00	$ 30,000.00	$ 130,000.00
Tax and Delivery (11%)	$ 160,600.00	$ 5,500.00	$ 15,730.00	$ -	$ 1,100.00	$ 99,000.00	$ 990.00	$ -		$ 3,300.00	$ 2,200.00	$ 15,180.00	$ 3,300.00	$ 14,300.00
Installation (20%)	$ 292,000.00	$ 10,000.00	$ 28,600.00	$ -	$ 2,000.00	$ 180,000.00	$ 1,800.00	$ -		$ 6,000.00	$ 4,000.00	$ 27,600.00	$ 6,000.00	$ 26,000.00
Manufacturer Services (4%)	$ 58,400.00	$ 2,000.00	$ 5,720.00	$ -	$ 400.00	$ 36,000.00	$ 360.00	$ -		$ 1,200.00	$ 800.00	$ 5,520.00	$ 1,200.00	$ 5,200.00
Total Mechanical	$ 1,971,000.00	$ 67,500.00	$ 193,050.00	$ -	$ 13,500.00	$ 1,215,000.00	$ 12,150.00	$ -		$ 40,500.00	$ 27,000.00	$ 186,300.00	$ 40,500.00	$ 175,500.00
Protective Coating (7%)	$ 139,100.00	$ 4,725.00	$ 13,513.50	$ -	$ 945.00	$ 85,050.00	$ 850.50	$ 79.13		$ 3,384.50	$ 1,890.00	$ 13,041.00	$ 3,384.50	$ 12,285.00
Electricity (10%)	$ 197,200.00	$ 6,750.00	$ 19,305.00	$ -	$ 1,350.00	$ 121,500.00	$ 1,215.00	$ 5.04		$ 4,085.00	$ 2,700.00	$ 18,630.00	$ 4,085.00	$ 17,550.00
Instrumentation (10%)	$ 198,800.00	$ 6,750.00	$ 19,305.00	$ -	$ 1,350.00	$ 121,500.00	$ 1,215.00	$ 113.04		$ 4,835.00	$ 2,700.00	$ 18,630.00	$ 4,835.00	$ 17,550.00
Housing	$ 139,000.00	$ -	$ -	$ 139,000.00	$ -	$ -	$ -	$ 1.00		$ -				
Subtotal	$ 2,661,900.00	$ 85,725.00	$ 245,173.50	$ 139,000.00	$ 17,145.00	$ 1,543,050.00	$ 15,430.50	$ 1,328.61		$ 60,654.50	$ 34,290.00	$ 236,601.00	$ 60,654.50	$ 222,885.00
Contingency (30%)	$ 798,600.00	$ 25,717.50	$ 73,552.05	$ 41,700.00	$ 5,143.50	$ 462,915.00	$ 4,629.15	$ 398.58		$ 18,196.35	$ 10,287.00	$ 70,980.30	$ 18,196.35	$ 66,865.50
Total Construction Cost	$ 3,480,500.00	$ 111,442.50	$ 318,725.55	$ 180,700.00	$ 22,288.50	$ 2,005,965.00	$ 20,059.65	$ 1,727.19	$ 20,000.00	$ 78,850.85	$ 44,577.00	$ 307,581.30	$ 78,850.85	$ 289,750.50
Engineering Design (10%)	$ 348,100.00	$ 11,144.25	$ 31,872.56	$ 18,070.00	$ 2,228.85	$ 200,596.50	$ 2,005.97	$ 172.72	$ 2,000.00	$ 7,885.09	$ 4,457.70	$ 30,758.13	$ 7,885.09	$ 28,975.05
Total Capital Cost	$ 3,828,600.00	$ 122,586.75	$ 350,598.11	$ 198,770.00	$ 24,517.35	$ 2,206,561.50	$ 22,065.62	$ 1,899.91	$ 22,000.00	$ 86,735.94	$ 49,034.70	$ 338,339.43	$ 86,735.94	$ 318,725.55
Annualized Capital Cost	$170,900.00	$5,473.49	$15,654.18	$8,875.07	$1,094.70	$98,522.80	$985.23	$84.83	$982.30	$3,872.75	$2,189.40	$15,106.83	$3,872.75	$14,231.07
Annualized O&M (5% Construction Cost)	$ 191,430.00	$ 6,129.34	$ 17,529.91	$ 9,938.50	$ 1,225.87	$ 110,328.08	$ 1,103.28	$ 95.00	$ 1,100.00	$ 4,336.80	$ 2,451.74	$ 16,916.97	$ 4,336.80	$ 15,936.28
Capital Cost per AFY	$ 1,400.00	$ 43.79	$ 125.23	$ 71.00	$ 8.76	$ 788.18	$ 7.88	$ 0.68	$ 7.86	$ 30.98	$ 17.52	$ 120.85	$ 30.98	$ 113.85
O&M Cost per AFY	$ 1,500.00	$ 49.03	$ 140.24	$ 79.51	$ 9.81	$ 882.62	$ 8.83	$ 0.76	$ 8.80	$ 34.69	$ 19.61	$ 135.34	$ 34.69	$ 127.49
Total Cost per AFY	$ 2,900.00	$ 92.82	$ 265.47	$ 150.51	$ 18.56	$ 1,670.81	$ 16.71	$ 1.44	$ 16.66	$ 65.68	$ 37.13	$ 256.19	$ 65.68	$ 241.34

(1) Assumes retrofit of existing clarifier/administration building per Harper Eng Estimate
(2) Assumes retrofit of existing headworks
(3) Assumes MBR cost provided by equipment supplier and include headworks through disinfection
(4) Assumes retrofit of existing digester per Harper Eng Estimate
(5) Equipment is defined as mechanical equipment or pipeline
(6) Cost Estimating Factors pursuant to Table 4-6 of Watereuse Research Foundation, Decision Support System for Selection of Satellite vs. Regional Treatment for Reuse Systems, 2009.