Appendix B: Project Description Data

B-1: Proposed Projects Descriptions

Kennedy/Jenks Consultants

1000 South Hill Road, Suite 200
Ventura, California 93003
805-658-0607
805-650-1522 (Fax)

Los Osos Wastewater Project Environmental Impact Report Proposed Projects Descriptions

October 31, 2008

Prepared for

Michael Brandman Associates

K/J Project No. 0893003*01

Table of Contents

List of Tables

List of Figures

Table of Contents (cont'd)

List of Acronyms

ADDWF	average day dry weather flow
ADWWF	average day wet weather flow
AFY	acre feet per year
Bldg	Building
BMP	Best Management Practices
BOD	biochemical oxygen demand
CCC	California Coastal Commission
CDP	California Development Permit
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
City	City of San Luis Obispo
CO_2	carbon dioxide
COD	chemical oxygen demand
County	County of San Luis Obispo
cy	cubic yards

DO	dissolved oxygen
DOSD	Department of Safety of Dams
ea	Each
EIR	Environmental Impact Report
ESHA	Environmentally Sensitive Habitat Areas
FSR	Fine Screening Report
ft	Feet
ft^3/MG	cubic feet/million gallons
FWPCA	Federal Water Pollution Control Act
gal	Gallon
gpd	gallons per day
gpm	gallons per minute
H_2S	hydrogen sulfide
HDD	horizontal directional drilling
HDPE	high density polypropylene
HP	Horsepower
in	Inch
I/I	Inflow/Infiltration
IPS	influent pump station
lbs/day	pounds per day
LCP	Local Coastal Program
lf	linear feet
LOCSD	Los Osos Community Services District
LOWWP	Los Osos Wastewater Project
LPGPs	low pressure grinder pumps
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
mi^2	square miles
mph	miles per hour

N	Nitrogen
NEPA	National Environmental Policy Act
NPDES	National Pollution Discharge Elimination System
O & M	Operation and Maintenance
PHWWF	peak hour wet weather flow
PMFPs	partially mixed facultative ponds
ppt	parts per thousand
PRC	Public Resources Code
RSR	Rough Screening Report
RWQCB	Regional Water Quality Control Board – Central Region
sf	square feet
SH	Solids Handling
SO_2	sulfur dioxide
STE	Septic Tank Effluent
STEP	Septic Tank Effluent Pumps
STEG	Septic Tank Effluent Gravity
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TDH	total dynamic head
TM	Technical Memorandum
TMDL	Total Maximum Daily Load
TSS	total suspended solids
USACE	U. S. Army Corps of Engineers
USFWS	U. S. Fish and Wildlife Service
WDR	Waste Discharge Requirements

1.0 Introduction

Los Osos is an unincorporated coastal community of approximately 15,000 residents located in San Luis Obispo County (County) at the south end of Morro Bay about twelve miles west of the City of San Luis Obispo Los Osos extends to the south and east of the Bay into the lower foothills of the Irish Hills. The City of Morro Bay lies about two miles to the north. The physical development of Los Osos began with subdivisions in the late 19th century, leading to a small community of semi-rural homes and vacation homes by the early 1960s. Drawn by the scenic bay-front setting and affordable land costs, the community's permanent population grew steadily during the 1970s and into the mid-1980s, spurred in part by the construction and operation of Diablo Canyon Nuclear Power plant and by the expansion of the California Polytechnic State University at San Luis Obispo. The development pattern in much of Los Osos consists of fairly long, narrow (25'-50') residential lots located on wide (40'-80') streets arranged generally in a grid. The majority of the community was constructed on the ancient dune systems formed by centuries of wind-blown beach sand deposited along the south end of Morro Bay. As a result, the terrain consists of gently rolling hills and sandy, unconsolidated soils. Figure 1-1 provides a Project Vicinity map that focuses on the location of Los Osos Community Services District (LOCSD) within San Luis Obispo County.

The Regional Water Quality Control Board – Central Coast Region (RWQCB) determined in 1983 that contamination in excess of State standards had occurred in the groundwater basin (upper aquifer) partially due to use of septic systems throughout the community. At that time, the RWQCB concluded that the "continuation of this method of waste disposal could result in health hazards to the community and the continued degradation of groundwater quality in violation of the Porter-Cologne Act." Therefore, in January 1988, the RWQCB established a discharge moratorium effectively halting new construction or major expansions of existing development until the County could provide a solution to the water pollution problem. The RWQCB Prohibition Zone includes most of the Los Osos community that is located within the General Plan Urban Reserve Line. Some areas, such as the Martin Tract and Bayview Heights, lie within the Prohibition Zone, but are excluded from the wastewater treatment and collection system due to lot sizes (greater than 1 acre). Since these injunctions, there have been many attempts to rectify the situation through construction and operation of a wastewater project. In response to the RWQCB, in the late 1980's the County developed a wastewater collection and treatment project and prepared an Environmental Impact Report (EIR) (1987). After preparation of a supplement to the EIR (1988), the County embarked on the detailed design process. In the mid 1990's, the project was modified to relocate the proposed wastewater treatment facility out of the rural area northeast of the community to a site on the east side of the more developed area of the community, which necessitated the preparation of a second supplemental EIR (1997).

In 1998 the community voted to establish a community services district with wastewater authority. The Los Osos Community Services District (LOCSD) developed a wastewater collection and treatment project with the treatment facilities located in the west-central portion of the community (referred to as the Mid-town site in this document). An EIR was prepared and certified for the project on March 1, 2001. After receipt of a Coastal Development Permit (CDP) from the California Coastal Commission (CCC), construction on the project was started in 2005. In the fall of 2005, a majority of the board members of the LOCSD were recalled in a special election; the new board immediately halted construction on the wastewater project. In August 2006, the LOCSD rescinded certification of the 2001 EIR's Statement of Overriding Considerations and filed for federal bankruptcy protection.

On September 20, 2006 Governor Arnold Schwarzenegger signed Assembly Bill (AB) 2701, a bill that Assemblyman Sam Blakeslee authored. AB 2701 authorizes transfer of wastewater authority from the LOCSD to the County. Based on policies established by the Board of Supervisors in June 2006, the County has embarked on a process to develop a community wastewater system in Los Osos. That process produced a Rough Screening Report and a Fine Screening Report. These documents focused on identifying a set of viable project alternatives for the purpose of establishing the feasibility of various project options and providing a basis for cost estimates for the Proposition 218 election that concluded in October 2007 that authorized LOWWP funding.

Since 2006, the County's efforts on the Los Osos Wastewater Project (LOWWP) are the result of an interdisciplinary team approach involving responsible and trustee agencies, consultants, and County staff members. The current team, composed of over 20 individuals representing several departments and divisions of the County, four engineering, environmental, and hydro-geotechnical consulting firms, and five public agencies, has established an efficient and interactive team approach to addressing the project. The County will continue and expand this approach through the environmental, design, regulatory permitting, and construction phases of the project.

The LOWWP consists of four main components: collection, treatment, effluent disposal, and solids treatment and disposal. Figure 1-2 presents a Project Location map that shows the various project site locations, including treatment plant sites and effluent disposal sites. Using 15% design information and the California Environmental Quality Act (CEQA)/National Environmental Policy Act (NEPA) process, coincidental with on-going efforts to define project costs and consider community preferences, the County project team has moved through an alternatives analysis process that has resulted in a fully developed project description. Based upon the volumes of documentation produced for the project over the past decades, the most recent County work produced, and the clear project purposes of wastewater treatment and water supply, the County is examining a wide range of feasible alternatives on a co-equal basis. This range of feasible alternatives is evaluated from an environmental perspective within this document. Public review of this Draft EIR will coincide with a community preferences survey and issuance of a design/build Request for Proposals for all or a portion of the project. This approach will allow the County to identify the preferred alternative using environmental, economic, and community preferences information. The County will ultimately produce a Final EIR that identifies the preferred alternative that results from this process and will make findings that support the final project decision.

1.1 Project Objectives

According to the County website (http://www.slocounty.ca.gov/PW/LOWWP.htm), the County Mission Statement for the LOWWP declares that the mission of the project is "to evaluate and develop a wastewater treatment system for Los Osos, in cooperation with the community water purveyors, to solve the Level III water resource shortage and groundwater pollution, in an environmentally sustainable and cost effective manner, while respecting community preferences and promoting participatory government, and addressing individual affordability challenges to the greatest extent possible."

The objectives of the project are the following:

1. The purpose of the wastewater facilities project is to alleviate groundwater contamination – primarily nitrates – that has occurred at least partially because of the use of septic systems throughout the community.

2. The wastewater project must address the issues of water quality defined by the RWQCB through issuance of Waste Discharge Requirements (WDR) for discharge limits.

3. The wastewater project must address water resource issues related to mitigating its own impacts on water supply and saltwater intrusion. Further, the wastewater project will maintain the widest possible options for beneficial reuse of treated effluent.

4. The wastewater project will address measures to minimize potential environmental impacts on the Los Osos community and surrounding areas, (including, but not limited to, habitat conservation, endangered species and habitat, air and water quality, greenhouse gas emissions, wetlands and estuary preservation or enhancement, and agricultural land enhancements.)

5. The wastewater facilities project will meet the project water quality requirements while minimizing life-cycle costs.

6. The wastewater project must comply with applicable local, state, and federal permits, land uses, and other requirements including the Local Coastal Plan, Environmentally Sensitive Habitat Areas (ESHA standards), State Marine Reserve, and archeological concerns.

1.2 Discharge Objectives

The RWQCB issued "Waste Discharge/Recycled Water Requirements Order No. R3-2003-0007" for the LOCSD when it was moving forward with the last abandoned wastewater project. The EIR for that project was completed in 2001, and LOCSD proceeded with obtaining all the requisite permits at that time, such as a CDP and the RWQCB order referenced above. The effluent and recycled water limitations from that order have been included here in Table 1-1. The new wastewater project must result in treated effluent and recycled water that meets these limitations.

Table 1-1: Effluent and Recycled Water Limitations from Previous Waste Discharge Requirements (Order No. R3-2003-0007)

Effluent Limitations			
Constituent	**Units**	**Monthly Average**	**Daily Maximum**
Settleable Solids	mg/L	0.1	0.5
BOD*, 5-Day	mg/L	60	100
Suspended Solids	mg/L	60	100
Total Nitrogen (as N)	mg/L	7	10
Recycled Water Limitations			
BOD, 5-Day	mg/L	30	90
Suspended Solids	mg/L	30	90
Turbidity	NTU	2**	5***
pH	Units	In range 6.5 - 8.4	

*Biological Oxygen Demand

**24-hour mean value

***Turbidity must not exceed 5 NTU more than 5 percent of the time within a 24-hour period and must not exceed 10 NTU.

2.0 Proposed Projects Descriptions

This section describes the unique aspects of each Proposed Project, and also includes a brief explanation of all major project components. Figure 2-1 provides a general conceptual layout of the major project components and demonstrates how they fit together to create a complete wastewater project. Table 2-1 summarizes the combination of site(s) and treatment process that constitutes each of the four Proposed Projects. Each Proposed Project would be capable of meeting the overall project objectives.

Table 2-2 lists the major components of the proposed projects. The Proposed Projects are combinations of the major project components that are described in more detail in Sections 3 through 7. The final Proposed Project will be selected through the Design/Build process with input from the environmental review process and community survey. It could be a different mix of project component options than any of the four Proposed Projects. Consequently, in order to evaluate the environmental impacts of each project component, each likely project component is included in at least one of the four options.

Table 2-1: Los Osos Proposed Projects – Site and Treatment Process Combinations

Primary Alternative Number	Site	Treatment Process
1	Cemetery/Giacomazzi/Branin	Facultative Ponds and Storage On-site
2	Giacomazzi	Oxidation Ditch or Biolac w/Storage at Tonini
3	Giacomazzi/Branin	Oxidation Ditch or Biolac w/Storage On-site
4	Tonini	Facultative Ponds and Storage On-site

Table 2-2: Major Project Components for Proposed Projects

Alt #	Collection System	Treatment Process /Biosolids	Disposal	Treatment Site	Conveyance System	Storage Location
1	STEP/STEG	Facultative Ponds	Broderson Leachfield and Tonini Sprayfield Irrigation	Cemetery/Giacomazzi/Branin	Raw sewage to treatment site; secondary effluent to Broderson and Tonini	On-site
2	Gravity	Oxidation Ditch/Biolac	"	Giacomazzi	Raw sewage to treatment site; secondary effluent to Broderson and Tonini	On Tonini
3	Gravity	Oxidation Ditch/Biolac	"	Giacomazzi/Branin	Raw sewage to treatment site; secondary effluent to Broderson and Tonini	On-site
4	Gravity	Facultative Ponds	"	Tonini	Raw sewage to treatment site; secondary effluent to Broderson and Tonini	On-site

2.1 Proposed Project Sites – Cemetery/Giacomazzi/Branin/Tonini

Proposed Projects 1, 2, and 3 would involve construction of the wastewater treatment plant and appurtenant structures on various combinations of the Cemetery, Giacomazzi, and Branin properties. Proposed Project 1 facilities would be constructed on all three sites. The extent of Proposed Project 2 facilities would be limited to Giacomazzi. Proposed Project 3 facilities would be limited to Giacomazzi and Branin. Access to these sites is provided by way of a level, unimproved road that borders the east of the sites which intersect Los Osos Valley Road opposite Clark Valley Road. Please see figures below for geographical locations.

The Cemetery Property consists of a rectangular 47.4-acre parcel north of Los Osos Valley Road. The Los Osos Mortuary and Memorial Park occupies the southerly portion of the site (approximately 19 acres). The site slopes gently downward to the north; the westerly boundary slopes downward to the west to a dirt road that provides access to surrounding farming operations. Approximately 6.5 acres in the northwest corner is currently cultivated with row crops.

The Giacomazzi property is a rectangular 38.2-acre parcel north of Los Osos Valley Road and west of Clark Valley Road. The site slopes gently downward to the north and east toward an ephemeral drainage that extends along the easterly portion of the site to Warden Lake and supports a small oak woodland along its northerly reaches. There is a collection of farm-related buildings along the western border with numerous tall trees surrounding the buildings. The level areas of the site have been cultivated with crops.

The Branin property consists of an irregularly shaped 42.2 acre parcel north of Los Osos Valley Road and adjacent to Warden Lake. The site slopes to the north and contains two ephemeral drainages.

Proposed Project 4 would involve construction of all the wastewater treatment plant facilities and appurtenant structures on the Tonini property. The total area of this parcel is approximately 400 acres, and this parcel is located east of the Cemetery/Giacomazzi/Branin sites, off Los Osos Valley Road at Turri Road. Please see Figure 2-9 below for geographical location.

2.2 Proposed Project 1

Figures 2-2 and 2-3 provide an illustration of the approximate extent of facilities that would be constructed under Proposed Project 1. Figure 2-2 provides the site layout at Cemetery/Giacomazzi/Branin that shows facultative ponds (~ 20 acres), an on-site storage pond for treated effluent, and an estimated 4 acres for appurtenant structures. The storage pond has been sized to approximately 10 acres. The sizing of the storage pond is further explained in Section 7.0, Effluent Disposal. Figure 2-3 shows the connections to the preferred raw wastewater conveyance and treated effluent pipeline alignments and the ultimate destinations of those alignments. The proposed collection system is a combination STEP/STEG system. Effluent disposal would occur through the use of sprayfields on Tonini and leachfields on Broderson. The approximate locations of the sprayfields and leachfields are shown on Figures 2-3, 2-5, 2-7, and 2-9.

2.3 Proposed Project 2

For Proposed Project 2, Figure 2-4 provides the site layout at Giacomazzi that includes oxidation ditch/Biolac (~ 10 acres), no on-site storage ponds, an area for biosolids processing (~2 to 6 acres), and an estimated 4 acres for appurtenant structures. The treated effluent storage pond would be located at Tonini under this Proposed Project. Figure 2-5 shows connections to the preferred conveyance and effluent pipeline alignments and the ultimate destinations of those alignments. The proposed collection system is a conventional gravity system. Effluent disposal would occur through the use of sprayfields on Tonini and leachfields on Broderson

2.4 Proposed Project 3

Proposed Project 3 is summarized in Figures 2-6 and 2-7. Figure 2-6 shows the site layout at Giacomazzi/Branin that includes oxidation ditch/Biolac (~ 10 acres), a treated effluent storage pond on-site, an area for biosolids processing (~2 to 6 acres), and an estimated 4 acres for appurtenant structures. The treated effluent storage pond is shown to be approximately 10 acres in size and is discussed in Section 7.0. Figure 2-7 shows the connections to the preferred conveyance and effluent pipeline alignments and the ultimate destinations of those alignments. The proposed collection system is a conventional gravity system. Effluent disposal would occur through the use of sprayfields on Tonini and leachfields on Broderson.

2.5 Proposed Project 4

An overview of Proposed Project 4 is presented in Figures 2-8 and 2-9. Figure 2-8 provides the site layout at Tonini that includes facultative ponds (~ 20 acres), a treated effluent storage pond on-site, and an estimated 4 acres for appurtenant structures. The figure also demonstrates that a large majority of the Tonini site would be available for sprayfields. Figure 2-9 shows an alternate view showing the connections to the preferred conveyance and effluent pipeline alignments and the ultimate destinations of those alignments. The proposed collection system is a conventional gravity system. Effluent disposal would occur through the use of sprayfields on Tonini and leachfields on Broderson.

.

3.0 Collection System

3.1 Introduction

This section describes the collection systems that have been proposed for the LOWWP. A collection system collects the wastewater from individual generators and conveys the wastewater to a main pump station. This main pump station is the terminus of the collection system, and the discharge of the pump station is the starting point for the raw wastewater conveyance system described in Section 4.0.

The two different collection systems that have been proposed for the Project are:

- A Gravity Collection System
- A Septic Tank Effluent (STE) Collection System

The gravity collection system consists of a combination of conventional gravity sewers and low pressure grinder pumps (LPGP). LPGP are small pumps placed in a pump vault that grind the wastewater solids and create a slurry and pump the wastewater to the sewer main lines in the street. Grinder pumps will be used when the individual generator connection is located at an elevation significantly below the main collection line. This would avoid having to excavate the collection main line trench low enough to allow gravity flow from the specific connection. Individual septic tanks are not used and the existing septic tanks are abandoned or converted to non-wastewater use. Gravity lateral pipelines are installed to connect each building to the street collection system pipeline. In a gravity system, the collection system conveys the collected wastewater to a main pump station where is it pumped to the treatment facility.

The other type of collection system, the STE collection system, consists of both septic tank effluent pumps (STEP) and septic tank effluent gravity (STEG) collection lines. This system is typically referred to as a STEP/STEG system. For this system, new septic tanks are installed at each connection. Gravity or pressurized lateral pipelines are installed to convey the septic tank effluent to the street collection system pipeline and to the treatment plant. Typically no separate main pumping station is required to pump the collected wastewater to the treatment facility.

For this project the majority of connections will be STEP, not STEG; however, the term STEP/STEG will be used to conform to previous studies and to allow for STEG systems where appropriate.

STEP/STEG is proposed for Project 1, and gravity is proposed for Projects 2, 3, and 4. These two collection system options are described below.

3.2 Gravity System

The gravity system consists of:

- On-Lot improvements
- Collection System
- Conveyance System (described in Section 4.0)

3.2.1 On-lot Improvements

On-lot improvements consist of rerouting house lateral pipes and abandoning the existing septic tanks and are a function of where existing facilities are located and the topography of the lot. Table 3-1 contains data from the Fine Screening Report (FSR) (Carollo, 2007) and shows the on-lot options and the estimated percent of lots requiring a specific option.

Table 3-1: On-lot options – Gravity System

DESCRIPTION	PERCENT OF LOTS
Abandon existing front yard septic tank, route lateral from front of house to new sewer main	75 %
Abandon existing backyard septic tank and install and reroute lateral from back of house to the front of house	20%
Abandon existing backyard septic tank, install LPGP, and reroute lateral from back of house to front of house	5%

The construction of new laterals in the front yards would result in limited disturbance with an average of approximately 25 feet of new 4-inch sewer lateral required.

Rerouting of sewer laterals from the backyard would be significantly more disruptive and involve an average of approximately 75 feet of new piping. The excavation for the backyard rerouting would be time-consuming and require a significant amount of hand labor or possibly some technique for pushing the pipe through the soil without mechanical excavation.

There may be a limited number of situations (approximately 5% or 240) requiring a LPGP which would be more disruptive as an excavation for the pump chamber would be required in addition to the sewer lateral excavation.

The cost of the on-lot improvements would be the responsibility of the homeowner.

3.2.2 Gravity Collection System

A detailed design of a gravity collection system was completed by Montgomery-Watson-Harza (MWH, 2004).

The layout of the collection system and the location of the pump stations are shown in Figures 3-1 through 3-6. In addition to the layout of the collection system, these figures show the pipe diameters, those pipe segments that are greater than 8 feet in depth and locations where the groundwater is less then 10 feet below the surface. Dewatering may be required during construction in such locations.

Figure 3-1 is a key map and divides the collection system into 4 areas. These areas are not drainage or wastewater sub-basins, but are simply physical areas for organizing the project plans. This collection system provides a collection system for the Prohibition Zone only.

This gravity collection system includes both gravity sewers and force mains. The force mains convey the wastewater from the various main and “pocket pump” stations to nearby gravity sewers or the treatment plant site. Pocket pumps are small pump stations serving a small cluster of lots. The principal elements of construction for this specific collection system design that conveys all the wastewater to the Mid-Town site include:

- 230,000 linear feet (lf) of gravity sewer and force mains
- 907 manholes
- 5 duplex pump stations
- 2 triplex pump stations
- 12 pocket pump stations
- standby power facilities
- 4,769 laterals.

In addition to these construction items, there are approximately 240 LPGP, but they are on-lot items and not part of the publicly owned collection system.

The sewer mains are proposed to be polyvinyl chloride (PVC) and range from 8-inches to 18-inches in diameter. The sewer lines would be buried at an average depth of 8 feet. However, some would be as deep as 18 feet.

Table 3-2 provides a summary of the collection system showing the approximate depths of the different sizes of pipe proposed for this project.

Table 3-2: Total Length of Pipe at Various Depths

PIPE DIAMETER	DEPTH: 0-8’	DEPTH: 9’–12’	DEPTH:13’-15’	DEPTH: 16’-18’
8-inch	159,256 ft	45,846 ft	2,240 ft	80 ft
10-inch	0	1,190	1,300	0
12-inch	0	2,413	654	654
15-inch	0	3,561	709	0
18-inch	0	860	600	0

In the gravity system, the individual service laterals are constructed to the property line and the homeowner is required to construct the house lateral that is located out of the public right-of-way.

3.2.3 Gravity System Construction

Given the sandy soil conditions and the need for the contractor to comply with the trench safety requirements of CalOSHA, only a very approximate estimate can be made of excavation requirements to install the gravity collection system. Assuming a total length of collection system of 43.5 miles, an average depth of 8 feet, a trench width of 4 feet at the bottom and a trench width of 4 feet at the top, then it can be estimated that approximately 270,000 CY of excavation is required. While most of the excavated material can be reused as backfill material, some material would have to be hauled off for disposal out of town. If it is assumed that 15% of the material would be hauled off, then 40,500 CY of material would have to be disposed of offsite. This would generate approximately 4050 truck trips. The above estimates assume that the pipeline contractor utilizes a sheeting and shoring system for the trench that would maintain nearly vertical trench walls and does not lay the trench walls back which is an alternative means of complying with CalOSHA requirements.

Table 3-3 contains data summarizing the physical characteristics of the various pump stations that are included in the LOWWP (Carollo, 2007). All the pump stations are submersible pump stations of either duplex or triplex designs. The size of each pump station wet well is shown in the table, and an estimate of the total excavation is provided based on the depth and diameter of the wet well. The resulting total excavation of approximately 1200 CY would result in approximately 150 truck trips.

This list of pumping stations in Table 3-3 does not include the Mid-Town Pumping Station, shown on Figure 3-1, which is required to pump the wastewater east of town.

Table 3-3: Pump Station Characteristics										
PS NAME	LOCATION	PS TYPE	PS SITE AREA (sf)	PS DIA (ft)	WETWELL TOP ELEV* (ft)	WETWELL INV ELEV* (ft)	BOTTOM EXC ELEV* (ft)	PUMP HP (each)	TOTAL EXC (cy)	STANDBY POWER
Baywood	2nd St. (opposite 1370)	Duplex	6045	10	10.16	-5.60	-14.10	5	198	Y/off-site
East Ysabel	Santa Ysabel & S. Bay Road	Duplex	11050	10	79.30	64.80	56.80	10	212	Y/on-site
East Paso	18th & Paso Robles Ave.	Duplex	10500	10	71.50	63.50	50.50	8	198	Y/on-site
West Paso	3rd & Paso Robles Ave.	Triplex	13600	12	17.04	4.04	-2.96	60	198	Y/on-site
Standby Power Bldg.	Between 1412 and 1428 8th		6800							Stand-by Power for Baywood and West Paso PS
Pocket Pump Sta (8)	North end of 4th, 7th, 8th, 9th, 10th, 11th, and 12th and13th Streets	Triplex -- 4th and 9th Duplex -- all others	2400 in road R-O-W	10	19-77	8-71	4-65	1	1866 total	N
Mountain View	Santa Ynez & Mountain View	Duplex	3000 in road R-O-W	10	100.20	86.70	79.20	5	198	Y/on-site
Pocket Pump Sta (4)	9th & San Luis, 9th & Ramona, 13th between Ramona and San Luis, 15th & Ramona	Duplex	2400 in road R-O-W	10	73-94	62-84	56-78	1	1866 total	N
Lupine	Lupine & Donna	Triplex	4200	12	13.60	-4.90	-14.40	30	326	Y/on-site
Sunny Oaks	Los Osos Road	Duplex	6300	10	154.85	141.85	134.85	3	188	Y/on-site
								TOTAL EXCAVATION 3,384 cy		

*Elevations shown are relative to mean sea level. A negative elevation implies elevation below mean sea level

While the actual means and methods of construction for these facilities would be determined by the contractor, a representative list of construction equipment can be provided. For each mainline crew, the following would be the minimum equipment required:

- 1 track-mounted excavator
- 1 front end loader
- 1 rubber tired backhoe with front-end loader
- 1 service truck
- Dewatering pumps
- Various pickup trucks and light duty vehicles

In addition to the mainline crew, a separate sewer lateral crew will have their own rubber-tired backhoe and service vehicles.

Dump trucks as described previously would be used to haul off excavated material. A separate paving crew would be required when the project is complete in order to restore the roadway surface. This crew would have their own motor grader, loader, paver, and roller. Hot asphalt would be supplied by dump trucks.

Additional trucks would be required for materials delivery, principally pipe, mechanical equipment, and concrete products. Pipe and mechanical equipment would be shipped in from the Los Angeles area that is 150-200 miles away. Approximately 150 truck loads of piping and mechanical equipment would be required. Concrete, both precast and ready-mix could be obtained locally within 25-50 miles. Approximately 300 additional truckloads of concrete products would be required.

The construction of the pump stations would require extensive sheeting and shoring. The individual pump stations would have some elements that utilize cast-in-place concrete and other elements that are pre-cast. The construction of the pump stations would require cranes and pile driving equipment in addition to the excavation equipment previously identified.

3.2.4 Long-term Operation and Maintenance

The long-term Operation and Maintenance (O&M) of the gravity collection system would center on pump maintenance and maintenance of the collection system. There are a sufficient number of pump stations and appurtenances that a full time 2-man crew would be required for pump station maintenance. The most significant maintenance activity for the collection system would be an annual cleaning. This would require a 2-man crew for approximately 2 months. This could be performed by the management entity that operates the facilities, contracted out to a private maintenance firm, or a maintenance agreement could be entered into with a nearby sanitary agency that would have the equipment and manpower required.

In addition to the 2-man pump maintenance crew, another 1 or 2 individuals would be required to address unseen conditions as they arise.

3.3 STEP/STEG System

A STEP/STEG system is more integrated than a gravity system. On-lot improvements including new septic tanks are really part of the collection system that connects to the pressurized collection system.

In a STEP/STEG system, the wastewater flows into a septic tank and the solids settle out. Figure 3-7 shows a modern, high quality watertight septic tank, including effluent filters and watertight risers. Effluent filters are recommended to prevent solids that could lead to solids buildup in the collection system, and risers are recommended in order to provide access for routine maintenance.

These appurtenances are required by California Assembly Bill (AB) 885 that is scheduled to be implemented in 2008. The final implementation schedule is unclear at this time. However it is to be noted that the State Water Resources Control Board (SWRCB) issued a contract to develop draft regulations on 19 February 2008.

The STE is pumped into a pressurized collection system that conveys the wastewater to the treatment site. Since the collection system is under pressure, no central pump station is required to transport the STE to a treatment site. STEP/STEG systems do not require manholes, but they do require pressure cleanouts at regular locations. In addition, air-vacuum valves are required at high points in the pressurized collection system to expel air that collects at these highpoints. These air-vacuum valves are a source of odor.

A preliminary layout of the STEP/STEG alternative has been developed (Ripley Pacific, 2006), but not to the same level of detail as the gravity collection system that has been completely designed by MWH. The principal elements of construction for the STEP/STEG alternative include for the Prohibition Zone:

- 59,300 linear feet of 10-, 8-, and 6-inch PVC force main (this includes the out of town conveyance to the Giacomazzi site)
- 203,600 linear feet of pressure sewer collector
- 1000 isolation valves and air release valves
- 200 flushing ports
- 500 linear feet of creek crossing
- 4769 new septic tanks
- 4769 new effluent pumps and controls

For the STEP/STEG system, the property owner is required to connect the existing service lateral from the building to the new septic tank and to abandon the existing septic tank or convert it to other uses. The installation of the new septic tank, pump, and electrical service is included in the collection system project cost.

The depth of bury for the STEP/STEG system collection mainlines and force mains would be between 4 and 6 feet in most locations. These elements of construction include a force main that would transport the collected STE to the wastewater treatment site. The conveyance system begins at the last connection on Los Osos Valley Road, location as yet unknown.

Included in these quantities is the installation of new septic tanks and pumps at each connection. In general these septic tanks and pumps would need to be installed in the front yards for future access, but approximately 5% or 240 would have to be installed in the back lots due to topographic considerations and limited space in the front yard. This would be challenging, given the narrowness and overall size of the lots, as depicted in Figure 3-8. In addition, electrical service would need to be provided from each house electrical panel to the new effluent pump.

No separate routing analysis has been performed for the STEP/STEG conveyance system, but it is assumed that the routes and the analysis would be the same as that of the gravity system. No separate main pump station is required for the STEP/STEG systems as the individual pumps are assumed to adequately pressurize the system and transport the effluent to the treatment plant site. The quantities for the pressure conveyance system are included in the overall quantities for the STEP/STEG system.

3.3.1 STEP/STEG Construction

There are four elements of STEP/STEG construction. They are:

- On-lot improvements
- STEP/STEG tanks with or without an effluent pump
- In-town collection system
- Out-of-town conveyance system (described in Section 4.0)

On-lot improvements, which consist of rerouting house laterals, abandoning or re-purposing the existing septic tank and installing new STEP/STEG tanks, are a function of where existing facilities are located and the topography of the lot. Table 3-4 shows the on-lot options and the estimated percent of lots requiring a specific option (Carollo, 2007).

Table 3-4: On-lot options – STEP/STEG

DESCRIPTION	PERCENT OF LOTS
Remove front yard septic tank, place new STEP/STEG tank in same location	7.5%
Abandon existing front yard septic tank, place new STEP/STEG in new location	67.5%
Abandon existing backyard septic tank and install new STEP/STEG tank in front yard	20%
Abandon existing backyard septic tank, install new STEP/STEG tank in the back yard and pump to collection system in front	5%

On-lot improvements, other than installation of the STEP/STEG tanks, would involve the rerouting of the sewer laterals and, in a limited number (approximately 5%) of cases, the installation of backyard STEP tanks and pumps. The construction of new laterals in the front yards would result in limited disturbance, with an average of approximately 25 feet of new 4-inch sewer lateral required.

Rerouting of sewer laterals from backyards would require significantly more excavation and disturbance of existing yard improvements, such as landscaping and paving, and would involve an average of approximately 75 feet of new lateral. The excavation for the backyard rerouting would be time-consuming and would require a significant amount of hand labor or possibly some technique for pushing the pipe without mechanical excavation. The limited number of situations requiring a backyard STEP system would require still further excavation for this pump chamber in addition to the sewer lateral.

The placement of a new 1500 gallon STEP would require an excavation of approximately 40 CY per site. The existing septic tanks would be pumped out, left in place, and backfilled with native sand, or re-purposed for use in storm water or grey water systems. The excess excavated sand would be hauled off. Given the swell characteristics of the sandy soil, it can be estimated that 3 truck loads of excavated material would have to be hauled off of each site. The excavated footprint for each site would be approximately 16' by 8'. This would apply to all lots.

Based on an excavation depth of 8 feet, the excavation volume for each STEP tank would be approximately 40 CY. Approximately 15 CY would have to be hauled off or could be used to backfill the existing septic if it is abandoned.

Additional disturbances would be required to provide electrical service to each STEP unit, but the amount of soil disturbance would be less than the disturbance and truck traffic associated with the installation of STEP/STEG tanks. It has not been determined how extensive the electrical modifications might be at each customer's electric panel. Also, it has not been determined if a "separate power drop" or PG&E meter is required. This issue was addressed in the FSR (Carollo 2007), but no resolution was reached.

Table 3-4 is an estimate for only the STEP installation, and not for the collection or conveyance system. The estimates for the excavation and truck counts for the collection system would be less than those for the gravity system, but estimates for the force main would be the same.

There are approximately 50,300 linear feet of 6-, 8-, and 10-inch sewer line and 203,600 linear feet of 2- and 3-inch line. For the larger diameter pipe that includes the transmission line to the Giacomazzi site, the construction will be done using conventional cut techniques. Assuming an average trench depth of 5 feet and a trench width of 3 feet, the total excavation would be approximately 28,000 CY. Assuming 15% of this material would be hauled off results in a total volume to be hauled off of 4200 CY or 420 truck loads.

It has been proposed that the small diameter lines be installed using directional drill techniques. This would minimize the surface disruption and only require excavation for individual lot connections and for various appurtenances such as air relieve valves and flushing ports. This would require 3 CY of excavation at each excavation point and there are approximately 6000 excavation points resulting in a total volume of excavation of 18,000 CY. Assuming a 15%

waste factor, then 2700 CY of material would have to be hauled off in approximately 270 truck loads.

The assumption is that the trench and excavations would stand vertical since they are shallow and that the shoring requirements would be minimal.

While the actual means and methods of construction for these facilities would be determined by the contractor, a representative list of construction equipment can be provided. For each mainline crew the following would be required:

- 1 track-mounted excavator (this would be smaller than the excavator used for the gravity option or could be a second rubber-tired backhoe)
- 1 front end loader
- 1 rubber tired backhoe with front-end loader
- 1 service truck
- Directional drilling equipment
- Various pickup trucks and light duty vehicles

In addition to the mainline crew, a separate sewer lateral crew would be used that would have their own rubber-tired backhoe and service vehicles. This crew would also have to have a crane in order to set the septic tanks.

Dump trucks as described previously would be used to haul off excavated material. A separate paving crew would be required when the project is complete in order to restore the roadway surface. This crew would have their own motor grader, loader, paver, and roller. Hot asphalt would be supplied by dump trucks.

3.3.2 STEP/STEG Operations and Maintenance

The O&M of the STEP/STEG system focuses on the septic tanks and associated pumps and on system appurtenances.

Sludge in the septic tank needs to be pumped out on a regular basis. Initially, it is assumed that the pumping interval would be 5 years. Once the STEP/STEG is operational, this would need to be verified with an inspection program that measures the sludge accumulation and cleans the effluent filters every two years. This would require the inspection of 2,340 septic tanks annually and the pumping of 936 septic tanks per year. Assuming the inspection of each septic tank and cleaning of the effluent filter requires 2 hours, a total of 4,680 person-hours per year would be required. This would require 2-3 full-time people. False alarms should also be anticipated on the individual pumping systems. Full-time around the clock (24/7) response would be required for false and real alarms.

In addition, there are 630 carbon filters on the air-vacuum valves and 4,679 pumps that would require routine maintenance and replacement. Once the system has been in operation for several years, one 2-person crew would be required for these activities.

The pumping of 936 septic tanks per year could be accomplished by in-house forces or contracted out to local septic tank pumpers. This pumping would generate two 1-man crews and would generate approximately 4 truck trips per day for each non-holiday weekday.

3.4 Exfiltration and Inflow/Infiltration

Exfiltration of treated or untreated sewage into the groundwater can occur when sewage is discharged from the collection system through damaged pipes and appurtenances or through leaks at joints and/or gaskets. The volume of exfiltration is a function of the hydrostatic pressure or head at the point of leakage, the age of the pipe, the pipe materials, and pipe condition. The higher the pressure at the point of leakage, the greater is the rate of leakage.

Modern gravity sewer systems are constructed of 20-foot lengths of PVC with bell-and-spigot joints sealed with rubber gaskets. This flexible pipe has a lower potential for leakage than older brittle clay pipe that comes in shorter sections. For gravity sewers the rate of leakage is a function of the available hydraulic head. This is the difference in elevation between the water surface elevation and the elevation in the soils where the groundwater flow changes from saturated flow to unsaturated flow. Given the sandy soils, this change from saturated to unsaturated flow would occur in close to the pipe. Therefore there is limited hydraulic head.

While STEP/STEG and LPGPs are not as susceptible to exfiltration as gravity sewer systems, exfiltration can still occur. STEP/STEG sewers operate under higher pressures and function more like potable water systems than gravity sewers. Because of this higher pressure, leakage (exfiltration) can occur just as leakage occurs in pressurized water systems. The exfiltration would most likely occur at fittings, valves (especially air release valves), and other appurtenances.

Other sources of exfiltration for STEP/STEG systems would include the gravity portion of the house laterals and septic tanks which operate under several feet of head.

Inflow/Infiltration (I/I) is a similar phenomenon. For I/I to occur, defects in the overall collection system must be present that permit entry of water into the collection system. Inflow is typically associated with groundwater entering the system where the sewer lines are located below the seasonal groundwater table. Infiltration is typically associated with rainfall events where rainwater enters the collection system directly during a rainfall event.

There are numerous locations where I/I can enter a gravity sewer system. These locations include:

- The sewer main line
- The laterals, both in the public right-of-way and on private property
- Manholes, both at the joints for individual sections and the ring and cover assembly

STEP/STEG systems and LPGP systems operate under pressure and therefore are not susceptible to I/I where pressurized; however, they are susceptible to I/I in the gravity portion of the house lateral, at the septic tanks and at associated appurtenances. Septic tanks, which are often old and poorly designed or constructed, have led to severe I/I and system failures. Therefore, the general recommendation for constructing STEP/STEG systems is to replace all existing septic tanks. The current design philosophy of these systems is to replace all septic tanks with modern, high quality watertight septic tanks (EPRI, 2003).

Exfiltration and I/I occur in all types of collections systems and can be minimized by:

- Utilizing high quality pressure rated PVC pipe (waterline pipe) for both mainlines and house laterals
- Utilizing butt-fusion welded HDPE, especially where pipe must be placed in the seasonally high groundwater table.
- Utilizing pre-cast manhole bases with cast-in-place gaskets
- Installing manhole inflow dishes/protectors (Cretex, Pollardwater, etc.) below the manhole ring and cover to prevent the entry of surface water
- Utilizing external joint seals (Infi-Shield) where manholes segments are joined in addition to traditional "mastic" joint sealant
- Replacing all septic tanks and insuring all appurtenances are sealed

3.5 Influence on Treatment Alternatives

The type of collection system utilized affects the design of treatment facilities as well as on the final disposal options. The type of collection system is related to the hydraulic loading, organic loading, and nitrogen/denitrification processes.

Table 3-5 provides a summary of the estimated flows at buildout with water conservation Without conservation, the average day dry weather flow (ADDWF), average day wet weather flow (ADWWF) and peak hour wet weather and peak hour wet weather flow (PHWWF) should be increased by 0.1 mgd. The flows given in Table 3-5 should be used to size wastewater treatment and disposal alternatives relative to hydraulic loading. These flows represent the anticipated flow for approximately 18,500 people (Carollo, February 2008).

Table 3-5: Gravity/STEP/STEG Hydraulic Loading

COLLECTION SYSTEM	ADDWF	ADWWF	PHWWF
Gravity	1.2 mgd	1.4 mgd	2.5 mgd
STEP/STEG	1.1	1.2	1.7

Table 3-6 provides a summary of the anticipated influent wastewater characteristics as a function of collection system type (Carollo, February 2008).

Table 3-6: Gravity/STEP/STEG Wastewater Characteristics

COLLECTION SYSTEM	BOD5	SS	TOTAL - N
Gravity – Average Day	340 mg/l	390 mg/l	56 mg/l
Gravity – Peak Day	350	400	58
STEP/STEG -- Unfiltered	140	80	56
STEP/STEG -- Filtered	120	40	56

The type of collection system has a limited effect on the design of the treatment facility relative to hydraulic design since the sewage flowrates would be essentially the same.

The type of collection system has a more significant effect on the facility process design. As the influent 5-day biochemical oxygen demand (BOD5) and suspended solids (SS) are significantly less for the STEP/STEG system, therefore there are less solids to handle and dispose of and the aeration demand is less.

It should also be noted that while the total nitrogen (N) is the same with either collection system, the nitrogen is principally in the nitrate form for the STEP/STEG alternative and in the organic and ammonia form for the gravity alternative. With respect to the STEP/STEG system, there is an inadequate amount of carbon in the septic tank effluent for the denitrification process; therefore, a supplemental unit process that adds carbon to the effluent would be required.

The values for the filtered STEP/STEG alternatives should be used because the existing septic tanks would be replaced with new septic tanks that would include effluent filters.

4.0 Conveyance Systems

4.1 Introduction

Two separate conveyance systems are proposed. One conveyance system will transport the wastewater from Los Osos to the wastewater treatment plant site, and a second conveyance system will convey the treated effluent back to town for disposal at the Broderson site. The conveyance system from Los Osos to the treatment plant site is different for the gravity and STEP/STEG options. The conveyance system from the treatment plant site to the disposal sites is the same irrespective of the type of collection system utilized. Possible routes for raw wastewater conveyance were presented in a Technical Memorandum “Out of Town Conveyance” (Carollo, March 2008).

4.2 Gravity Raw Wastewater Conveyance System

4.2.1 Proposed Alignment

Figure 4-1 provides the proposed route for conveyance of wastewater from Los Osos to the wastewater treatment plant for Projects 2 and 3. Figure 4-2 provides the proposed route for Project 4. A central pump station is proposed at the Mid-town site on Los Osos Valley Road to collect wastewater and transfer it to an out-of-town wastewater facility. From the central pump station, the force main goes out along Los Osos Valley Road to the Cemetery and then turns north to the Giacomazzi site. This alignment is along existing public and private roads and does not disturb any agricultural land. The construction of the conveyance system would use conventional open cut techniques.

4.2.2 Creek Crossing Options

The location of the proposed creek crossings are indicated on Figure 4-3. Open-cut trenching may be feasible in some locations during the summer months when there is no flowing water in the stream. This particular method is considered viable for routes traveling Los Osos Valley Road where the creek bed is dry in the summer. Trenching would require significant disturbance and full restoration of the disturbed streambed and banks as permitting requirements.

4.2.3 Pump Stations

Various types of pump stations were investigated for pumping the collected raw wastewater from a pump station in Los Osos to the selected treatment plant site. Table 4-1 summarizes the identified advantages and disadvantages of these various types of pump stations (Carollo, March 2008). Table 4-2 presents the most conservative design criteria for the proposed submersible pump station with the force main located along Los Osos Valley Road.

Table 4-1: Advantage and Disadvantages of Potential Sewage Pump Stations/Configurations

Option	Description	Advantages	Disadvantages
Submersible Non-Clog	Pumps are located in a wet well submerged in the sewage Control panel is located on posts at grade and typically, a separate valve box houses the isolation valves on the force main	Pumps can pass large solids the size of a baseball without clogging Small footprint Generally lowest capital cost	Low pump efficiency Larger force main discharge piping Control panel is in the open O&M: Pumps have to be lifted out of the wet well by a hoist at grade for maintenance
Submersible Grinder	Grinder pumps are located in a wet well submersed in the sewage Grinder pump grinds the sewage into a slurry and conveys to the next location Control panel is located on posts at grade and typically, a separate valve box houses the isolation valves on the force main	Smaller diameter discharge piping Small footprint Low capital cost compared to alternatives	Multiple pumps required (May not be feasible) Control panel is in the open O&M: Pumps have to be lifted out of the wet well by a hoist at grade for maintenance
Wet Well Mounted (Vacuum or Self-primed)	Pumps are located at grade above the wet well and use vertical suction to pump the sewage out of the wet well Pumps can be primed with a small vacuum or be self-priming The control panel, pumps and valves are typically located in a removable, insulated and heated fiberglass enclosure	Protective enclosure for control panel, pumps and valves O&M: All equipment is located at grade Smallest footprint	Higher capital cost Larger force main discharge piping
Factory-Built Dry Pit Station with Separate	Control panel, pumps, and valves and housed in a	In the case of a power failure, the	High capital cost

Wet Well	cylindrical steel chamber separate for the wet well Pumps are typically non-clog and have the motor located on the top of the pump similar to a vertical turbine pump A cylindrical hatch, similar to a manhole, provides access to the pump chamber from grade	wet well can be accessed at grade and sewage pumped around the pump chamber to the force main using a portable engine-driven pump O&M: All equipment is totally enclosed in a dry-pit/well Pump chamber is prefabricated and installed below grade	Maintenance is below grade Larger force main discharge piping
Built-in-Place Station with Separate Wet Well	A below grade well houses the pumps The dry and wet well is constructed of the reinforced concrete while the control room structure is usually brick and block Pumps are typically non-clog and have motor located on the top of the pump similar to a vertical turbine pump	An engine-driven generator can be installed in the control room to power the pumps in case of a power failure O&M: All equipment is totally enclosed in a dry pit/well	Below grade wet well and above grade control room are constructed on-site Highest capital cost Larger footprint Larger force main discharge piping
(a) *Reference*: Carollo, Out of Town Conveyance			

Table 4-2: Proposed Conservative Design Criteria

PARAMETER	LOS OSOS VALLEY ROAD FORCE MAIN
Type of Pump Station	submersible (non-clogging)
Pump Station Area	0.1 acre
Number of Pumps	2 duty and 1 standby
Design Flow and Head	875 gpm @ 170 TDH
Pump HP	75
Wetwell Depth and Diameter	20 feet by 12 feet
Force Main Size	14 inch
Force Main Length	18,700 feet

The criteria listed above apply to pumping the wastewater for Proposed Projects 1 to 3 to the site near Giacomazzi. Pumping to the Tonini site for Proposed Project 4 would require an additional 9600 lf of forcemain. However, the total pumping horsepower would be similar because the Tonini site (elevation 85) is at a lower elevation than the Giacomazzi site (elevation 95).

4.3 STEP/STEG Raw Wastewater Conveyance System

4.3.1 Proposed Alignment

The proposed alignment is similar to the alignment described above for the gravity conveyance system in Section 4.2.1.

4.3.2 Proposed Creek Crossing

The proposed creek crossing alignments are similar to the creek crossing alignments described above for the gravity conveyance system in Section 4.2.1.

4.3.3 Pump Station

There is no central pump station in the STEP/STEG alternative. The individual household pumps that are part of the STEP pressurize the collection system and the conveyance system that delivers raw wastewater to the treatment sites.

4.4 Treated Effluent Conveyance System

4.4.1 Introduction

The effluent conveyance system conveys the treated effluent back to Los Osos. It runs from the discharge of the wastewater treatment facility back to Los Osos where an equalizing pump station would be located to discharge the effluent to the Broderson disposal site, and will be 12 inches in diameter or less (Carollo, April 2008.)

4.4.2 Proposed Alignment

Both the Tonini site and the Broderson site are located off of Los Osos Valley Road. Therefore, the alignment for the treated effluent force main is along Los Osos Valley Road. Figures 4-4 and 4-5 show the proposed alignment for the proposed projects. The raw wastewater force main and the treated effluent force main should meet separation criteria similar to those between a potable waterline and a sewer force main. The two lines should not be placed in the same trench and should be between 4 and 10 feet apart, depending on the materials of construction of the two pipelines and their relative elevations. They could be placed on the same side of the road if there is sufficient room and clearance from other utilities or they may need to be placed on opposite sides of the road.

4.4.3 Proposed Creek Crossing

The proposed creek crossings for the effluent conveyance system are similar to that described for the raw wastewater conveyance system and are described in Section 4.3.2 above.

4.4.4 Pump Station

To deliver the treated effluent to the Broderson leachfield site for all four proposed projects, two pump stations are required. One pump station would be at the wastewater treatment site and deliver water to Broderson, and a second pump station would be at Broderson to deliver a constant flow at a constant pressure in order to achieve equal distribution throughout the leachfield disposal area. This second pump station may or may not be required in the final design, but it is included in the project description at this time.

The maximum monthly volume of effluent to be disposed of at Broderson is approximately 65 acre-feet (Carollo, “Effluent Reuse and Disposal Options,” March 2008). This would require a continuous pumping rate of 500 gpm or a 12-hour pumping rate of 1000 gpm.

Table 4.3 shows the pumping requirements for an effluent pump station located at either the Giacomazzi or the Tonini site.

Table 4-3: Effluent Pumping Requirements

LOCATION	LENGTH	PIPE DIA	PUMPING RATE	ELEVATION DIFFERENCE	TOTAL DISCHARGE HEAD	PUMP HP
Giacomazzi	26,800 lf	12 in.	1000 gpm	95 feet	130 feet	50 hp
Tonini	26,800	12	1000	105	160 feet	75 hp

The effluent pumps would discharge into a below grade flow equalization tank located at the lower end of the Broderson with a capacity of approximately 100,000 gallons. A duplex pumping station would be located at the flow equalization tank that would deliver the effluent at a flow rate of 500 gpm and a pressure of 40 psi to the disposal area. .

4.5 Short-term Construction Impacts

The short-term construction impacts of the gravity and STEP/STEG raw wastewater and effluent conveyance pipeline systems would be similar. While the final parameters of the force main are unknown, an estimate can be made of the amount of excavation and the resulting truck trips utilizing one of the longer alignments out to the Tonini Site. Since this is a force main, it can be constructed shallower than the collection system and follow the ground line. Assuming a depth of trench of 5 feet, a trench width of 3 feet and a waste of a 15%, an estimate can be made of the excavation, waste and truck loads of disposal for each of the 4 projects relative to the raw wastewater and effluent conveyance systems. These estimates are presented in Table 4-4 and 4-5.

Table 4-4: Raw Wastewater Conveyance System Earthwork Summary

PROJECT NO.	WWTP LOCATION	PIPELINE LENGTH	EXCAVATION	WASTE	HAUL OFF TRUCKLOADS
1	Giacomazzi	18,700 feet	10,400 cy	1600 cy	160
2	Giacomazzi	18,700	10,400	1600	160
3	Giacomazzi	18,700	10,400	1600	160
4	Tonini	28,500	16,000	2400	240

Table 4-5: Treated Effluent Conveyance System Earthwork Summary

PROJECT NO.	STORAGE POND LOCATION	PIPELINE LENGTH	EXCAVATION	WASTE	HAUL OFF TRUCKLOADS
1	Giacomazzi	26,800 feet	15,000 cy	2,400 cy	240
2	Tonini	26,800	15,000	2,400	240
3	Giacomazzi	26,800	15,000	2,400	240
4	Tonini	26,800	15,000	2,400	240

This analysis assumes that the trenches would stand vertical because of the shallow depth and that minimal sheeting and shoring would be required.

While the actual means and methods of construction for these facilities would be determined by the contractor, a representative list of construction equipment can be provided. For each mainline crew, the following would be the minimum equipment required:

- 1 track-mounted excavator
- 1 front end loader
- 1 rubber tired backhoe with front-end loader
- 1 service truck
- Dewatering pumps
- Various pickup trucks and light duty vehicles

Dump trucks as described previously would be used to haul off excavated material. A separate paving crew would be required when the project is complete in order to restore the roadway surface. This crew would have their own motor grader, loader, paver, and roller. Hot asphalt would be supplied by dump trucks. In addition trucks are required to deliver the pipe appurtenances to the project site. Approximately 100 truck loads of pipe, asphalt and other materials would be required for the construction of the raw wastewater conveyance system and an additional 100 truck loads for the effluent conveyance system.

There are short-term construction considerations associated with the gravity raw wastewater pump station, but none with the STEP/STEG system as there is no main pump station for the STEP/STEG alternative.

For the gravity pump station, another 100 CY of excavation resulting in an additional 10 truck trips would be required for the additional pump station. Similar quantities of excavation would be required for the effluent pump station.

In addition to the equipment identified above for the mainline construction, a crane would be required for the construction of the pump station.

4.6 Long-term Operation and Maintenance Considerations

There are limited additional long-term operation and maintenance requirements associated with the additional pump station(s) and pipelines as they do not add significantly to the total linear footage of pipe to be maintained and there are a significant number of pumps in the conveyance system. No additional staff would be required to maintain these facilities.

5.0 Liquid Treatment Process

This section presents a review of the treatment process elements associated with each of the major treatment process alternatives identified for consideration in the DEIR. Each major treatment process alternative is described along with the supporting technologies typically encountered.

5.1 Partially-Mixed Facultative Ponds

Treatment using partially-mixed facultative ponds (PMFPs) relies on the large volume available in the ponds and the resulting extended detention times to treat organic wastes and reduce nitrogen levels. Pond systems are typically selected to minimize the level of energy input required for treatment. PMFPs are also selected because they require minimal effort for managing biosolids; the solids remain in the pond and are digested in the anaerobic layer at the bottom of the pond. Accumulated solids are removed from the pond typically every 15 to 20 years, with more effective pond systems exhibiting lower cleaning frequency.

Treatment involving PMFPs also requires multiple support systems, both upstream and downstream of the principal process. Each process element requires area, energy input, and maintenance. The proposed treatment process associated with the LOWWP pond system includes the following components:

- Headworks – screening, flow measurement
- Pond System

Additional processes include the following:

- Nitrogen removal – nitrification/denitrification
- Algae management – solids handling for algae removed from the PMFPs
- A rock trap for septage receiving
- Biosolids management – as required, anticipated to be on a 15 – 20 year cycle

Figure 5-1 presents a schematic view of the major components included in treatment systems involving PMFPs. The following sections contain brief descriptions of the major process components, including the ponds.

5.1.1 Influent Pumping and Flow Equalization

Influent pumping to a treatment facility can be accomplished using a dedicated influent pump station (IPS) at the facility, or via the conveyance system pump stations. It is anticipated that the conveyance system pump stations would deliver influent flow to the treatment facility, and there would not be a dedicated IPS.

One of the benefits of PMFPs is that they provide flow equalization for peak flows entering the treatment facility. Incoming flows are pumped into the facultative ponds, which would provide storage during peak flow events in addition to providing treatment. This operational scheme allows the facility to operate at regular, predictable flows downstream of the ponds.

5.1.2 Headworks

The headworks at a wastewater treatment facility receive incoming raw wastewater. Headworks are intended to provide preliminary treatment, removing inorganic materials that can cause problems in the downstream processes. The headworks at a facility with PMFPs would include screening equipment and flow measurement. A summary of these elements is provided below:

5.1.2.1 Screening

Wastewater typically carries not only organic matter, but also inorganics such as rags, cleaning pads, feminine hygiene products, hair, and rubber goods. These materials, particularly fibrous materials, can cause significant problems in downstream process equipment.

Screen systems are typically sized for gravity systems and are selected to accommodate the anticipated hydraulics in the headworks while providing as small an open area as possible to prevent up to 95% of the inorganic material from passing. Fine screens can consist of perforated plates, or, more commonly in recent designs, parallel bar systems with as low as 0.25-inch separation between the bars. Bar separation is selected to allow organic materials to pass through, which would provide the necessary substrate for downstream biological process. Material accumulated on the submerged screen section is automatically drawn toward the top of the screen by automatic rakes.

PMFP systems are not as sensitive to the accumulation of inorganic material, and screen openings can be larger than for fine screen systems. Use of screening ahead of PMFPs is good operational practice to maintain active volume in the ponds and to make subsequent pond cleaning and biosolids processing more efficient by minimizing inorganic materials that must be removed from the biosolids.

Screened organic matter is typically mixed with organic matter when the rakes deposit the material in the hopper at the top of the screen mechanism. The collected materials consist of raw wastewater solids and are a major source of odors and can be a health and safety hazard for operations staff. Modern screening systems include integrated washing and compacting systems to clean organic matter from the screenings and to reduce the volume of the residual inorganics. In addition, modern screening systems are made of corrosion resistant materials (e.g., stainless steel) and are enclosed systems to contain odors and minimize health and safety hazards. The washed and compacted screenings are less of an odor source than the raw material collected on the screen, but an enclosed building with odor control equipment is typically designed to further reduce potential impacts.

Collected screenings are hauled to a landfill for disposal as there is no reuse market. Off-haul volumes vary with each facility. Average values have been observed in the range of 10 cubic feet/million gallons (ft^3/MG) for fine screen systems. The LOWWP treatment facility would generate an average of approximately 12 ft^3/MG each day, which results in 3 cubic yards each calendar week.

If STEP/STEG is used, the volume of solids to be managed at the treatment facility treatment plant is anticipated to be approximately 25% of a gravity system (Carollo, August 2007). Use of manually-cleaned bar screens rather than automated screening systems is feasible for STEP/STEG. Capital costs for simple bar screens are approximately 10% of fine screening systems. In this scenario, bar screens would require cleaning on a weekly basis or possibly less frequently, requiring approximately the same amount of staff time as would be expected for inspection visits to an automated fine-screen system.

Manually cleaning bar screens would expose staff to raw wastewater and residual solids, as well as odors. It is possible to install smaller, automated screening systems with washer/compactor assemblies to minimize staff contact and odors. However, with respect to screening, installation of smaller automated screens would not provide the treatment cost advantages anticipated with the reduced volume of solids reaching the treatment facility from a STEP/STEG system.

If a STEP/STEG system is used septage will be hauled to and received at the treatment facilities. The septage receiving station must provide for screening of inorganics, washing and handling of the screenings and odor control.

5.1.2.2 Flow Measurement

Influent flow measurement is an important data collection activity for any wastewater facility. Data is usually collected at the headworks, and it can be used to pace main process pump operations, chemical feeds, and oxygen delivery systems. It is also used in reporting to the Regional Water Quality Control Board (RWQCB).

Influent flow measurement is typically accomplished using magnetic flow meters or open Parshall flumes that use ultrasonic sensors to measure the depth of flow over a constriction of a specific geometric shape. Supervisory Control and Data Acquisition (SCADA) software receiving the data computes the incoming flow.

Flow measurement equipment does not pose a health and safety risk and it does not generate odors or noise. No residual matter is collected by these systems. Operations staff may prefer to collect influent flow samples in an automated sampler that collects samples from the flow monitoring location. Staff must handle the raw wastewater samples in transporting them to the facility laboratory.

5.1.3 Secondary Treatment – PMFPs

The following discussion addresses the description, conceptual layout, and cost information along with pond operations and maintenance.

Four variations on PMFP configurations were identified (Carollo, March 2008). The following information in Table 5-1 summarizes area and energy requirements for each of the pond configurations.

Table 5-1: Summary of PMFP Pond Sizing and Energy Use

Type of Pond	Footprint (acres) Gravity/STEP[1]	Depth (ft)	Secondary Treatment Energy Requirements (kWh/year) Gravity/STEP
Dual Power Multicellular Aerated Pond (DPMC)	14 / 12	10	1500K/1380K
Advanced Integrated Pond System (AIPS)	22 / 19	≤16 (avg. 12)	720K / 570K
Air Diffusion Systems (ADS)/Nelson Aerated Pond System	30 / 26	15	690K / 550K
ADS/Nelson Pond – over DSOD guidelines[2]	20 / 17	15	690K / 550K

1) Not including cells for nitrification, which would require an area of approximately 2 additional acres for each pond alternative.
2) Includes cells with over 15-acre-ft in storage, requiring DSOD permitting.

The California Department of Water Resources (DWR) Division of Safety of Dams (DSOD) is charged with ensuring the design and construction of dams protects the health and safety of the public. The DSOD has jurisdiction over dams that meet specific criteria, as shown in Figure 5-2 (California DSOD, 2008).

Dam height is measured from the downstream toe to the maximum storage elevation/spillway. DSOD identifies specific exemptions, including the following:

> "WASTE WATER CONTROL FACILITY ponds, which are 15 feet or less in height, have a maximum storage capacity of 1500 acre-feet or less, are off-stream."

The County has indicated a plan to accept an offer from DSOD to assume the responsibility for liability and oversight, in lieu of DSOD staff, for the LOWWP. The County Board of Supervisors must pass a resolution to legally assume liability.

In order to focus the DEIR analysis, the Advanced Integrated Pond System (AIPS) pond system is proposed for evaluation. The basis for this recommendation is as follows:

- Area requirements are within 10% of the area target of 20 acres for pond systems
- Does not require DSOD permitting
- Annual energy requirements are 50% less than fully aerated systems

- Annual energy requirements are 4.4% greater than ADS/Nelson ponds that store less than 15 ac-ft and which require more area than AIPS ponds
- Reports from long-term operations indicate low odor production and long-term (20 yr) solids storage.

Implementation of STEP/STEG results in the following benefits over gravity when using AIPS for treatment:

- Area requirement for the AIPS system is 16% less than for gravity
- Annual energy requirements are 31% less than for gravity

PMFPs provide a low-energy means of reducing BOD and TSS loads in treatment facility discharge. In addition, ponds provide effective in-plant flow equalization that permits operation of the facility at predicable flows, reducing costs of operations. However, ponds can have the following impacts:

- <u>Stratification</u> – facultative ponds stratify into layers during the normal operating cycle. The lowermost layer is typically anaerobic, and the digestion of solids that is carried out in ponds is completed in the anaerobic layer. It has been observed that facultative ponds “turn over” at changes in season, particularly when wind velocities over the pond increase. Ponds that mix in this way can release significant amounts of odor, making PMFPs a potential major source of odors. Partial mixing would alleviate some of the potential for odor emissions by providing an “aerobic cap” over the anaerobic layer. Even with aerobic mixing, a system that relies on an anaerobic process contained in a large, the open air vessel can release odors.

- <u>Algae growth</u> – ponds are open to sunlight, and algae growth is a normal occurrence in pond systems. Algal growth requires removal from the process stream to avoid violations of suspended solids limits. Removal techniques, such as filtration and dissolved air floatation thickening (DAFT), increase the energy demands of the liquid process and increase the carbon footprint of the operation. Some facilities are attempting to digest algae with sludge removed from the pond system. However, this is an unconventional operating scheme for PMFPs, and algae are typically dewatered and hauled offsite. DAFT is typically used for algae removal. The volume of DAFT has not yet been estimated. Some pond systems do not remove any algae for several years

- <u>Maintenance</u> – over 95% of the solids that enter the ponds stay in the ponds. The accumulation of solids, which include the biological growth yielded by the metabolism of soluble and suspended BOD, reduces the active volume of the ponds over time. A well operated pond system has a typical maintenance frequency of 15 to 20 years for taking ponds offline for maintenance. The solids that are removed must be managed for disposal in a single, bulk operation using temporary gravity equipment. While infrequent, there is considerable staff time and exposure (including subcontractors) to solids residues. The potential for odor emissions during these cleaning events is high.

5.1.4 Nitrogen Removal

None of the pond systems summarized in Table 5-1 above would remove nitrogen to the discharge limits required in the WDR (≤ 7 mg/L 30-day avg; 10 mg/L daily max). In addition, nitrogen removal rates in PMFPs vary with seasonal conditions and may drop to insignificant levels at different times of the year. Additional treatment processes are required to meet the discharge requirements. The low-energy treatment advantages offered by PMFPs would be at least partially offset by the energy required to remove nitrogen to the specified limits. The following sections describe the steps involved in nitrogen removal.

5.1.4.1 Nitrification

Nitrification is the biologically-mediated process through which ammonia is converted to nitrate. This process is aerobic, and requires the availability of an electron donor (carbon). Insufficient availability of oxygen and carbon can result in incomplete nitrification.

Although nitrification is a natural process, mechanical systems are used to support and control the nitrification process in a wastewater treatment system. A common process for providing nitrification downstream of a pond system is a trickling filter. Trickling filters consist of stacked, modular plastic media over which process water is sprayed at a controlled rate. Air is drawn through the media by blowers either pulling air from the top of the stack (concurrent flow) or up through the stack (counter-flow). The media modules are constructed with an open framework to allow for air flow and greater surface for microbial growth. The partially-treated process stream passes over the fixed growth on the media. Due to the prior treatment in the ponds, there is substantially reduced carbon – based biological activity on the media. The combination of reduced activity and the extended life of the biological film allows for nitrifying bacteria to thrive and the nitrification process to proceed.

The media stacks require containment to keep the process water within the footprint of the trickling filter. Odor control is frequently required due to the high volume of air passing over the media. Trickling filters handling well-oxygenated water from the “aerobic cap” pond layer typically do not generate as much odor as fixed-film reactors processing primary effluent. However, odor generation is a concern, and odor control equipment is typically included. Given the sensitivity of Los Osos residents to future odors from the LOWWP treatment facility, as evidenced by citizen communications received to date, the inclusion of odor control equipment is proposed (see Section 5.1.8).

Since PMFPs do not typically remove nitrogen to the desired levels, supplemental nitrification/denitrification process equipment is required, increasing the energy demand of a treatment facility centered on PMFPs. Additional costs result from installation and operation of

- Blowers to move air through a trickling filter
- Pumps to deliver process water to the top of the media stack (e.g., static lifts of between 10 and 20 feet)
- Odor control

5.1.4.2 Denitrification

Denitrification is a biologically-mediated process that results in the conversion of nitrate to nitrogen gas. Denitrification is conducted under anaerobic conditions, and requires the availability of an electron donor (carbon). Insufficient availability of carbon can result in incomplete denitrification.

PMFPs perform some nitrification, but denitrification at the rates required of typical treatment facilities requires the support of mechanical systems. These systems consist of enclosed filtration systems that use granular media to provide an inorganic attachment point for biological growth. When denitrification is conducted downstream of a separate secondary treatment process (i.e., PMFPs), the denitrification process is frequently carbon-limited. A carbon supplement is required, and it is usually supplied in the form of methanol, which must be delivered and stored onsite at the treatment facility. Methanol is highly flammable and properly rated transportation, transfer, and storage equipment is required. Handling procedures must follow documented procedures.

The equipment and chemicals associated with denitrification require additional staff time for operational inspections and maintenance. During maintenance events, staff is exposed to confined spaces and chemical hazards. Transportation of methanol to the facility can occur on a frequency ranging from weekly to monthly, depending on use rate and onsite storage capacity.

5.1.4.3 Nitrogen Removal Process Modifications – STEP/STEG

The effect of STEP/STEG on nitrogen removal centers is the need to provide a supplemental carbon source for denitrification to be effective in achieving the WDR discharge limit for total nitrogen. Effluent concentrations anticipated from PMFPs operating without supplemental nitrification/denitrification processes are shown in Table 5-2 (Carollo, August 2007):

Table 5-2: Nitrogen Removal Limits – Gravity vs. STEP/STEG

Collection System Type	Nitrogen Removal Limit, Total-N (mg/L)
Gravity	15
STEP/STEG	54

By retaining solids (carbon source) at each customer location, STEP/STEG reduces the nitrogen removal effectiveness of PMFPs by over 3.5 times. The nitrification/denitrification process for STEP/STEG would require a greater volume of carbon supplement in the form of methanol than a gravity system, resulting in more truck trips and more staff exposure, identified above.

5.1.4.4 Costs of Nitrogen Removal

Preliminary estimates of total annual O&M costs and total capital costs as well as for nitrification and denitrification are provided in Table 5-3 (Carollo, August 2007).

Table 5-3: Cost Summary PMFPs

Collection System	Treatment Process Cost Component	Costs
Gravity	PMFP Construction	$14.7M
	PMFP O&M	$510,000
	Nitrification Construction	$1.0M - $3.8M (1)
	Nitrification O&M	$35,000 - $90,000(1)
	Denitrification Construction	$3.6M
	Denitrification Annual O&M	$250,000
STEP/STEG	PMFP Construction	$13.7M
	PMFP O&M	$510,000
	Nitrification Construction	$1.0M - $3.3M (1)
	Nitrification O&M	$35,000 - $90,000(1)
	Denitrification Construction	$3.6M
	Denitrification Annual O&M	$250,000

1) Low cost assumes fully nitrifying pond system is feasible. High cost assumes implementation of nitrifying trickling filters.

The cost impacts of implementing STEP/STEG, as reported in the FSR, appear to have little impact on the overall cost; STEP/STEG reduces the capital cost of PMFPs by less than 7%. The FSR reports no differential for O&M costs. Based on the expectation that additional carbon source and staff time would be required if STEP/STEG were implemented, it is anticipated that the overall O&M costs for nitrification/denitrification would be similar to those for a gravity system.

5.1.5 Algae Removal

Secondary clarification and/or filtration are typically required to meet effluent suspended solids requirements in the Waste Discharge Requirements (WDR). In the case of treatment facilities operating PMFPs, the ponds act as a clarification system while also carrying out secondary treatment. When ponds are part of the treatment process, secondary clarification is typically not required.

One side effect of operating facultative ponds is the growth of algae that must be removed from the plant discharge to meet WDR requirements (Carollo, March 2008). The Ponds Options TM

(March 2008) references this issue (see Ponds TM Section 2.2.2) and identifies mitigation measures that include complete mixing of the ponds or covering the ponds. Complete mix would affect the effectiveness of pond treatment by setting up conditions not favorable to anaerobic degradation of solid matter at the bottom of the pond. Covering the ponds is costly from a construction and maintenance perspective.

The conventional approaches for algae removal are DAFT systems or filtration. The residual materials from these processes would require management in the treatment facility solids process (see Section 5.1.6). Dissolved air flotation systems (DAFT) systems typically involve open tanks that are not significant sources of odors but which can be health and safety hazard for operations and maintenance staff. Filtration systems can either be enclosed membrane or cloth-based systems or open-topped fine-grained granular media systems, both of which require infrequent attention for maintenance.

5.1.6 Solids Management

The management of biosolids is discussed in Section 6.0. Management of algae as solids is a challenging problem for treatment facilities. Because of the heavy cellulose cell wall, algae are not well suited to digestion. Drying or composting offer the most effective means of managing solids consisting mostly of algae.

5.1.7 Construction & Operations – PMFPs

Construction of a new treatment facility involves significant site disturbance over the entire project area. Disturbance includes excavation for new facilities, site grading for storm water drainage, and staging areas for contractor equipment and supplies. The area required by the ponds is estimated to be 20 acres. Construction of the entire treatment facility would involve disturbance to an area at least 1.5 times greater than the 20-acre pond area. Construction would require approximately 18 to 24 months.

5.1.7.1 Construction Volumes

Table 5-4 provides estimates of the volume of excavation during construction of the treatment process components. Excavation volumes for these elements are estimated based on conceptual sizing and are based on a gravity collection system.

Table 5-4: Estimates of the Volume of Excavation – PMFPs

Liquid Process Component	Estimated Excavation Volume (cy)	Truck Trips (9 cy/truck)*
Headworks	600	67
Secondary Treatment (Ponds)	79,800	8,867
Algae Removal	600	67
Nitrogen Removal (nitrification/denitrification)	700	78
Administration & Maintenance Structures	1300	144
Total	83,000	9,223

* Truck capacity is 10 CY. Estimate based on assumption that actual loads would be less than full.

5.1.7.2 Construction Equipment

While the actual means and methods of construction for these facilities would be determined by the contractor, a representative list of construction equipment is provided. A list of major construction equipment anticipated for PMFPs is presented in Table 5-5.

Table 5-5: Major Construction Equipment – PMFPs

Equipment	Estimated Quantity
Earth moving (tracked)	2
Earth moving (wheeled)	3
Grading	2
Compaction Roller	1
Backhoe (Wheeled)	3
Trackhoe (excavator)	2
Mobile Crane	2
Pickup	10
3 cy dump	3

Water truck (dust suppression)	1
Asphalt spreader/compaction	1

5.1.7.3 Operations – PMFPs

Operational impacts from the PMFPs are summarized in Table 5-6.

Table 5-6: Operational Considerations – PMFPs

Process Component	Operations Notes
Headworks	• Residues from screening and degritting can be odor sources. • Contact with screenings can be health and safety hazards for operations and maintenance staff. • Screening and degritting systems wash organic matter, reducing the potential for odor and health hazard. • For STEP/STEG, possible to use manually-cleaned bar screens.
Secondary Treatment (Ponds)	• Ponds are potentially the major source of odors. • Open pond poses safety hazard for staff and visitors. • Ponds could potentially attract vectors such as mosquitoes and other airborne pests.
Algae Removal	• Filters likely to be cloth or granular media. Tanks would not pose odor or noise issues. • If granular media filtration is used, maintenance would involve accessing tanks, involving confined space entry techniques. • DAFT units involve open concrete tanks with moving skimming equipment that requires regular maintenance. Exposure of staff to health and safety risks during operations and maintenance is possible. Low odor potential from DAFT tanks
Nitrogen Removal	• Nitrification requires mechanical equipment and aerobic conditions. Air blowers, pumps, and odor control equipment are required. • Denitrification requires anaerobic conditions. A carbon supplement in the form of methanol is anticipated. Use of methanol requires specialized equipment and procedures. • STEP/STEG requires greater quantities of methanol than for gravity systems, resulting in more maintenance time, more opportunities for exposure, and more delivery truck trips.

5.1.8 Odor Control - PMFPs

Managing odor at a wastewater treatment facility is an ongoing activity involving operating procedures and specialized equipment. Odor control systems are typically used for process components with a small footprint. Covering systems extending over a large area, such as PMFPs, to capture foul air is not practical due the costs of the cover materials and the maintenance involved with the cover.

Consequently, odor control for PMFPs would not involve specialized odor scrubbing equipment. Odor control would be limited to maintenance of an “aerobic cap” over the anaerobic layer described above (see Section 5.1.3). As noted, this approach offers limited assurance for consistent, long-term odor control.

When accumulated solids are removed from the ponds, control of odors would be difficult to achieve. One approach involves dewatering the pond to be cleaned and removing the accumulated solids using earth moving construction equipment. Effective odor control would not be possible during this activity. Another approach involves using a hydraulic dredge that removes the accumulated solids from beneath the “aerobic cap” water layer; the pond is not dewatered in this approach. Transferring the solids to the dewatering equipment and the dewatering process would generate odor that can be mitigated by using a hopper and pump system that is enclosed and outfitted with odor scrubbing equipment. The dewatering process can also be enclosed and outfitted with odor scrubbing equipment.

Odor control systems rely on either chemical conversion or capture of chemical compounds that contribute to odor. Systems that rely on conversion typically involve wet chemistry and require regular deliveries of chemicals. The large footprint of wet chemistry systems and the need for regular supplies of chemicals make these systems less attractive for wastewater applications.

Odor control systems that rely on inorganic materials to trap odor-causing compounds from the incoming air stream are well suited to wastewater applications. These systems require infrequent maintenance, and the exchange of the inorganic media occurs on an annual basis or less frequently, depending on the odor concentrations. These systems are enclosed with a dedicated blower system to draw air from an enclosed area (e.g., room housing dewatering equipment), pass that foul air through inorganic media, and exhaust scrubbed air to the atmosphere. Systems based on inorganic media are the most cost-effective for wastewater applications and are proposed for the LOWWP.

5.2 Oxidation Ditch/Biolac ®

Treatment process alternatives considered in the DEIR include the following:

- Oxidation Ditch (ox ditch): Mechanical process that allows for BOD reduction (oxidation of organic wastes) combined with effective nitrogen removal. Characterized by a concrete oval-shaped trench with brush or paddle-style mechanical aeration devices that create zones in the process flow with high dissolved oxygen (DO). DO is consumed as process flow circulates around the oval ox ditch, creating alternating aerobic and anoxic zones that promote nitrogen removal. Separate nitrification/denitrification systems are typically not required when an ox ditch is used with a gravity collection system.

- Biolac: This is a pond-based proprietary technology from Parkson Corporation that relies on fine-bubble aeration to achieve BOD reduction. With Biolac, it is possible to create alternating aerobic and anoxic zones in the pond to promote nitrogen removal. Separate nitrification/denitrification systems are not typically required when used with a gravity collection system. Biolac offers a lower construction cost than ox ditches (less volume of concrete) and lower energy costs due to the higher efficiency of oxygen transfer via fine-bubble aeration.

Ox ditch and Biolac are different process systems, but they share similar area requirements and similar process trains, involving similar upstream and downstream support process components. The two process systems have been considered together in this section because of these general similarities, and they are considered interchangeable in the Project Alternatives where references to “Ox Ditch/Biolac” are present. Each process system is briefly described in this section.

The proposed treatment process associated with the LOWWP Ox ditch/Biolac system would include the following elements:

- Headworks – screening, degritting, flow measurement
- Ox Ditch/Biolac
- Secondary Clarification

Additional processes include the following:

- Nitrogen removal –denitrification as a separate process when used with STEP/STEG
- Biosolids management (see Section 6.0)

Figure 5-3 presents a schematic view of the major components included in treatment systems involving Ox Ditch/Biolac. The following sections contain brief descriptions of the major process components, including oxidation ditch and Biolac systems.

5.2.1 Influent Pumping and Flow Equalization

The conveyance system pump stations would deliver influent flow to the treatment facility. There would not be a dedicated IPS.

With Ox Ditch/Biolac, very limited flow equalization capacity is available in the secondary treatment process. Since a separate flow equalization tank has not been planned for any of the Project Alternatives, no separate flow equalization volume would be available to attenuate peak flows entering the treatment facility. Treatment process components for Project Alternatives involving ox ditch/Biolac would require sufficient freeboard and treatment capacity in process tanks to accommodate peak hourly flows, which are reported in the TM “Flows and Loads”, dated February 2008. Facility sizing would depend on whether a gravity or STEP/STEG system is used. STEP/STEG would result in smaller process components associated with ox ditch/Biolac.

5.2.2 Headworks

As indicated in Section 5.1.2, the headworks at a wastewater treatment facility receive incoming raw wastewater and remove inorganic materials that can result in operations and maintenance problems in the downstream processes. Headworks at a facility with ox ditch/Biolac would include screening equipment, degritting equipment, and flow measurement. A summary of these elements is provided below:

5.2.2.1 Screening

The inorganic load in wastewater consisting of debris and fibrous materials can cause significant problems in downstream process equipment, including fouling pumps, weirs, and piping. In addition, operating hours of gravity equipment can be reduced by the need to clear inorganics that may foul the mechanisms. Digesters typically are the final resting place of inorganics that are not screened; taking a single digester offline for cleaning to remove these materials can cost over $100,000 and take significant staff resources to complete.

For ox ditch/Biolac systems that involve mechanical systems and aeration membranes, fine screen systems are typically specified. Fine screen systems are sized to accommodate the anticipated hydraulics in the headworks while limiting the open area to prevent approximately 95% of the inorganic material from passing. As noted in Section 5.1.2.1, fine screens can consist of perforated plates, or, more commonly in recent designs, parallel bar systems with as little as 0.25-inch separation between the bars. Bar separation is selected to allow organic materials to pass through, which would provide the necessary substrate for the downstream biological process. Material accumulated on the submerged screen section is automatically drawn toward the top of the screen by automatic rakes.

Also noted in Section 5.1.2.1, screened organic matter is mixed with organic matter when the rakes deposit the material, referenced as screenings in the screen hopper. Screenings consist of raw wastewater solids and inorganics, and the combination is a major source of odors and can be a health and safety hazard for operations staff. Screening systems include integrated washing and compacting systems to clean organic matter from the screenings and to reduce the volume of the residuals. Screening systems have been designed by the manufacturer to resist corrosion and to contain foul air as much as possible. Washed and compacted screenings are less of an odor source than material collected on the screen, but in areas where odor concerns are high, it is sound practice to enclose screen systems in a building with odor control equipment to reduce potential impacts.

Screenings are typically hauled to a landfill for disposal. Off-haul volumes vary with each facility, and no estimates of screenings volume have been provided in LOWWP TMs.

5.2.2.2 Degritting Equipment

Wastewater flows frequently carry inorganic particulate matter such as sand and small-diameter gravel, collectively referred to as grit. Grit in wastewater collection systems is typically a greater problem in communities with older collection systems with significant infiltration/inflow (I/I) issues or in communities that have combined storm and sanitary sewer systems. Grit entering treatment facilities causes significant damage to pumping systems, particularly on the solids handling side of the facility. The result is substantially higher O&M costs and extensive staff time spent rehabilitating damaged pumping equipment.

The second major impact of grit is accumulation in digesters, reducing the active volume of a digestion system. Digesters outfitted with inadequate mixing systems are prone to rapid accumulation of grit at facilities with inadequate or no degritting equipment. As noted above, the costs of taking digesters out of service for maintenance are substantial.

Degritting systems are typically required for Ox Ditch treatment facilities. Equipment manufacturers have developed a wide range of degritting systems. Typical approaches involve systems that rely on vortex flows or on aeration to separate grit from the main flow stream. The separation involves several mechanical components, each of which operates in a challenging duty environment and requires regular maintenance. Degritting systems typically involve enclosed tanks to prevent release of odors and for the safety of operations staff.

Grit collected by degritting systems is delivered to a classifier for washing and dewatering. Classifiers involve a screw conveyance system that transports grit out of a water bath to a grit hopper. As the grit is transported within the classifier mechanism, commingled organic matter is washed away, and free water drains out of the grit cake. Spent washwater and organic matter are returned to the treatment process. The washed grit collected in the hopper is still a source of odors, but a localized source that would be noticeable to onsite staff and visitors and which is unlikely to produce sufficient odor to affect offsite receptors. Collected grit must be hauled offsite for disposal at a landfill as there is no reuse market. Off-haul volumes vary with each facility, and no estimates have been provided in the LOWWP TMs. Because the LOWWP collection system would be constructed of fused pipe sections, grit volumes are expected to be relatively low, and grit volumes in the first 10 years of operation may be on the order of a few cubic yards per month during the wet weather season provided surface inflow is minimized.

5.2.2.3 Flow Monitoring

The notes provided in Section 5.1.2.3 apply to treatment processes involving ox ditch/Biolac.

5.2.3 Secondary Treatment – Ox Ditch/Biolac

A description of ox ditch and Biolac treatment systems are provided below.

5.2.3.1 Ox Ditch

In an ox ditch, mixed liquor, which is a combination of influent sewage (i.e., the food source) and suspended biomass (referenced as activated sludge), is transported around a concrete oval pathway by rotors, brushes, or other mechanical aeration devices located at one or more points along the flow circuit. Jet aeration devices and combinations of diffused aeration and submersible mixers have also been used. Rotors are most commonly used to maintain tank motion and aerate the contents of the ox ditch. Blades, plastic bars, angle steel, or other steel shapes are mounted on the rotor cylinder to promote circulation and entrain air in the mixed liquor as the assembly rotates. Agitating the water surface also enhances the air-water interface, helping to further increase the DO concentration in the mixed liquor. The tank and mixing is configured to promote unidirectional channel velocities from 0.8 to 1.0 feet per second (ft/s), in order to keep activated sludge in suspension in sections of the ditch that are not outfitted with mechanical mixing.

As mixed liquor passes the aeration rotors, the DO concentration rises sharply but declines as flow traverses the circuit. Depending on the relative locations of wastewater influent, removal of effluent, sludge return, and aeration/mixing equipment, oxidation ditches can achieve nitrification and denitrification in addition to the oxidation of organic waste. To achieve single-stage nitrification, influent typically enters the circuit near the rotor and effluent exits upstream of the influent. The process can be modified to perform denitrification with proper control of the DO. DO control ensures sufficient DO for oxidation treatment (BOD reduction) but limits the excess supply of oxygen. Minimizing excess DO prompts the formation of anoxic zones after sufficient travel time around the circuit, when oxygen uptake from the biomass begins to deplete the supply of DO. The location and size of the anoxic zones vary due to changing wastewater quality and flow. The DO control system adjusts oxygen transfer accordingly to continue both single-stage nitrification and denitrification. It is important to maintain sufficient mixing to keep the biomass in suspension. This may limit the turndown of the rotors unless a supplemental mixing device is included.

Rates of nitrification and denitrification in the system described above are typically low because the resulting low DO concentrations are not ideal for either nitrification or denitrification. Furthermore, low DO concentrations promote the growth of filamentous bacteria. However, the large biomass and long hydraulic retention time (HRT) provide adequate time for nitrification and denitrification to occur. Nitrogen removals higher than 90 percent have been reported with oxidation ditches, although highly variable wastewater flows and characteristics would make it difficult to achieve consistent nitrogen removal for this or any other process.

A variation of the process described above involves operation of the oxidation ditch in distinct aerobic and anoxic phases for improved denitrification and better control of filamentous bacteria. As with the previously described operational strategy, the rotors supply mixing and aeration for single-stage nitrification.

Denitrification is accomplished in a separate ox ditch operation. For a period of about 6 to 8 hours each day, in one or more increments, the rotors are turned off and a submersible mixer is activated to keep the biomass in suspension without aeration. As a result, the entire oxidation ditch becomes anoxic, creating ideal conditions for denitrification. Because the oxidation ditch is a continuous process, the nitrate concentration in the effluent fluctuates, since denitrification is accomplished in intermittent phases. However, the composite concentration of nitrate in the effluent is low. The anoxic phase can be timed to coincide with the period of highest flows to maximize the growth of new biomass under anoxic conditions. This mode of operation favors the growth of non-filamentous bacteria for improved settleability.

In some applications, a phased operation scheme has been applied to two or more oxidation ditches to accomplish nutrient removal. This configuration provides the operator with more flexibility to control the length of the individual phases by varying nitrification and denitrification volumes, compared with operation of a single oxidation ditch. However, for small flows, it would be simpler and more cost effective to add an anoxic selector ahead of the oxidation ditch. Separate secondary clarification and return activated sludge (RAS) pumping would also be required if an oxidation ditch were implemented.

Ox ditch systems have been popular with process designers because they provide a compact treatment system for medium to low waste strength influent (i.e., influent BOD < 300 mg/L typical of residential waste streams) where nitrogen removal is required. With DO control, the operation of an ox ditch is typically fully automated, allowing operators to modify settings from SCADA interface screens without needing to directly view the ox ditch.

An ox ditch is constructed of vertical concrete walls and uses medium-to-low efficiency aeration systems. A typical treatment facility configuration involves two ox ditches to allow for one of the ox ditches to be taken offline for maintenance while the facility continues to meet discharge requirements. This level of redundancy is required if the treatment facility is not equipped with separate flow equalization storage.

Aeration rotors used in ox ditches, since they operate at the water surface, achieve an oxygen transfer efficiency ranging from approximately 1.0 lb oxygen/horsepower – hour (lb O_2/HP – hr) to 2.3 lb O_2/HP – hr. Oxygen transfer efficiency is a measure of the mass of oxygen than can be transferred into a unit volume of mixed liquor per unit of time.

Ox ditches require periodic maintenance to repair mixing rotors, valve systems, and instrumentation. To access floor mounted aerators, the tank must be dewatered and staff must enter the concrete tank (the ox ditch) to access the equipment. During operations, little staff attention is required. However, the tanks are open and can pose a hazard to staff and visitors without standard safeguards such as railing systems.

Odor generation and air emissions in general are not typically an issue for ox ditch systems because the systems are aerated and have a relatively small footprint compared to PMFPs. Odor and air emissions from an ox ditch system are not typically controlled.

5.2.3.2 Biolac

Biolac systems provide the same treatment and operational advantages as ox ditch systems in terms of organic waste oxidation and nitrogen removal while offering lower construction costs and higher efficiency aeration. Biolac is a pond-based system that utilizes fine-bubble aeration operating on DO control to create aerated and anoxic zones within the pond. The alternating of aerated and anoxic zones provides for nitrogen removal.

Aeration is supplied using flexible aeration “chains” that extend across the pond from headers installed on the pond berm tops. Each chain feeds a fine-bubble diffuser suspended several feet below the chain and above the floor of the Biolac pond. Oxygen transfer efficiency of fine-bubble aeration is approximately 3.0 – 4.0 lb O_2/HP – hr; fine bubble aeration is regularly specified for activated sludge applications to take advantage of the high oxygen transfer efficiency.

Clarifiers are integrated into the end of the Biolac basin opposite the influent. The typical Biolac system includes internal rectangular clarifiers, for separation and recycling of activated sludge, that sit inside the footprint of or adjacent to the aeration basin. The clarifiers are constructed of concrete, with the exception of a floating partition wall, which separates it from the basin. A sloped back wall and flocculating rake mechanism traveling the length of the clarifier are used to promote settling into a hopper at the bottom of the clarifier. Settled solids are either wasted to control the mixed liquor solids concentration and solids retention time (SRT) or are returned to the front of the basin. Effluent leaves the clarifier through a floating weir, allowing the liquid level in the aeration basin to fluctuate. Return activated sludge (RAS) pumping is typically provided with airlift pumps.

Biolac systems are used for both municipal and industrial wastes, Biolac works well for the influent waste strength identified above for ox ditch. Without the need for vertical concrete walls, construction costs for Biolac are lower than for ox ditches (see Section 5.2.5.2). Odors are not a significant concern because the majority of a Biolac pond is aerated. The aeration of the ponds makes them less attractive as a vector attractant because of surface turbulence. The open ponds can pose a hazard to staff and visitors without proper personnel safeguards such as railings and engineered walking surfaces on the berms.

5.2.4 Secondary Clarification

Secondary clarification is typically required to meet effluent suspended solids discharge requirements. Secondary clarification systems involve open concrete tanks that permit solid matter to settle out of the process flow. Well operated treatment facilities can achieve their suspended solids objectives without tertiary filtration using secondary clarification alone.

The potential for significant odor generation from a secondary clarifier is low because the wastewater has been oxidized by upstream processes. Solids collected at the bottom of each secondary clarifier tank are pumped to the solids handling process, which is discussed in Section 6.0.

5.2.4.1 Return Activated Sludge (RAS) Pumping

Activated sludge wastewater treatment results in the growth of biomass produced by the metabolism (oxidation) of organic wastes. As new wastewater is pumped into the treatment vessel, an equal volume of treated water flows (or is pumped) out of the treatment vessel. In the case of ox ditch/Biolac, flow is transferred to secondary clarification tanks. Because biomass is cultivated for optimum performance in the treatment vessel through DO levels and mixed liquor concentration, it is not good practice to allow large volumes of activated sludge biomass to be discharged from the treatment vessel. To maintain mixed liquor concentrations that provide consistent and efficient treatment, specific volumes of mixed liquor are pumped back into the treatment vessel as RAS. To keep the overall mass of solids in the treatment system balanced, another pumping rate is established to waste biomass to the solids handling system as waste activated sludge (WAS).

Part of the energy footprint of an activated sludge system includes RAS and WAS pumping. RAS pumping is continuous as long as the treatment process is operational. WAS pumping is periodic, and is typically based on mixed liquor concentration.

5.2.5 Nitrogen Removal

Both ox ditch and Biolac can be operated to nitrify and denitrify. Separate treatment processes are not required as in the case of PMFPs when ox ditch/Biolac is used with a gravity collection system. The availability of solids in the waste stream provides sufficient carbon source for complete nitrification/denitrification. With a STEP/STEG system, there may be insufficient carbon to complete the denitrification process. A supplemental carbon source will likely be required.

5.2.5.1 Nitrogen Removal Process Modifications – STEP/STEG

The impact of STEP/STEG on nitrogen removal requires the inclusion of a separate denitrification process. In addition, the use of methanol as a carbon supplement for denitrification would also be required (see Section 5.1.4.2).

The use of STEP/STEG also reduces the nitrogen removal efficiency of both ox ditch and Biolac by a factor of nearly 5.5, as shown in Table 5-7 (Carollo, August 2007).

Table 5-7: Nitrogen Removal Limits, Total N – Ox Ditch/Biolac

Collection System Type	Ox Ditch: N Removal Limit, Total-N (mg/L)	Biolac: Removal Limit, Total N (mg/L)
Gravity	7	7
STEP/STEG	39	37

5.2.5.2 Costs of Nitrogen Removal – STEP/STEG

Preliminary estimates of annual O&M costs and capital costs for nitrogen removal are provided in Table 5-8 (Carollo, August 2007).

Table 5-8: Cost Summary - Ox Ditch/Biolac

Collection System	Treatment Process Cost Component	Ox Ditch Costs	Biolac Costs
Gravity	2ndary Trtmt Construction	$19.6M	$17.2M
	2ndary Trtmt O&M	$690,000	$700,000
	Nitrification Construction	-	-
	Nitrification O&M	-	-
	Denitrification Construction	-	-
	Denitrification Annual O&M	-	-
STEP/STEG	2ndary Trtmt Construction	$16.5M	$14.2M
	2ndary Trtmt O&M	$570,000	$550,000
	Nitrification Construction	-	-
	Nitrification O&M	-	-
	Denitrification Construction	$3.6M	$3.6M
	Denitrification Annual O&M	$250,000	$250,000

The cost impacts of implementing STEP/STEG, as reported in the FSR, reverses the anticipated cost benefits at the treatment facility. STEP/STEG reduces the capital cost of ox ditch construction by $3.1M, but requires the addition of $3.6M in additional construction for the denitrification facility. Capital costs for Biolac show similar variations. The main difference is a net increase of $130,000 in annual O&M costs for ox ditch and a net increase of $150,000 in annual O&M costs for Biolac due to the need for denitrification for the STEP/STEG system.

5.2.6 Solids Management

The management of biosolids is discussed in detail in Section 6.0.

5.2.7 Construction & Operations – Ox Ditch/Biolac

As noted in Section 5.1.7, construction of a new treatment facility involves considerable disturbance to a site to install major process components and associated process piping and support equipment. The area required by ox ditch/Biolac process is estimated to be 8 to 10 acres. Construction would need to grade an area at least 1.5 times that area. Construction would require approximately 18 to 24 months.

5.2.7.1 Construction Volumes

Table 5-9 provides estimates of the volume of excavation during construction of the treatment process components. Excavation volumes for these elements are estimated based on conceptual sizing and are based on a gravity collection system.

Table 5-9: Estimates of the Volume of Excavation – Ox Ditch/Biolac

Liquid Process Component	Estimated Excavation Volume (cy)	Truck Trips (9 cy/truck)*
Headworks (including IPS)	800	89
Secondary Treatment (Ox Ditch/Biolac)	22,800	2,533
Secondary Clarification	3,500	389
Nitrogen Removal (denitrification)	200	22
Administration & Maintenance Structures	1,300	144
Total	28,600	3,177

* Truck capacity is 10 CY. Estimate based on assumption that actual loads would be less than full.

5.2.7.2 Construction Equipment

While the actual means and methods of construction for these facilities would be determined by the contractor, a representative list of construction equipment is provided. A list of major construction equipment anticipated for construction of the ox ditch/Biolac process and associated systems is presented in Table 5-10.

Table 5-10: Major Construction Equipment – Ox Ditch/Biolac

Equipment	Estimated Quantity
Earth moving (tracked)	2
Earth moving (wheeled)	3
Grading	2
Compaction Roller	1
Backhoe (Wheeled)	3
Trackhoe (excavator)	2
Mobile Crane	2
Concrete Delivery Trucks	15
Concrete Pumper truck	1
Pickup	10
3 cy dump	3
Water truck (dust suppression)	1
Asphalt spreader/compaction	1

5.2.7.3 Operations

Table 5-11 summarizes the operational notes for an ox ditch/Biolac process.

Table 5-11: Operational Considerations – Ox Ditch/Biolac

Liquid Process Component	Operations Notes
Headworks	• Residues from screening and degritting can be odor sources. • Contact with screenings and grit can be health and safety hazards for operations and maintenance staff. • Screening and degritting systems wash organic matter, reducing the potential for odor and health hazard.
Secondary Treatment (Ox Ditch/Biolac)	• Remote operations possible. • Aeration systems would be highest energy consumer at the treatment facility (approximately 1.5 million kWhr/year). • Open tanks/ponds can pose safety hazard for staff and visitors. • Limited potential for odor generation.
Secondary Clarification	• Open tanks require safeguards • Tanks would pose minimal odor potential. • RAS/WAS pumping required and add to energy footprint.
Nitrogen Removal	• Nitrification/denitrification can be completed in ox ditch/Biolac when a gravity collection system is used. • Secondary treatment (both systems) relies on DO control. • Separate denitrification process required when STEP/STEG collection system is used. A carbon supplement in the form of methanol would be required. Use of methanol requires specialized equipment and procedures. • STEP/STEG requires additional denitrification treatment process, increasing costs, staff maintenance requirements and staff exposure to potential hazards.

5.2.8 Odor Control – Ox Ditch/Biolac

Odor control for ox ditch/Biolac would be limited to the headworks and solids handling processes. Both ox ditch and Biolac have sections of the process that are aerated. The addition of oxygen and the relatively small footprint of these processes reduce the potential for odor generation.

Headworks handle raw influent, which is the major source of odor-causing compounds found in the treatment facility. Headworks equipment used for screening and degritting is enclosed and constructed of corrosion resistant materials. For more reliable odor control, the proposed headworks will be enclosed in a structure outfitted with odor scrubbing equipment. Odor control in enclosed areas with a relatively small air volume and low concentrations of odor compounds are best served by scrubbing systems that rely on inorganic media. Odor controls systems based on inorganic media are is proposed for the LOWWP (see Section 5.1.8).

Solids handling would also generate odors. Odor control for solids handling is discussed in Section 6.5.4.

6.0 Solids Process

This section provides a summary of the anticipated process loading, technology options, disposal scenarios, and costs for solids management.

Decisions on biosolids handling and disposal must be linked to septage receiving regulations and community perception regarding reuse (Carollo, April 2008). In this section, it is assumed processing biosolids to meet sub-Class B requirements and then transporting them to a landfill facility, would be the most likely method of disposal. Production of Class A biosolids for reuse in the community or surrounding area is considered a less likely disposal method, due primarily to an undocumented market and higher costs for producing Class A biosolids. Producing Class B solids requires additional costs for processing than sub Class B and produces no material benefit.

6.1 Comparison of STEP/STEG and Gravity Collection Systems on Solids Handling Requirements

Facility sizing and, to some extent, process selection for solids handling for the LOWWP is influenced by the choice of whether to go with a gravity or STEP/STEG collection system. Section 5 of the FSR reports a differential in daily solids loading of 3000 lbs/day; the solids load from a STEP/STEG system is 25% of the load from a gravity system (1000 lbs/day vs. 4000 lbs/day). The differences between the two types of collection systems for solids digestion, drying, and/or composting have been estimated in terms of area requirements, truck trips, and costs and are summarized in Table 6-1 (Carollo, April 2008):

Solids digested in the onsite septic facilities will be trucked to the treatment plant on a routine basis and placed into the PMFP. Assuming 80% volatile solids in the raw wastewater and 60% volatile solids destruction in the onsite septic tanks, the 3000 lb differential mentioned above will be reduced by about 50% to about 1500 lbs.

Table 6-1: Comparison of STEP/STEG and Gravity for Solids Process

		Anaerobic Digestion		Solar Drying		Composting	
		SH	STEP/STEG	SH	STEP/STEG	SH	STEP/STEG
Criteria	Unit	4000 lbs/day	1000 lbs/day	4000 lbs/day	1000 lbs/day	4000 lbs/day	1000 lbs/day
Facility Footprint	SF	14,000	8,000	32,000	9,000	20,000	10,000
Truck Trips	weekly	2.5	0.6	1	0.2	8	2
Truck CO_2 Emissions	annual tons	10.2	2.4	4.1	0.82	32.7	8.2
Construction Costs	$s	$6,000,000	$3,900,000	$3,400,000	$2,200,000	$2,800,000	$1,500,000

6.2 Solids Process Components

The solids handling process proposed for the LOWWP treatment facility is hauling of sub- Class B biosolids to a landfill for disposal. In the following subsections, the main solids process components are identified and described.

6.2.1 Production of Class B and Sub-Class B Biosolids

Several processes are available for reducing both the volatile solids and pathogen content of the biosolids produced in a wastewater treatment facility, sufficiently to meet the requirements for Class B, although sub-class B is the proposed option. Following is a brief discussion of several that were considered for the LOWWP treatment facility.

- Anaerobic digestion is well-suited to larger facilities (>5 MGD) and affords opportunities for energy recovery from the solids in the form of methane gas that can be used to fuel cogeneration equipment. Anaerobic digestion requires a sufficient load of volatile solids, which must be available in consistent quantities. This type of digestion requires regular testing and maintenance to keep the process within an optimal operating range. With the possibility of STEP/STEG limiting the volatile solids load on the treatment facility combined with the high cost of construction and operation, anaerobic digestion was considered not suitable for the LOWWP.

- The aerobic digestion process involves holding wastewater biosolids under aerobic conditions for at least 30 days and is capable of producing Class B biosolids with relatively minimal area requirements and limited odor potential. Sub-Class B means holding the wasted solids in an aerobic digester less than the time necessary to obtain a Class B (38 percent reduction). Stabilization of pathogens and volatile solids is less than achieved in Class B.

- Solar drying offers many advantages, particularly the ability to achieve Class A solids through the use of greenhouse drying systems. To achieve Class A status, undigested sludge must be dried to a minimum solids content of 90%. Solids content this high limits the disposal options for this sludge because it creates dust issues that do not comply with stipulations of the California General Order regarding biosolids and guidelines from the National Fire Protection Association (Carollo, April 2008). Solar drying could be used to generate Class B solids.. Solar drying was not considered best suited for the LOWWP.

- Composting can meet either Class A or Class B requirements depending on the time of treatment and the temperature the waste is subjected to during the process. For this type of composting, the enclosed tanks offer control of odors and limit staff contact with wastes.

The proposed process for production of sub- Class B biosolids at the LOWWP is aerobic digestion. The solids will be thickened before digestion and dewatered following digestion.

6.3 Thickening and Dewatering

Free-draining water must be removed from sludge taken from the secondary treatment process (thickening) prior to digestion and then dewatered to condition the sludge for landfill disposal. Typically, mechanical systems are used for removing water from sludge, but these are limited to achieving between 15% and 25% solids concentration with chemical addition. Drying beds offer higher solids content (i.e., less water) than mechanical systems but do not offer the same advantages of small footprint and short time periods to achieve the desired moisture content.

Belt filter presses (BFPs) are commonly used for dewatering and can achieve solids concentrations of 18% to 20%. Other systems include centrifuges and screw presses. Centrifuges require high-levels of maintenance and energy input. Screw presses require more facility area than BFPs while providing performance ranging between 20% and 25% discharge solids, lower required input energy, and less need for maintenance. Screw presses are proposed for the LOWWP.

A major advantage of screw presses is the containment of odors. Dewatering equipment is subjected to some of the harshest conditions at a treatment facility because the most common odor-causing compound, hydrogen sulfide (H_2S), is released in high-ambient levels around the equipment. H_2S leads to rapid and aggressive corrosion. BFPs are open systems, allowing for the release of foul air that can be an odor source detected by offsite receptors and that contributes to corrosion. Screw presses are closed systems that contain most of the odor-causing compounds. Enclosure of the dewatering facility in a structure with odor scrubbing equipment is common practice and is proposed for the LOWWP. Odor scrubbing equipment described in Section 5.1.8 is typically used for dewatering facilities.

Staff and visitors are exposed to short-term effects from odor and noise when working in the dewatering structure. Short-term chemical exposure is also associated with dewatering. A typical practice is to inject polymers into the sludge feed to dewatering equipment to enhance the capture of solids. Polymers are non-volatile, but can be corrosive to skin when stored “neat” (not diluted). Storage systems are designed to prevent a release during filling and operations.

6.4 Disposal

Disposal involving offsite hauling to a local landfill is proposed as the primary method for disposing of biosolids. The reason for this is that the alternative is reuse. Because the local use of land is either agriculture or urban development, the only speculative reuse option would be for agricultural land application. However, the speculation that agriculture might accept treated biosolids for agricultural land application has been firmly resisted by a representative of the agricultural community due to the combination of type of crops (row vegetables) and public health concerns in general.

In other locations within southern California (e.g. Ojai, California and Lompoc, California), Class A biosolids are produced and readily accepted by the public for land application without hesitation. In those communities, there is neither a direct connection between land-applied biosolids and agricultural crops for human consumption nor is there a localized concern about the presence of a processing facility to produce the Class A sludge. Both of those factors would be problematic in Los Osos.

6.5 Construction and Operations

6.5.1 Construction Volumes

Table 6-2 provides estimates of the volume of excavation to prepare a project site for construction of the solids handling process components. Excavation volumes for these elements are estimated based on conceptual sizing and are based on a gravity collection system. Excavation volumes for solids handling associated with STEP/STEG would be about 30% smaller due to smaller size requirements. It is likely that the only solids processing facilities for a pond system would be DAFT with a small footprint, possibly 1000 sq ft. Algae would likely be returned to the pond and permanently removed on a periodic basis using temporary equipment.

Table 6-2: Estimates of the Volume of Excavation – Solids Process

Solids Process Component	Estimated Excavation Volume (cy)	Truck Trips (9 cy/truck)*
Dewatering	900	100
Aerobic Digestion	1000	110
Total	**1,900**	**210**

* Truck capacity is 10 cy. Estimate based on assumption that actual loads would be less than full.

6.5.2 Construction Equipment

The equipment listed Section 5.1.7.2 would also be used in the construction of the solids process.

6.5.3 Operations

Table 6-3 summarizes operational notes associated with solids handling.

Table 6-3: Operational Considerations – Solids Process

Solids Process Component	Operations Notes
Dewatering	• Screw press is proposed. • Corrosion and odors are significant issues requiring engineering and operational control. Mitigated by closed screw press design. • Staff and visitors are exposed to short-term impacts from odor and noise when working in the vicinity of dewatering equipment.

Aerobic Digestion	• Continuous process • Biosolids are aerated and mixed for an average of at least 30 – 40 days at ambient temperatures • Some staff exposure to noise from aeration blowers. Odor plume must be controlled and treated.
Hauling & Disposal	• Digested and dewatered, Class B biosolids would be trucked to a local landfill. • Biosolids will be dewatered to about 15% solids prior to hauling

6.5.4 Odor Control – Solids Handling

Odor control for solids handling would be necessary for digestion and dewatering.

As noted in Section 6.2, dewatering of undigested sludge generates a significant amount of odor and contributes to a highly corrosive environment around the dewatering equipment. Use of enclosed dewatering equipment, specifically a screw press, is proposed. In addition, the proposed LOWWP dewatering facility would be enclosed and outfitted with odor scrubbing equipment that captures foul air compounds using inorganic media, as described in Section 5.1.8.

Odor control for digestion requires collecting the off-gases from the digestion process and scrubbing them of odorous compounds.

7.0 Effluent Disposal

7.1 Disposal Options

The projection of 1,290 AFY of effluent disposal reflects a population of 18,500 at buildout and wet weather infiltration into the collection system of 336 AFY for three months per year. This projection assumes implementation of a conservation program to retrofit the community with low flush toilets (160 AF). No disposal alternative alone has enough capacity to accept the entire 1,290 AFY effluent flow (Carollo, April 2008). Therefore, different disposal options must be combined to create a complete disposal project.

7.1.1 Sprayfields

Sprayfield disposal is the practice of spraying effluent on land to dispose of the water through evapotranspiration and percolation. Soils on the sprayfield surface area of the Tonini Site as shown on Figure 7-1 represent reasonable material for spray applications. Sprayfield disposal would require secondary treatment. Sprayfields would be operated to maximize evaporation and minimize runoff. This would entail spraying only during the daytime and collecting any tailwater (run-off) and returning it to the sprayfields for reapplication. Disposal would occur through evapotranspiration, or through both evapotranspiration and percolation on approximately 175 acres.

Water from the treatment facility would be pumped to the Tonini property through a pressurized pipeline. The irrigation lines to the spray heads would be buried less than two feet below grade. Spray heads would be detachable and approximately three feet tall. They would rotate and spray water out to a radius of approximately 15 feet and would be installed at approximately 30-foot spacing. A drain would be constructed at the bottom of the sprayfield slopes to collect the tailwater (run-off), and a pump would be required to reapply the water.

Because the effluent disposed at the sprayfields would likely not meet Title 22 tertiary treatment standards, the sprayfield area would be fenced off to prevent public contact with the water. Nutrient management to prevent nitrates in the groundwater would consist of harvesting the grass grown in the field several times over the course of a year.

7.1.2 Leachfields

Effluent disposal through leachfields is not dependent on weather conditions, and would not occur uniformly throughout the year (i.e., more effluent can be disposed in the winter if less is disposed in the summer when sprayfields can be used, as long as the annual total does not exceed the annual hydraulic capacity for the site.) Broderson is the only potential leachfield site that incurs a seawater intrusion mitigation benefit. The annual capacity of the Broderson site is 448 AFY (Carollo, April 2008).

The Broderson site would be accessed by a gravel road that extends south from the end of Broderson Avenue. The site would require fencing to limit public access. The active leachfield area at the Broderson site would be approximately 7 of a total of 75 acres. The area would be excavated to an average depth of 6.5 feet during construction and backfilled with a 4-foot layer of gravel for drainage, which would be covered by geotextile fabric. Final cover would consist of a minimum of 2.5 feet of native soil backfill. The percolation piping would consist of 4-inch perforated PVC pipe laid approximately one foot below the geotextile fabric layer, with the perforations facing upwards. If the pores beneath the leachfield become clogged over time, the leachfield would be excavated and the ground beneath it would be ripped or disked. The estimated frequency of ripping ranges between 5 and 10 years (Carollo, April 2008).

7.2 Proposed Combination of Disposal Options

Table 7-1 summarizes the disposal options and their capacities that would be combined and become the disposal component of each Proposed Project. The data contained in the table were taken from the Carollo TM "Effluent Disposal and Reuse Alternatives – Final Draft" (Carollo, April 2008).

Table 7-1: Proposed Combination of Disposal Options

Alternative Component	**Capacity (AFY)**	**Total Seawater Intrusion Mitigation = 187 AFY Total Capital Cost = $13.7-15.5 M* Total O&M = $440-530K/year Total Treatment required = Secondary**
Sprayfields (175 acres)	842	
Broderson	448	
Conservation	160	
Storage (46 ac-ft)	N/A	
*Costs not itemized (Carollo, April 2008)		

7.2.1 Seasonal Storage

Storage ponds for treated effluent would be lined to prevent percolation and the banks would be protected with riprap. After storage for several months, the effluent would be screened or filtered to remove algae that could cause clogging before being sent for disposal. The ponds would be emptied as the ability to accept effluent increases at the sprayfields in the spring and summer. The storage pond would be empty in the summer and fall.

The maximum feasible depth below grade varies depending on the site that is selected, but a depth of 15 feet would be possible in any location east of Los Osos Creek. The freeboard required for any pond would be approximately 4 feet to comply with seismic codes. Figures 7-2 through 7-4 display the possible footprints on the respective treatment sites for the four Proposed Projects. Three possible footprints and associated heights of the storage pond dam (or berm) are shown for the proposed disposal option in Table 7-2. The possible footprints for the three storage pond options are shown in Figures 7-2 through 7-4.

Table 7-2: Possible Footprints for Storage Pond

Storage Capacity (AFY)	Approximate Area (acres)	Approximate Height of Dam (ft)
46	10	6
46	6	10
46	4	15

The California Department of Water Resources (DWR) Division of Safety of Dams (DSOD) is charged with ensuring that the design and construction of dams protects the health and safety of the public. The DSOD jurisdictional criteria were previously presented in Figure 5-2 relative to facultative ponds (California DSOD, 2008). The criteria also apply to the proposed storage pond. Dam height is measured from the downstream toe to the maximum storage elevation/spillway. DSOD identifies specific exemptions, including the following:

> "WASTE WATER CONTROL FACILITY ponds, which are 15 feet or less in height, have a maximum storage capacity of 1500 acre-feet or less, are off-stream."

While the possible storage pond configurations presented here would qualify for the exemption, the County would elect to accept an offer from DSOD to assume the responsibility for liability and oversight for all facilities included in the LOWWP. The County Board of Supervisors would pass a resolution to legally assume liability and DSOD involvement in the management of the pond would cease.

References

California Department of Water Resources - Division of Safety of Dams Jurisdictional Size Chart (http://damsafety.water.ca.gov/jurisdictionalchrt3.cfm); 2008.

Carollo Engineers - *Potential Viable Project Alternatives Rough Screening Analysis*; March 2007

Carollo Engineers – *Viable Project Alternatives Fine Screening Analysis*, Final Draft; August 2007.

Carollo Engineers - *Technical Memorandum*: *Low Pressure Collection System*, Final Draft; January 2008.

Carollo Engineers - *Technical Memorandum: Flows and Loads*. Final Draft; February 2008.

Carollo Engineers – Technical Memorandum: *Effluent Reuse and Disposal Alternatives.* Final Draft; March 2008.

Carollo Engineers – *Technical Memorandum: Partially Mixed Facultative Pond Options*, Final Draft; March 2008.

Carollo Engineers – *Technical Memorandum: Out of Town Conveyance*, Final Draft; March 2008.

Carollo Engineers – *Technical Memorandum: Solids Handling Options*, Final Draft; April 2008.

Crawford, Multari & Clark Associates – *Draft Environmental Impact Report for the Los Osos Community Services District Wastewater Facilities Project*; November 2000.

EPRI - *Guidance Manual for the Evaluation of Effluent Sewer Systems*; August 2003.

Fugro West, Inc. - *Geotechnical Report, Los Osos Wastewater Project, Los Osos Community Services District*; 9 March 2004.

Montgomery Watson Harza (MWH) - *Drawings for the Construction of the Los Osos Wastewater Project Area, A and D*; *Drawings for the Construction of the Los Osos Wastewater Project Area, B and C*; February 2004.

Regional Water Quality Control Board – Central Region - Waste Discharge/Recycled Water Requirements Order No. R3-2003-0007; 2003.

Ripley Pacific - *Los Osos Wastewater Management Plan Update*, 8 December 2006.

USEPA (600/R-01/034) – *Ex-filtration in Sewer Systems*; December 2000.

Figures

Figure 1-1

Project Vicinity

Los Osos Wastewater Project EIR

N

Legend

Property Boundary

Service Area Boundary

Figure 1-2

Project Location

Los Osos Wastewater Project EIR

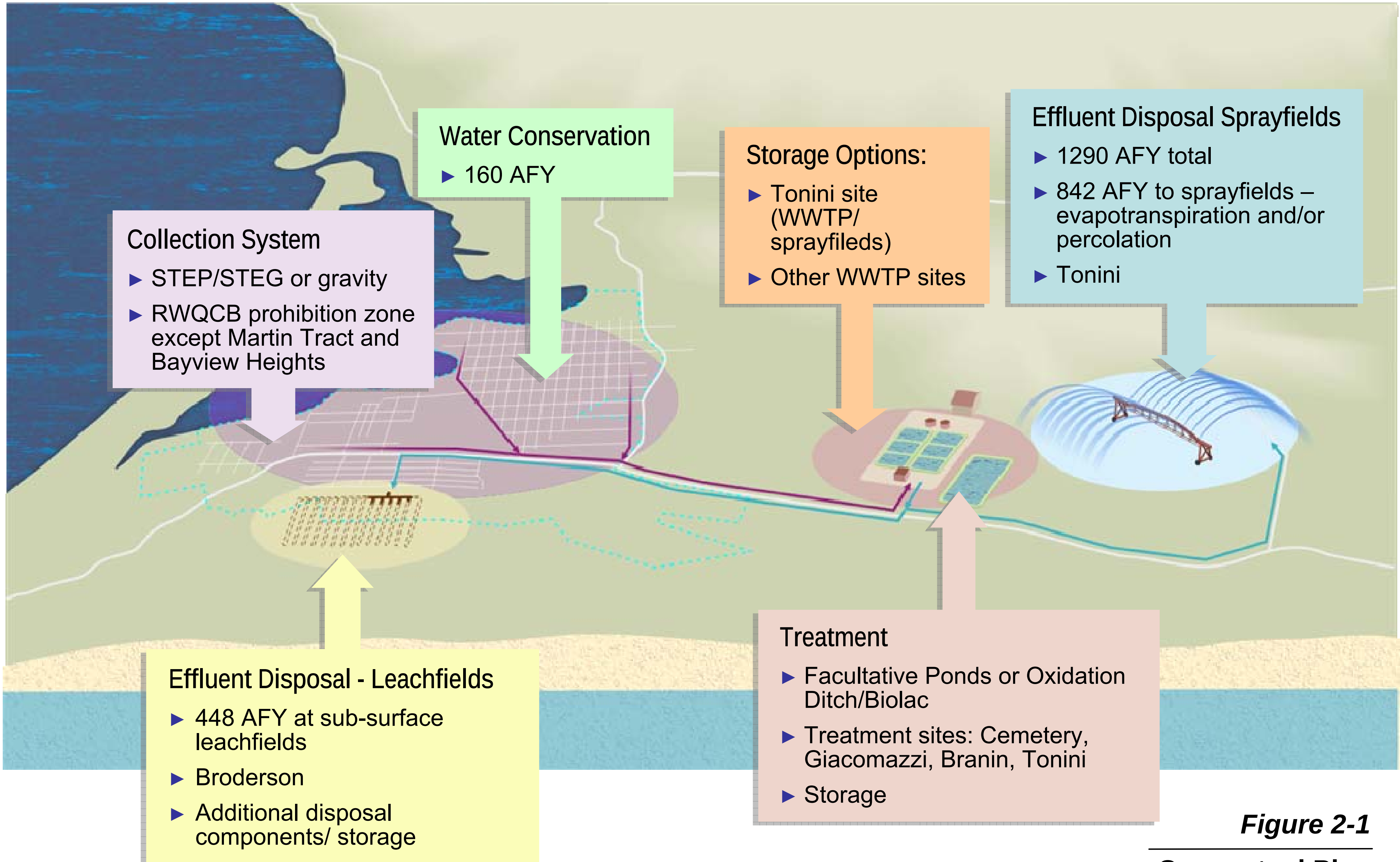


Figure 2-1

Conceptual Plan

Los Osos Wastewater Project EIR

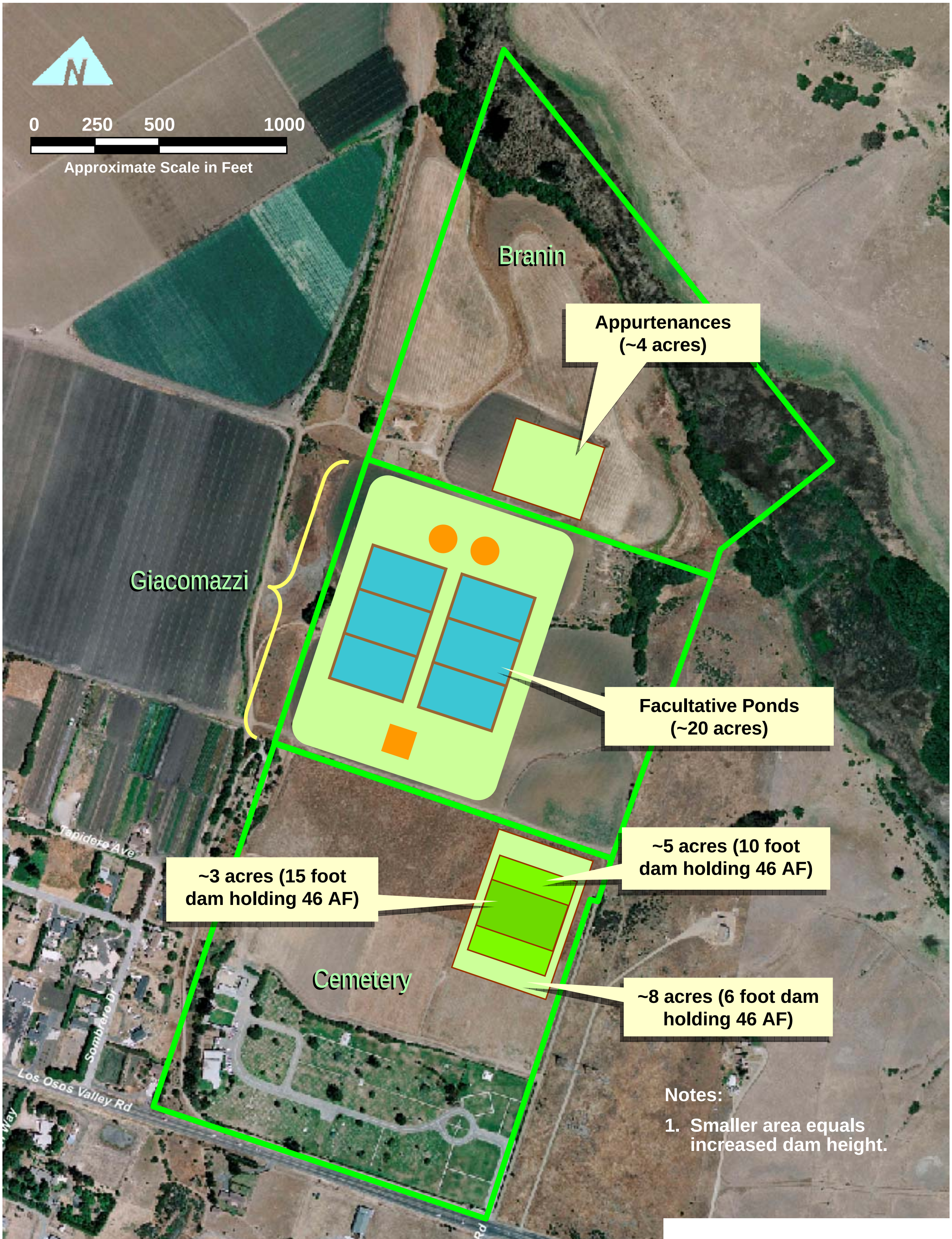
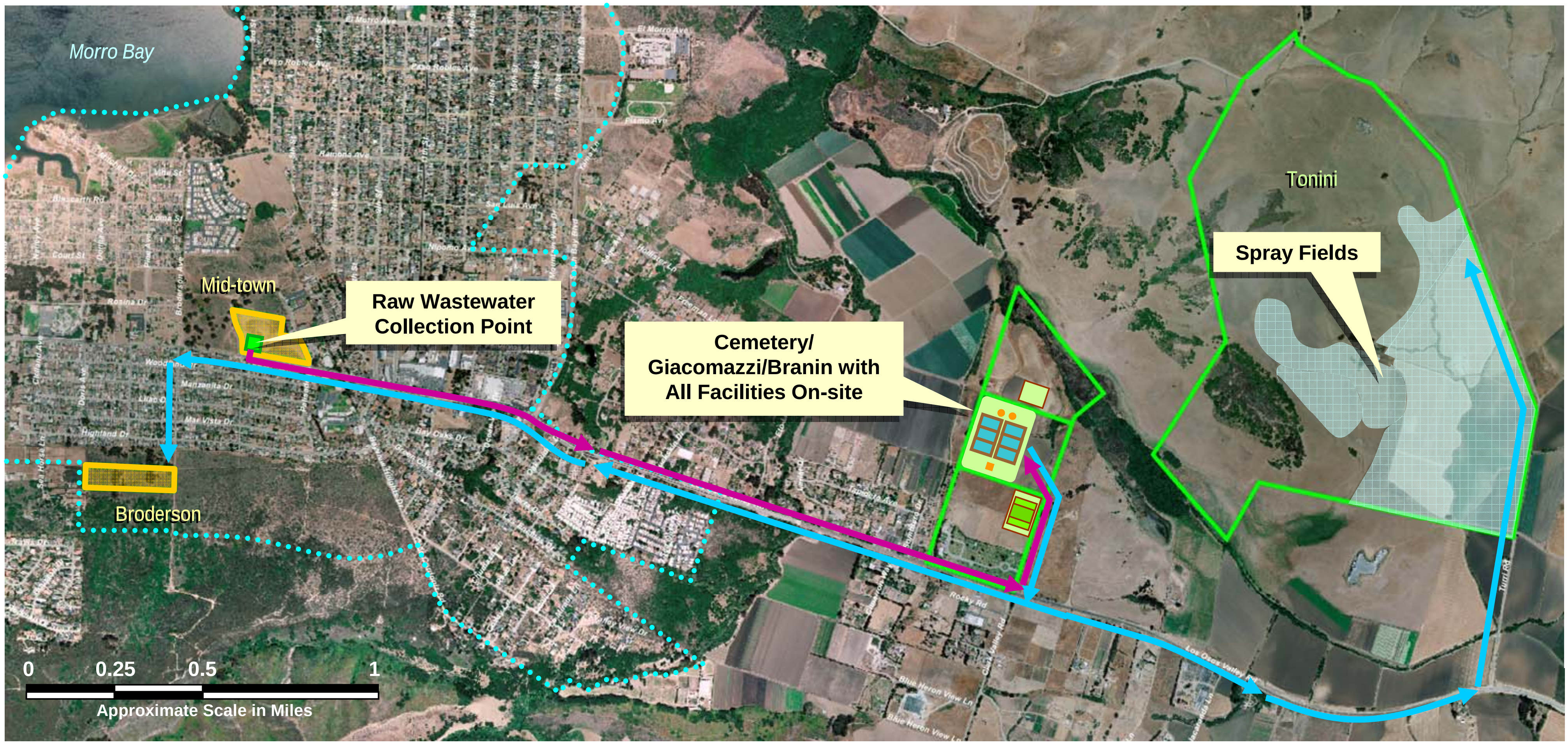


Figure 2-2

Legend

Property boundary

Proposed Project 1-Cemetery/Giacomazzi/Branin-Facultative Ponds with Storage On-site



N

Legend

- Property Boundary
- Service Area Boundary
- Raw Wastewater Conveyance to Treatment
- Effluent Conveyance to Disposal

Notes:

1. Proposed conveyance routes are approximate.

Figure 2-3

Proposed Project 1 – Site Layout with Conveyance of Wastewater and Effluent

Los Osos Wastewater Project EIR

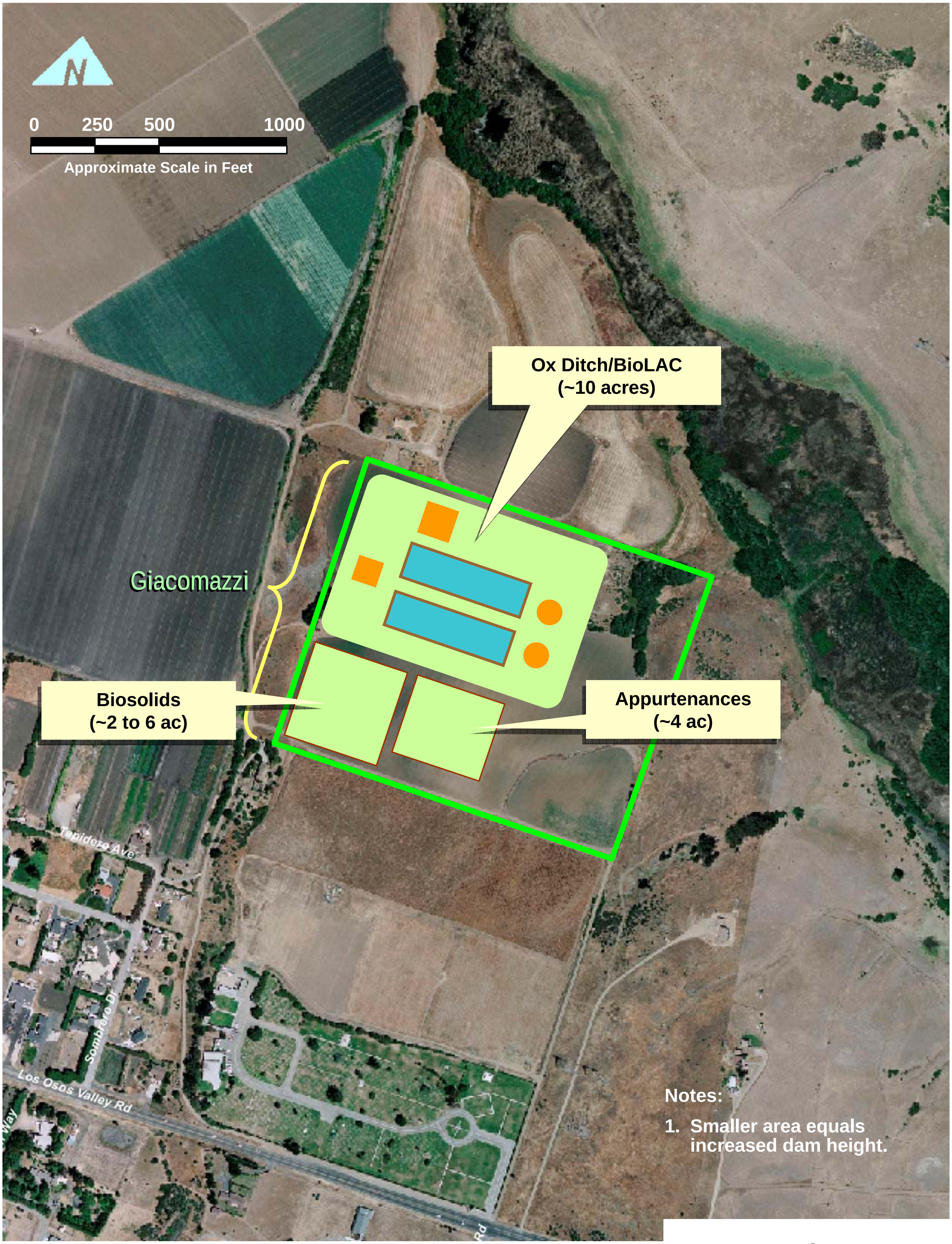
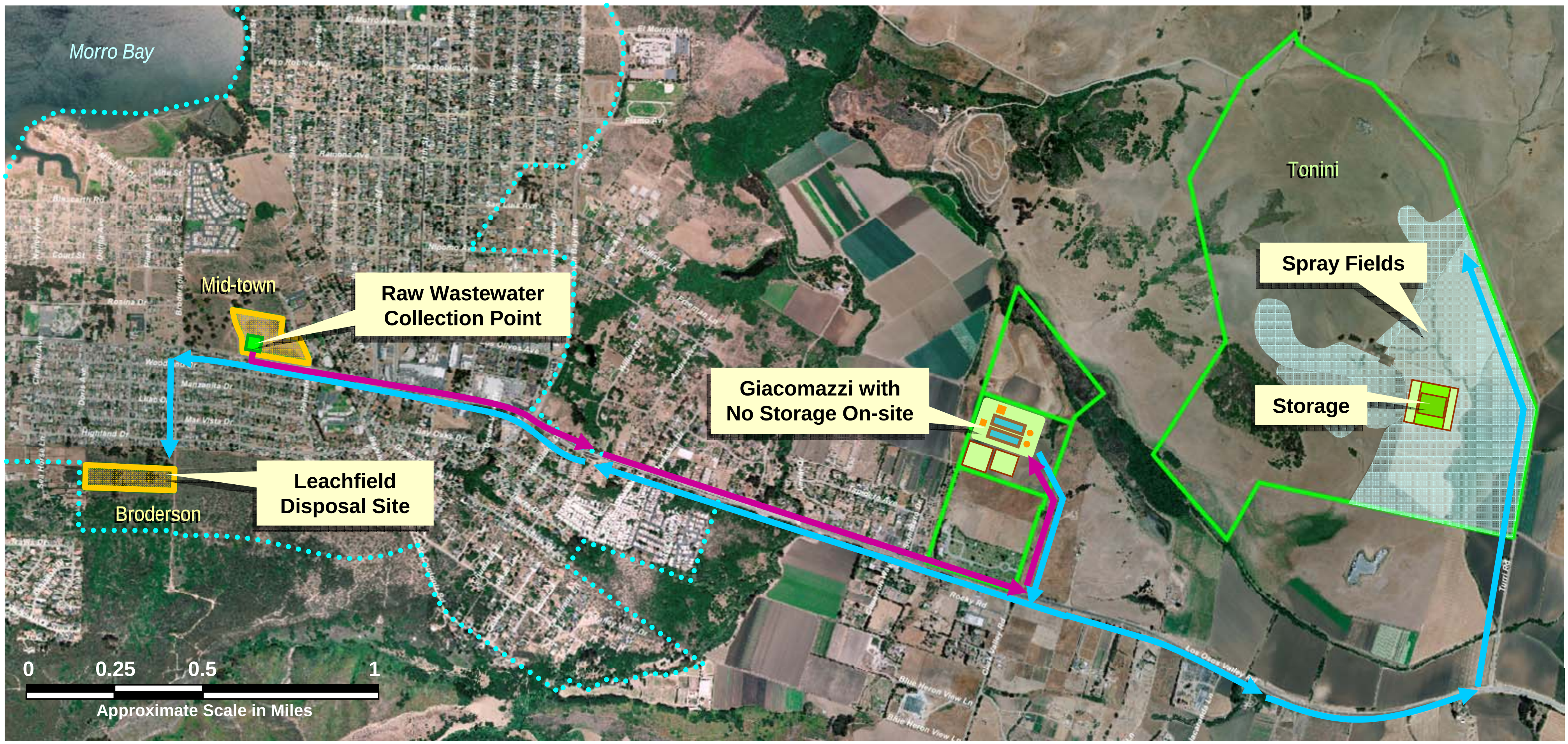


Figure 2-4

Legend

Property boundary

Proposed Project 2 - Giacomazzi-Ox Ditch/Biolac with Storage at Tonini



Legend

- Property Boundary
- Service Area Boundary
- Raw Wastewater Conveyance to Treatment
- Effluent Conveyance to Disposal

Notes:

1. Proposed conveyance routes are approximate.

Figure 2-5

Proposed Project 2 – Site Layout with Conveyance of Wastewater and Effluent

Los Osos Wastewater Project EIR

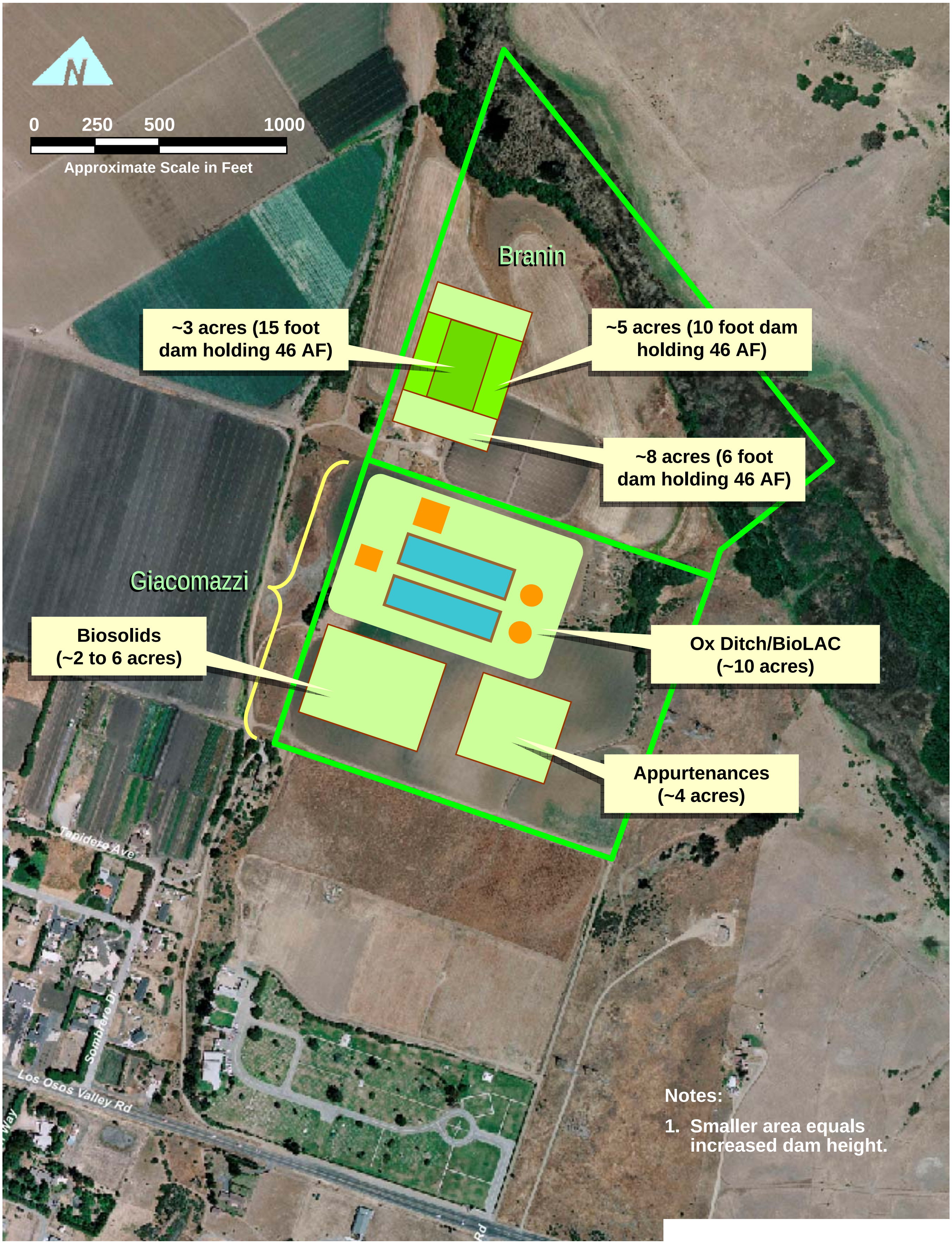


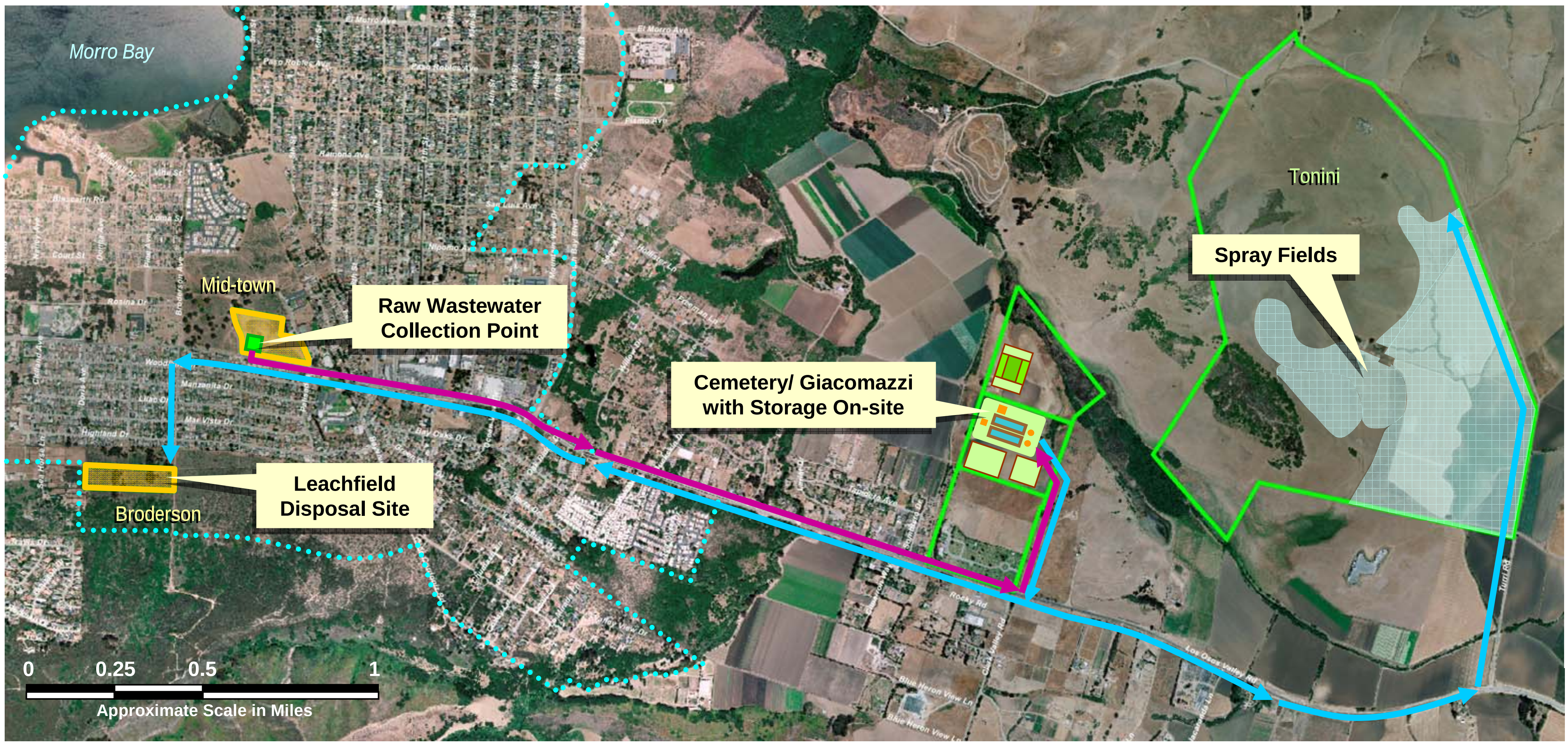
Figure 2-6

Legend

Property boundary

Proposed Project 3 - Giacomazzi/Branin-Ox Ditch/BiolacC with Storage On-Site

Los Osos Wastewater Project EIR



N

Legend

Property Boundary

Service Area Boundary

Raw Wastewater Conveyance to Treatment

Effluent Conveyance to Disposal

Notes:

1. Proposed conveyance routes are approximate.

Figure 2-7

Proposed Project 3 – Site Layout with Conveyance of Wastewater and Effluent

Los Osos Wastewater Project EIR

Legend

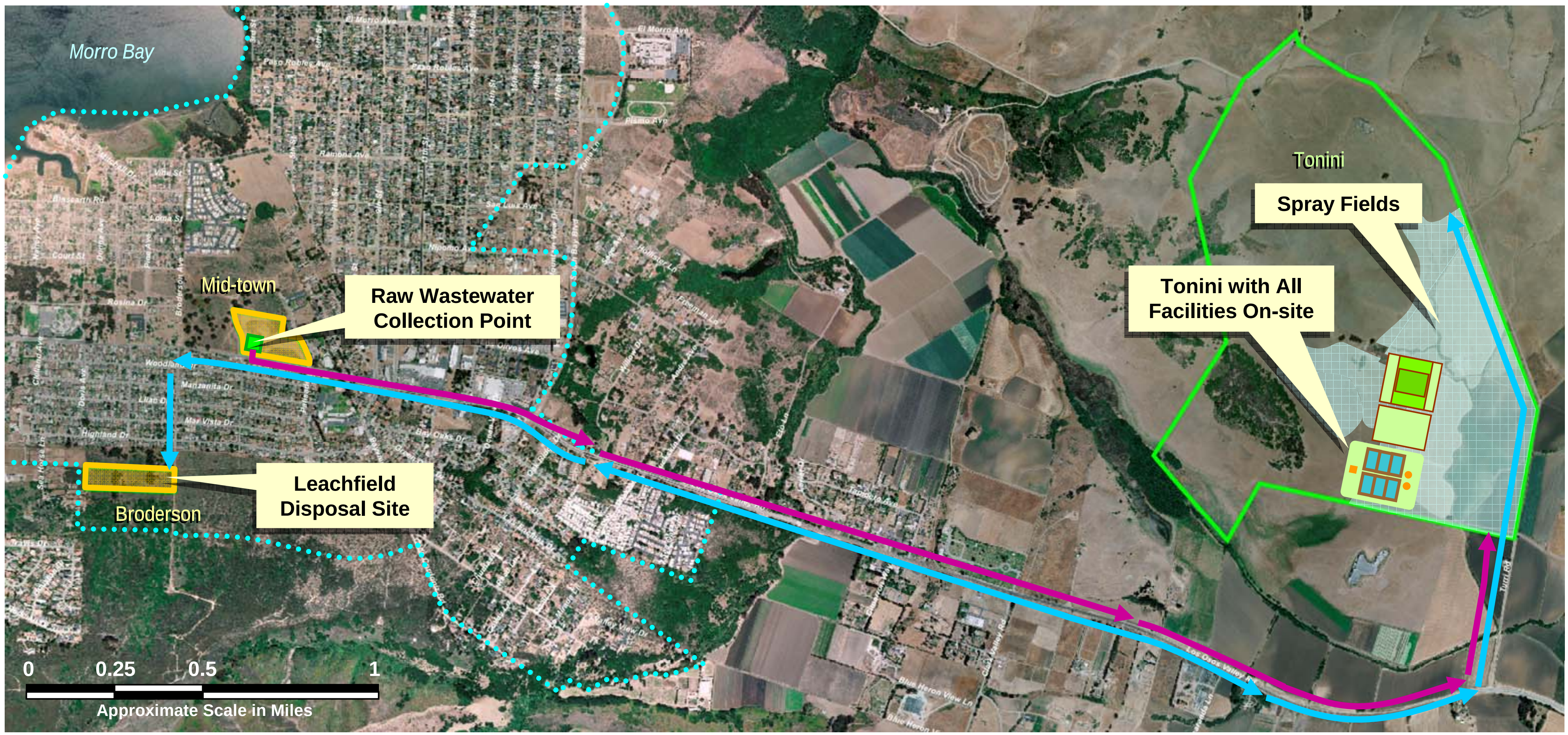
Property boundary

Spray field

Figure 2-8

Proposed Project 4 –Tonini- Facultative Ponds with Storage

Los Osos Wastewater Project EIR



Legend

Property Boundary

Service Area Boundary

Raw Wastewater Conveyance to Treatment

Effluent Conveyance to Disposal

Notes:

1. Proposed conveyance routes are approximate.

Figure 2-9

Proposed Project 4 – Site Layout with Conveyance of Wastewater and Effluent

Los Osos Wastewater Project EIR

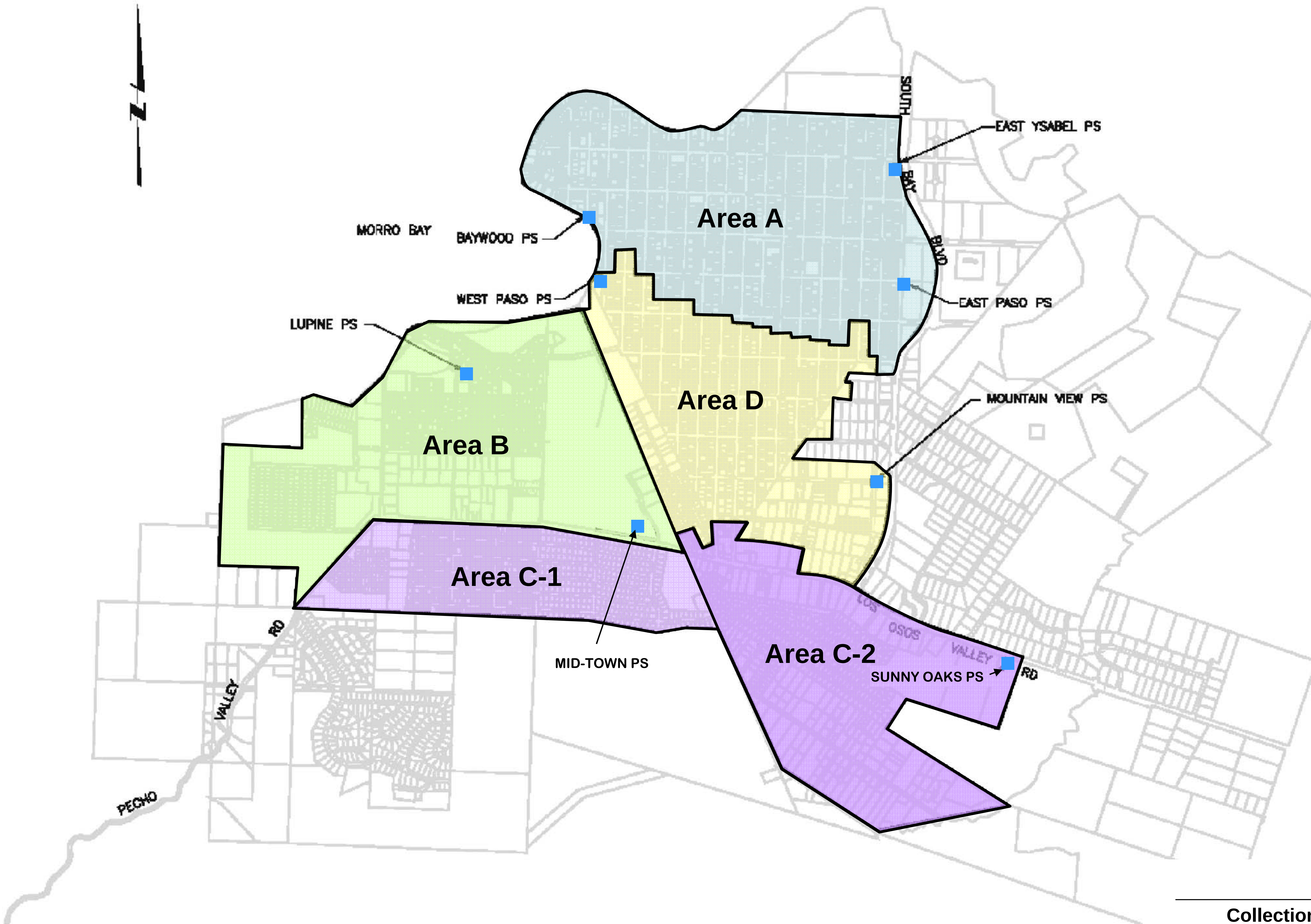


Figure 3-1

Collection System Layout – Site Plan

Los Osos Wastewater Project EIR

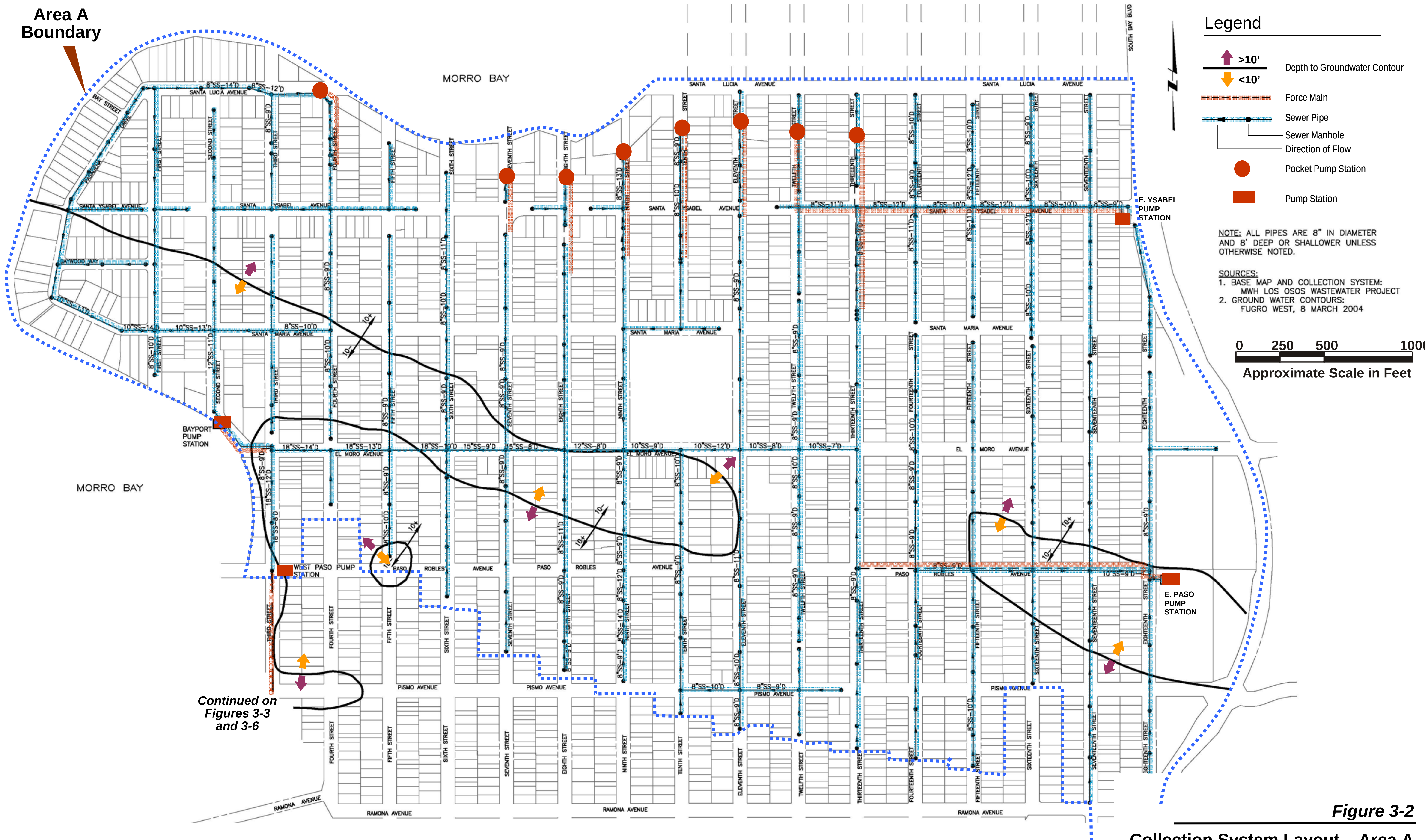


Figure 3-2

Collection System Layout – Area A

Los Osos Wastewater Project EIR

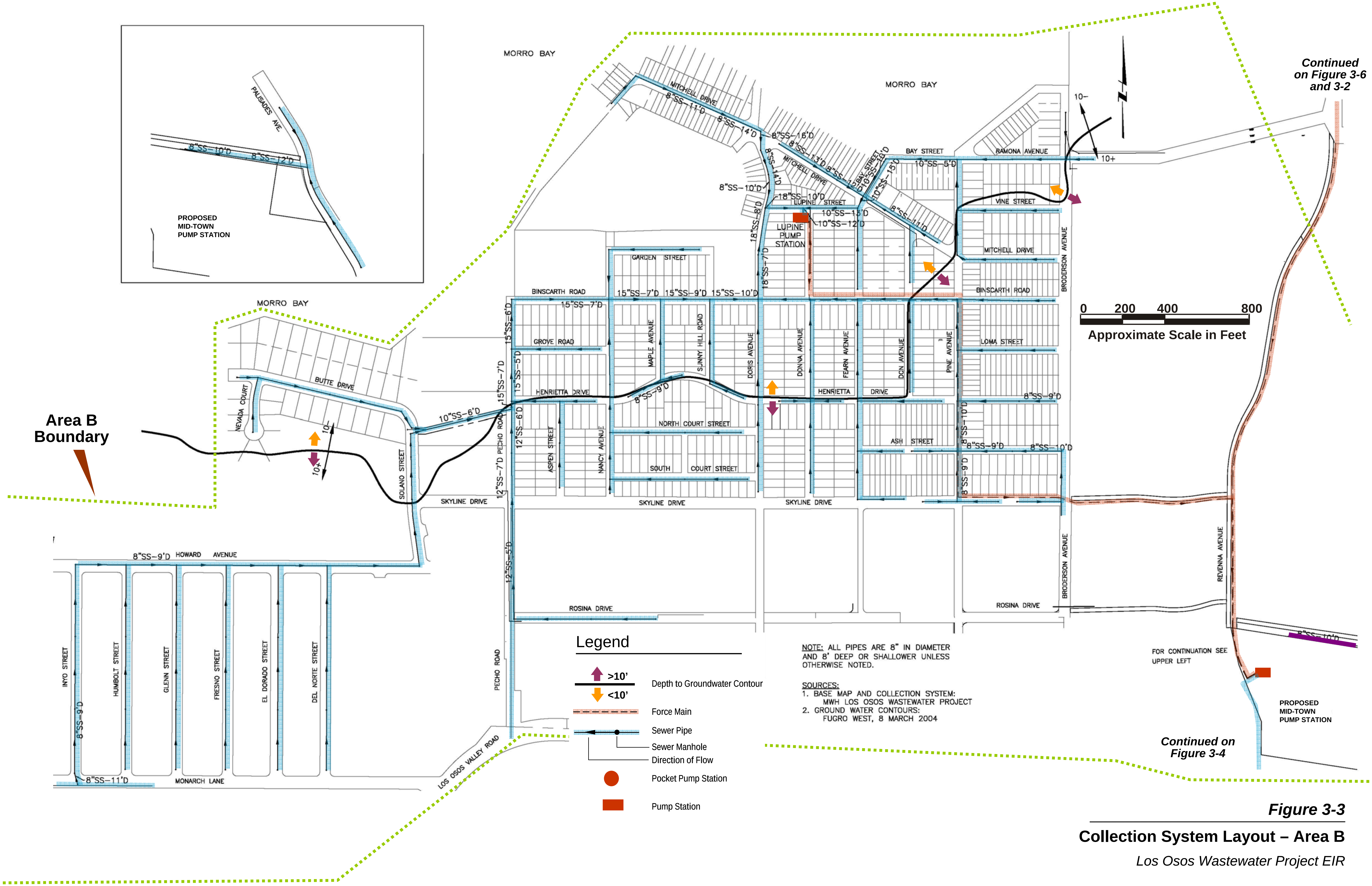


Figure 3-3

Collection System Layout – Area B

Los Osos Wastewater Project EIR

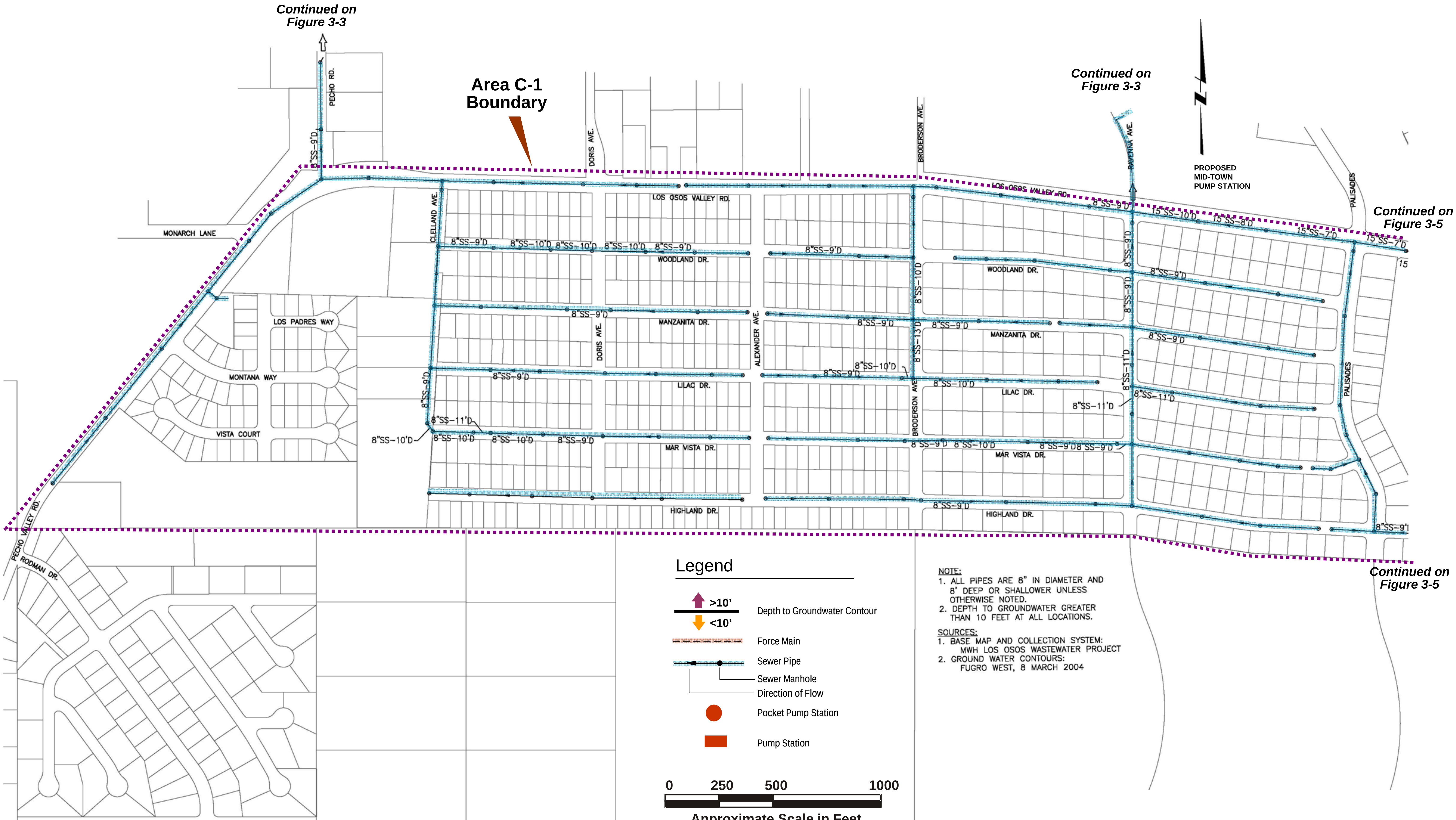


Figure 3-4

Collection System Layout – Area C-1

Los Osos Wastewater Project EIR

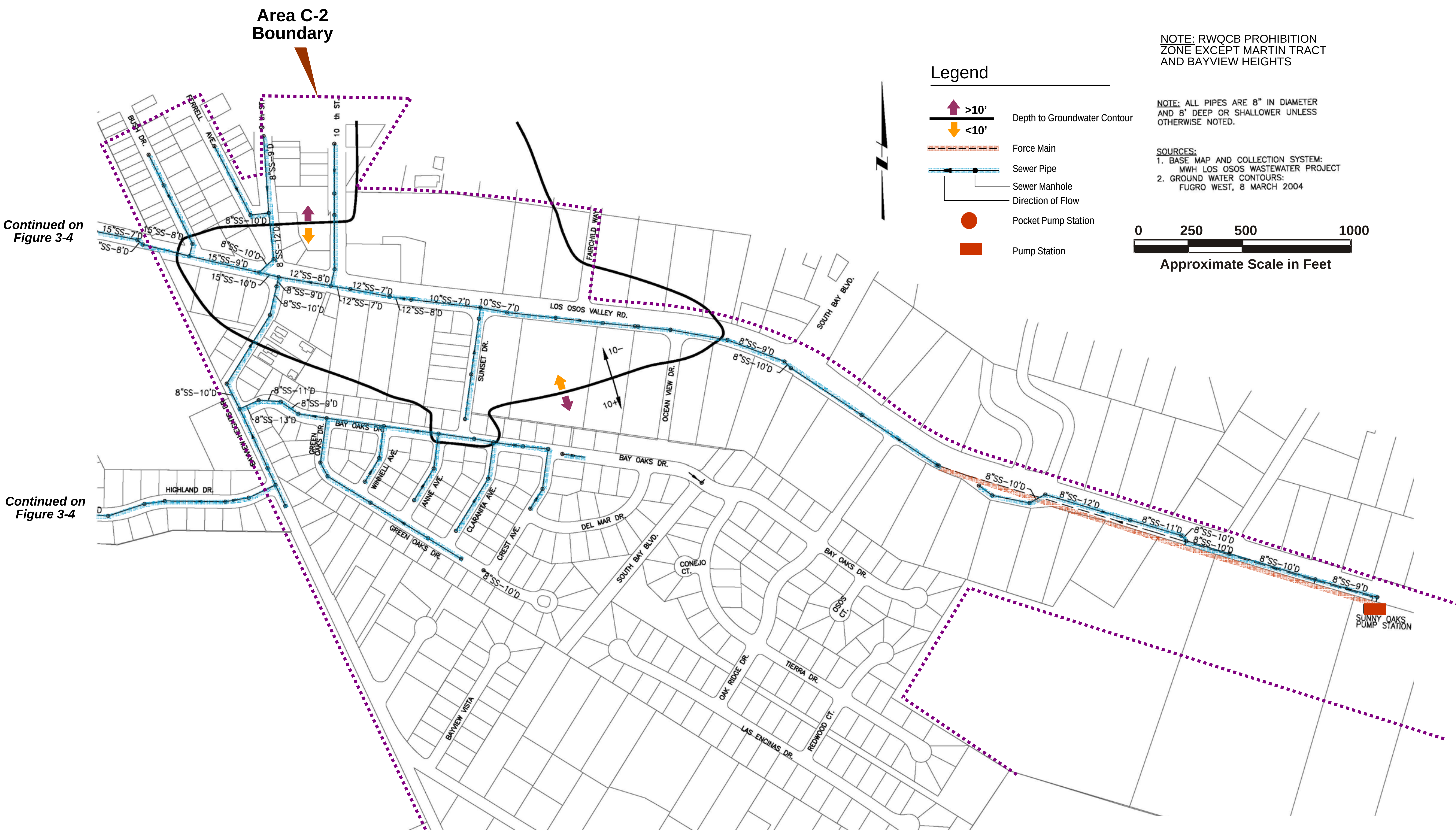


Figure 3-5

Collection System Layout – Area C-2

Los Osos Wastewater Project EIR

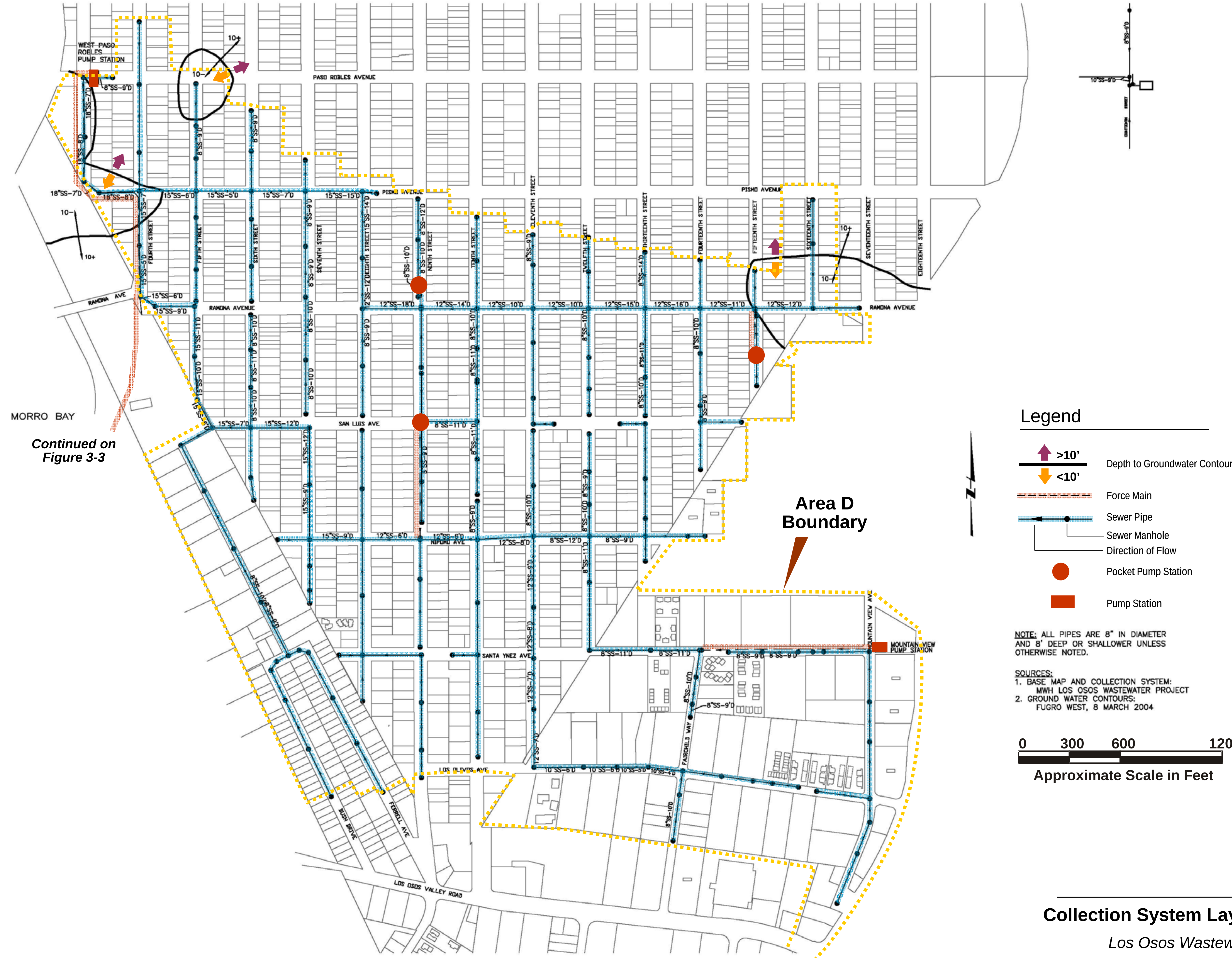
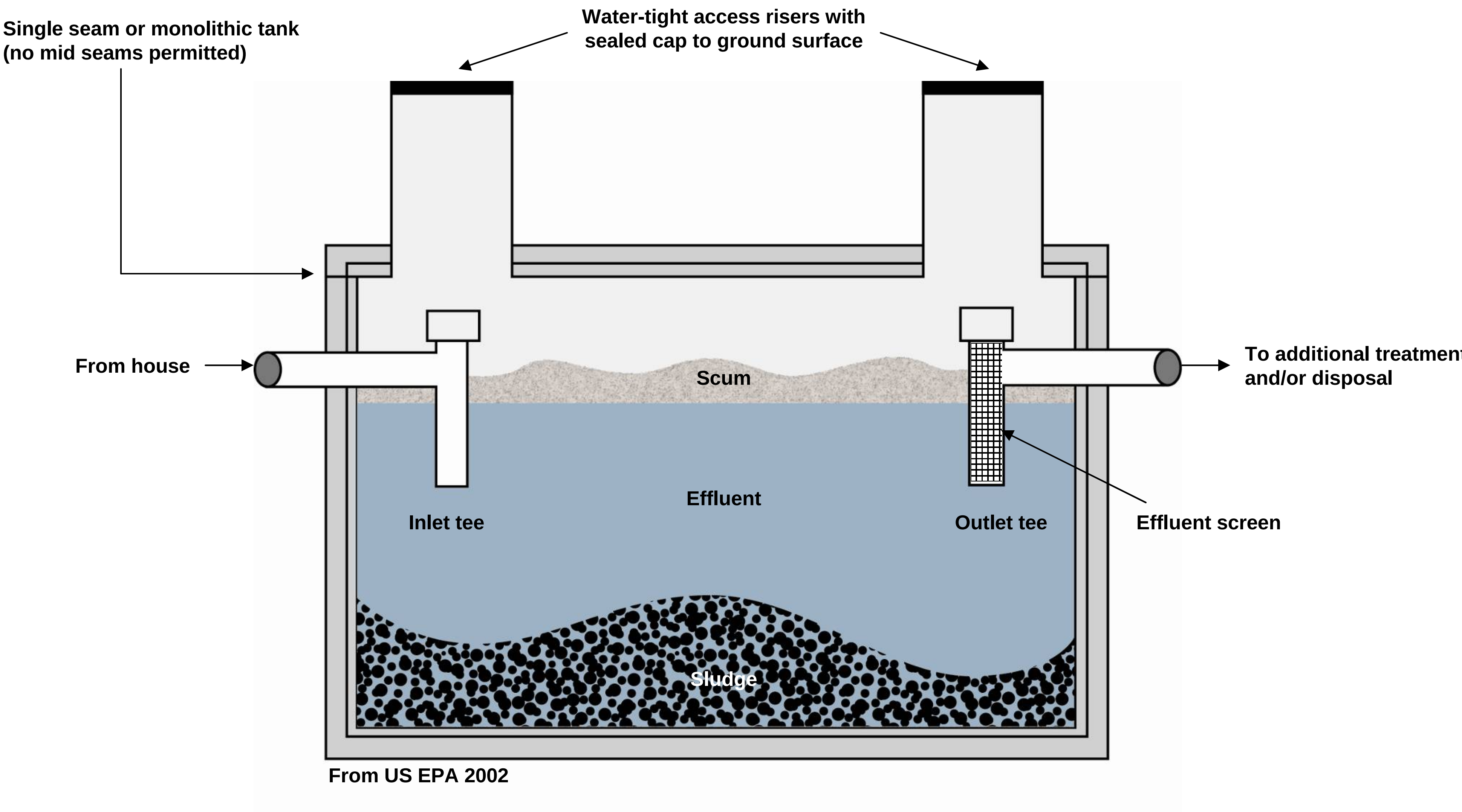


Figure 3-6

Collection System Layout – Area D

Los Osos Wastewater Project EIR



Note: Risers and effluent screen required by AB 885 that will be implemented in 2008

Figure 3-7

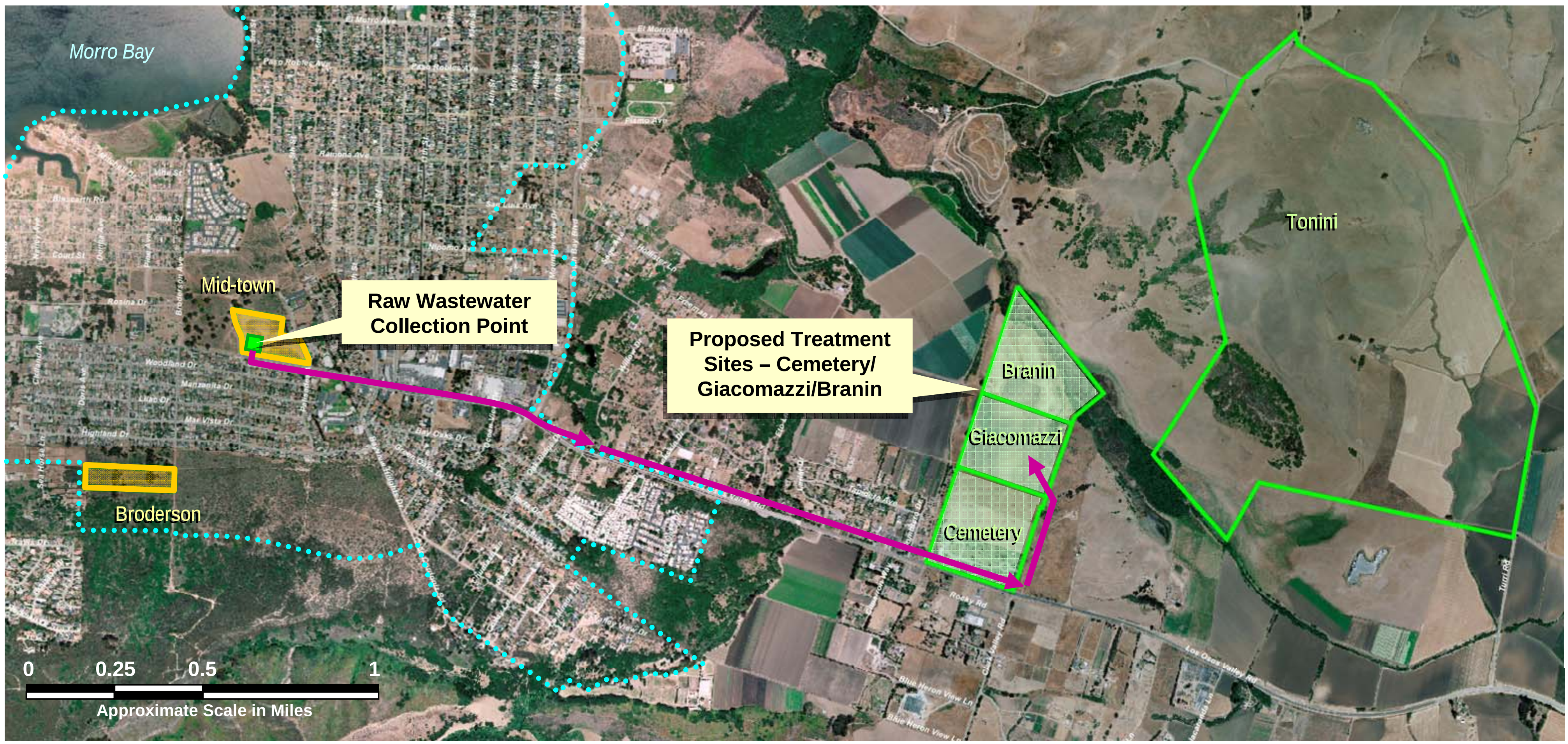
Modern Septic Tank

Los Osos Wastewater Project EIR

Figure 3-8

Typical Septic Tank Installations

Los Osos Wastewater Project EIR



Legend

- Property Boundary
- Service Area Boundary
- Raw Wastewater Conveyance to Treatment

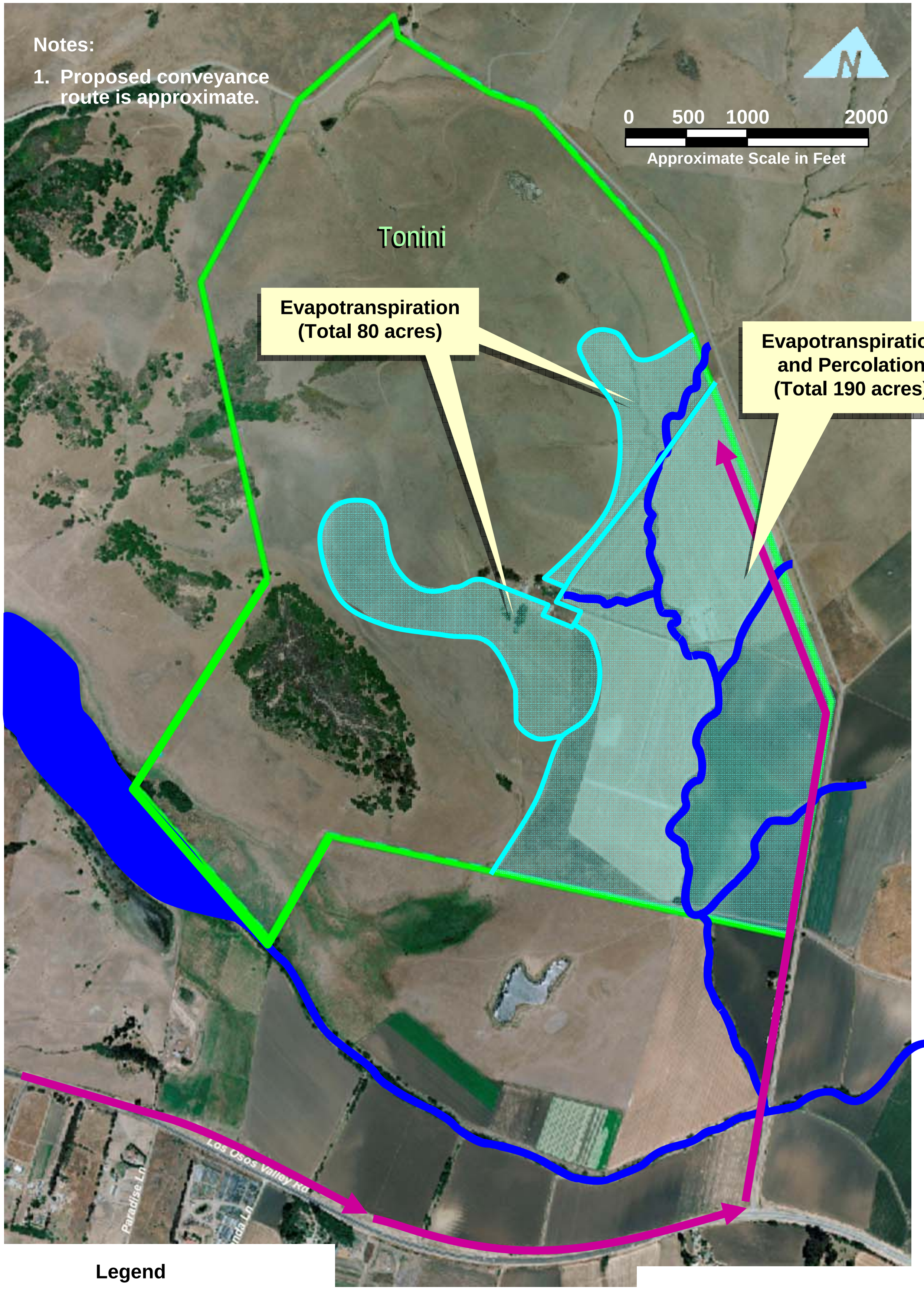
Notes:

1. Proposed conveyance routes are approximate.

Figure 4-1

Raw Wastewater Conveyance from Collection Point to Proposed Treatment Plant Site(s)

Los Osos Wastewater Project EIR

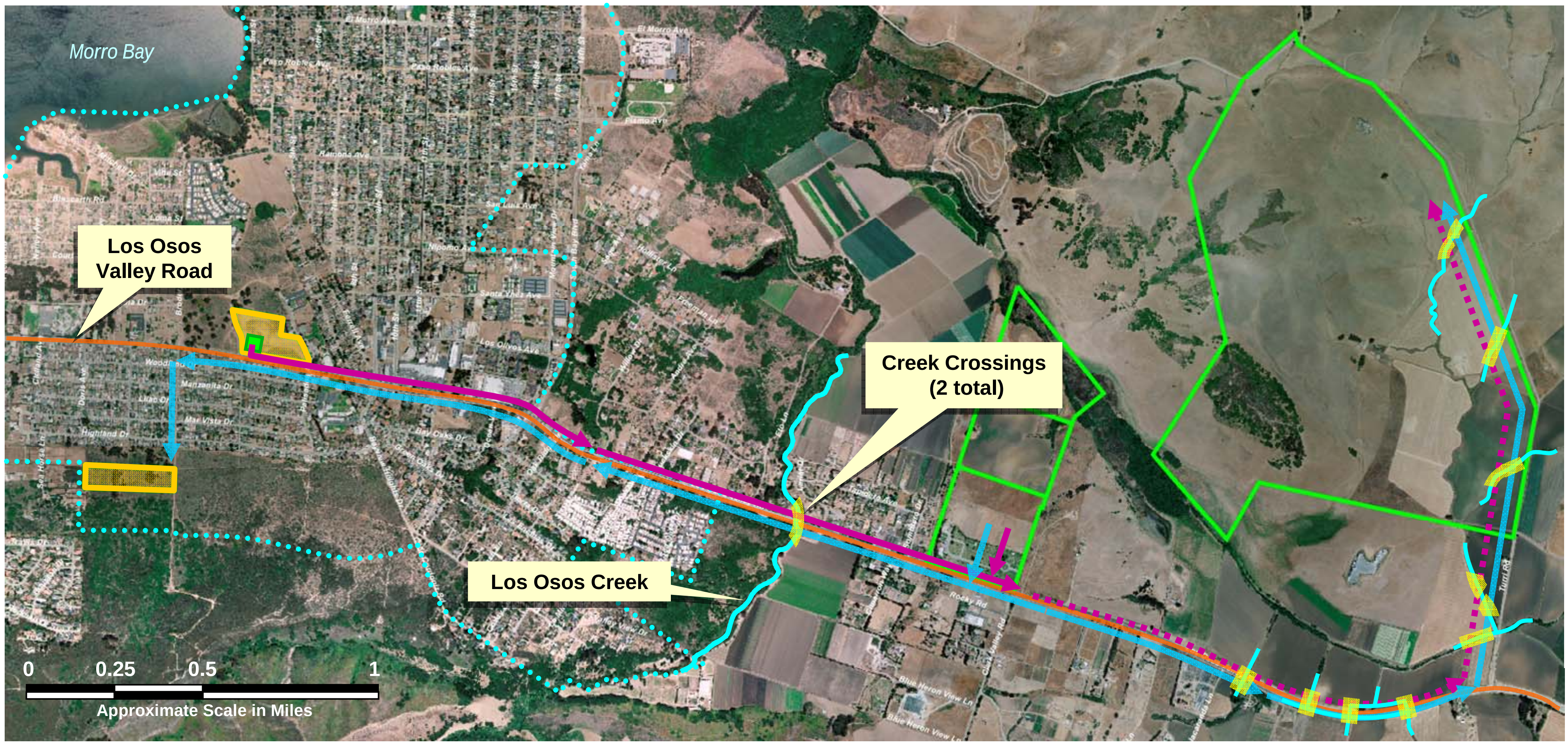


Legend

- Proposed Conveyance
- Property Boundary
- Spray Field
- Drainage Channel

Figure 4-2

Raw Wastewater Conveyance to Tonini Treatment Plant Site and Sprayfields



N

Legend

- Property Boundary
- Service Area Boundary
- Raw Wastewater Conveyance to Treatment, Alternatives 1-3
- Raw Wastewater Conveyance to Treatment, Alternative 4
- Effluent Conveyance to Disposal
- Drainage Crossings

Notes:

1. Proposed conveyance routes are approximate.

Figure 4-3

Location of Creek Crossings

Los Osos Wastewater Project EIR

N

Legend

- Property Boundary
- Service Area Boundary
- Effluent Conveyance to Disposal

Notes:

1. Proposed conveyance routes are approximate.

Figure 4-4

Conveyance of Effluent from Treatment Site to Broderson and Tonini for Proposed Projects 1-3

Los Osos Wastewater Project EIR

N

Legend

Property Boundary

Service Area Boundary

Effluent Conveyance to Disposal

Notes:

1. Proposed conveyance routes are approximate.

Figure 4-5

Conveyance of Effluent from Treatment Site to Broderson and Tonini for Proposed Project 4

Los Osos Wastewater Project EIR

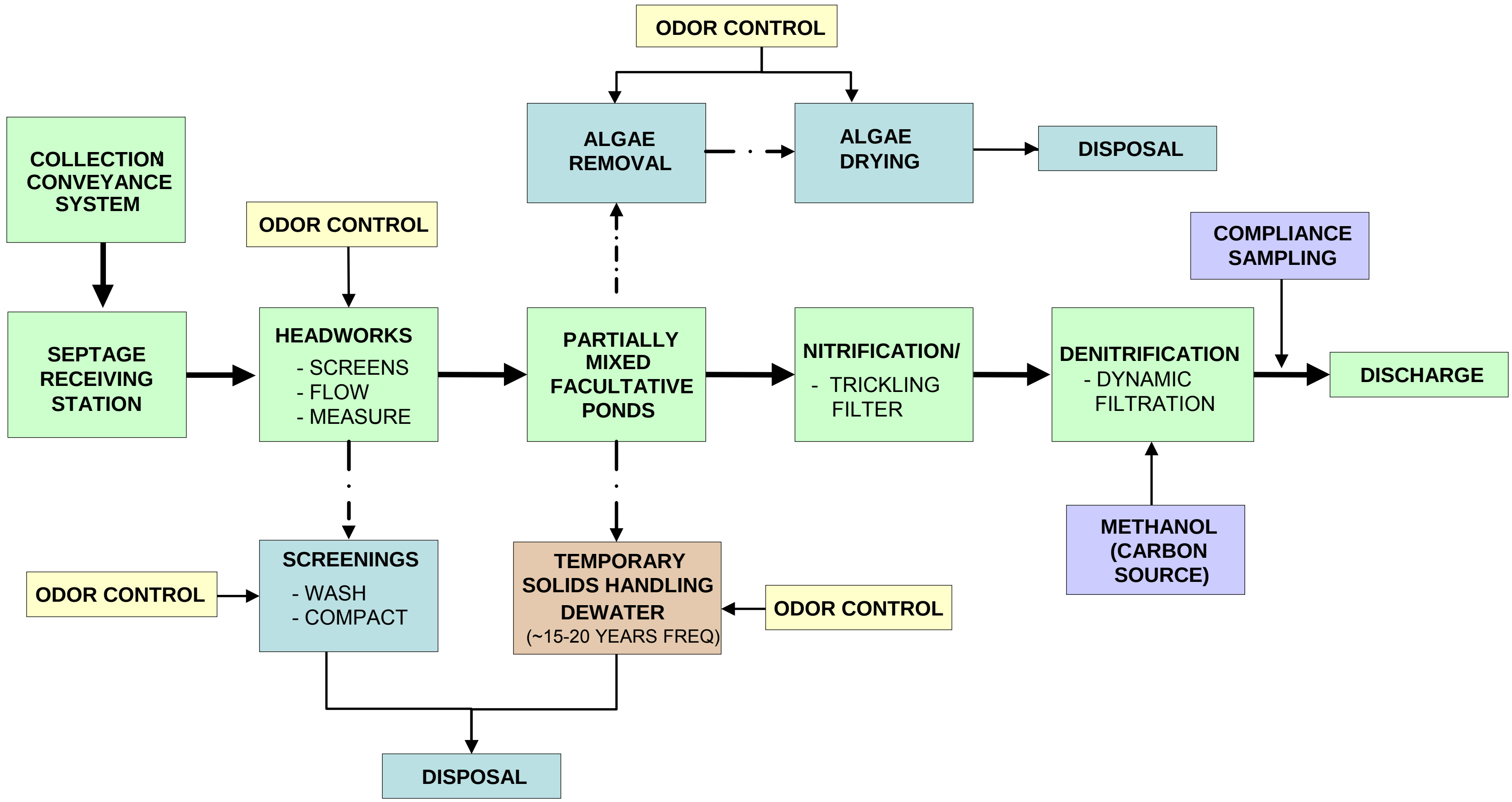


Figure 5-1

Partially-Mixed Facultative Ponds Conceptual Process Schematic

Los Osos Wastewater Project EIR

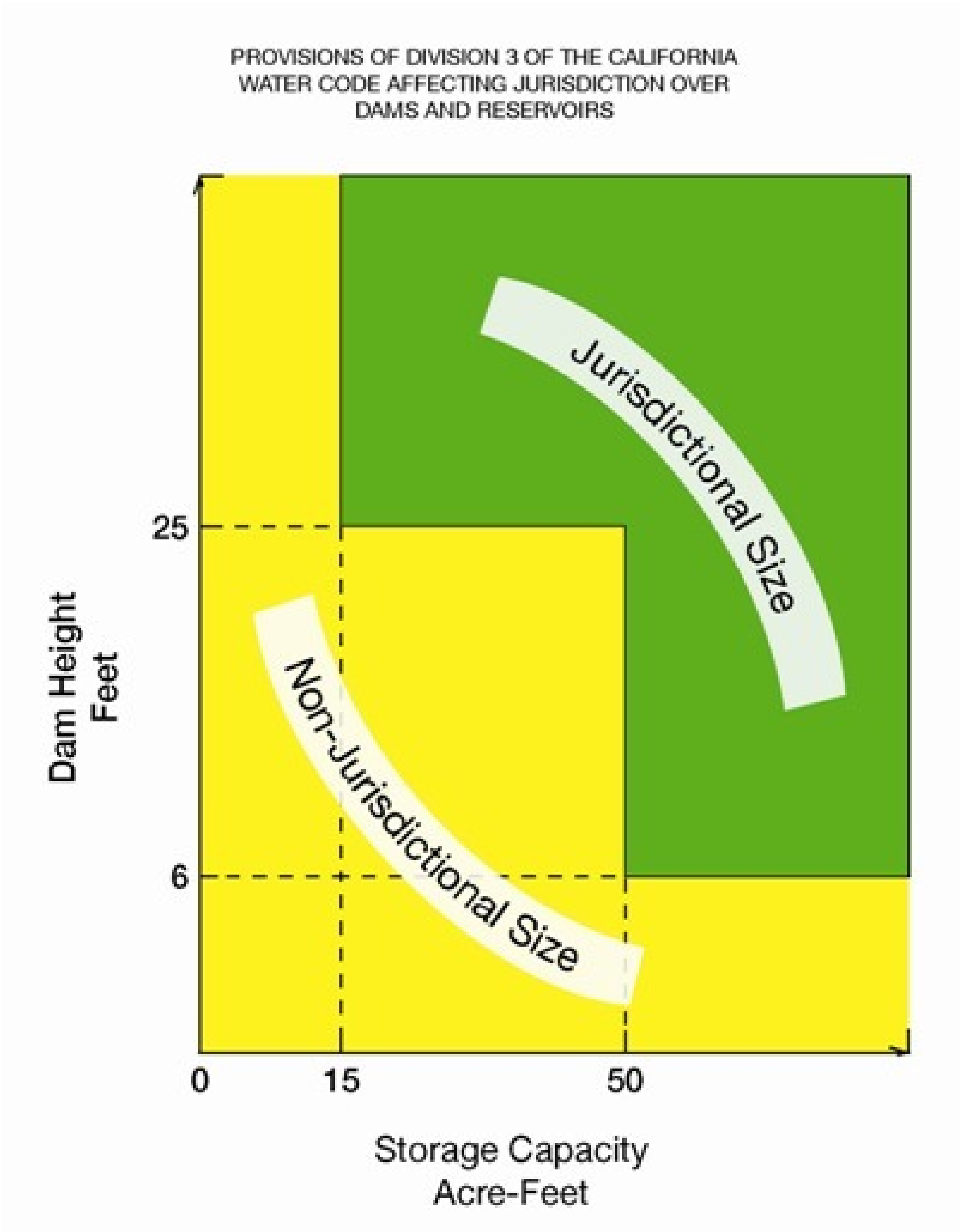


Figure 5-2

**Division of Safety of Dams –
Jurisdictional Size Chart**

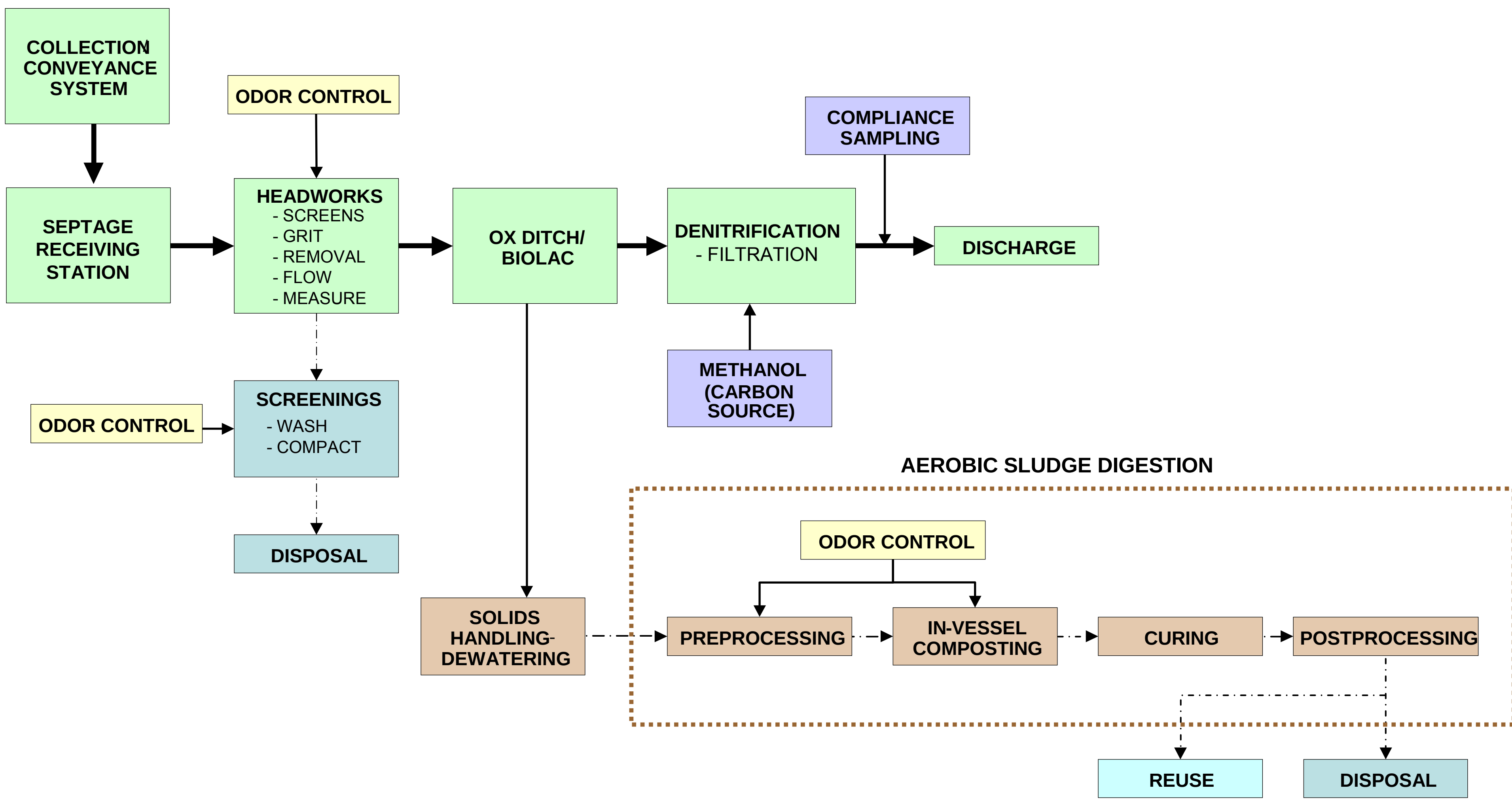
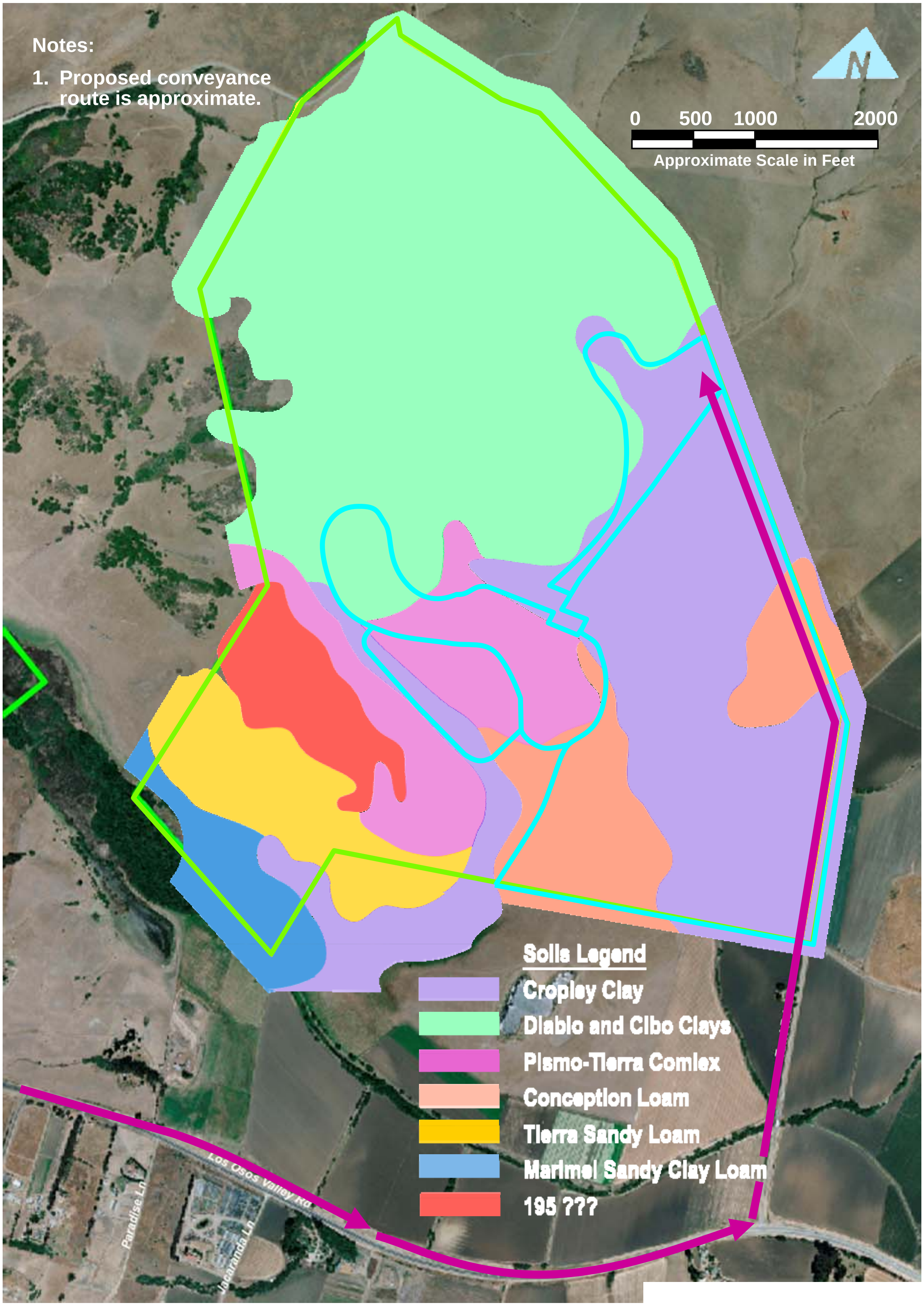


Figure 5-3

Oxidation Ditch/Biolac Conceptual Process Schematic

Los Osos Wastewater Project EIR



Legend

Proposed Conveyance

Property Boundary

Spray Field

Figure 7-1

Surface Soils at Tonini Site

Los Osos Wastewater Project EIR

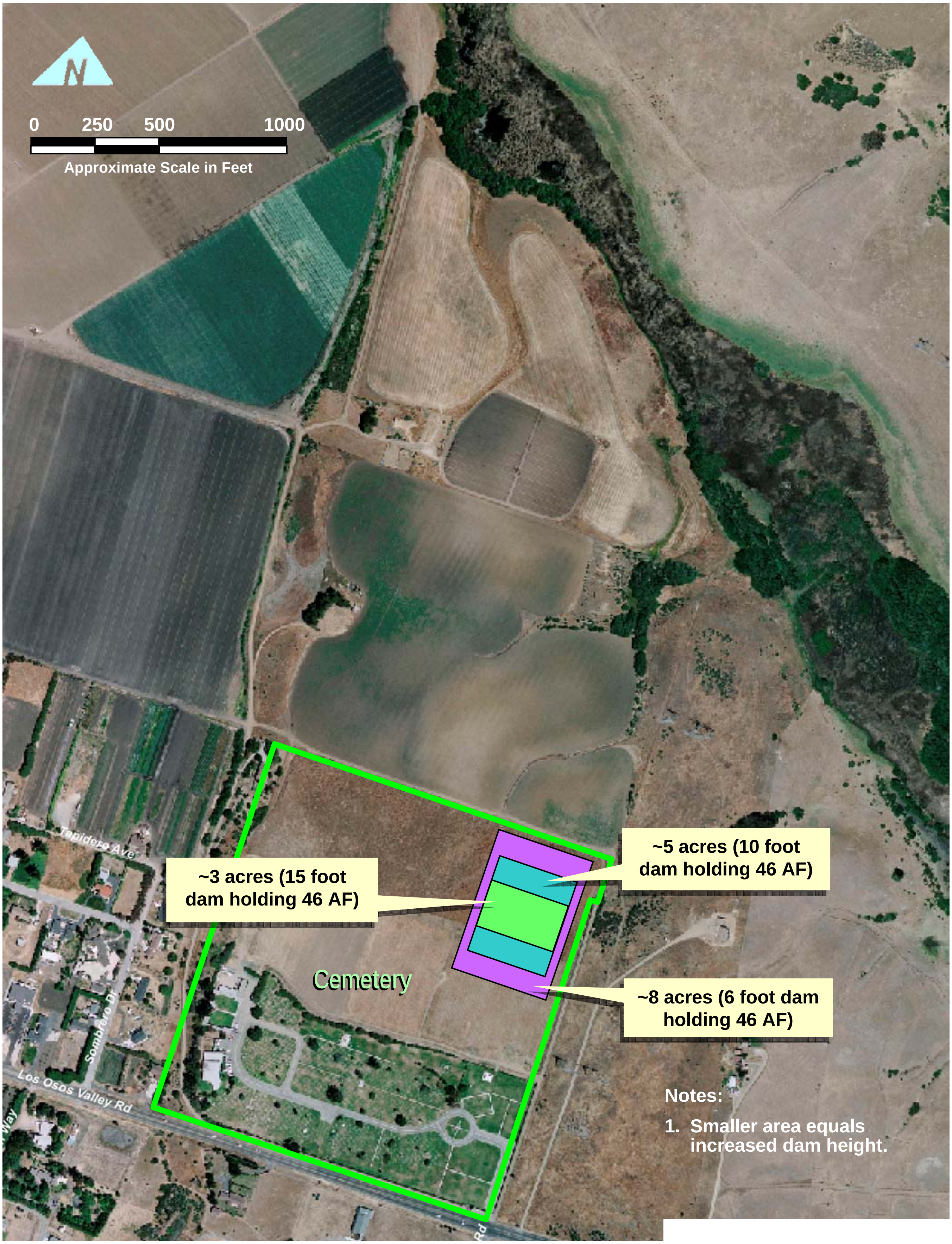


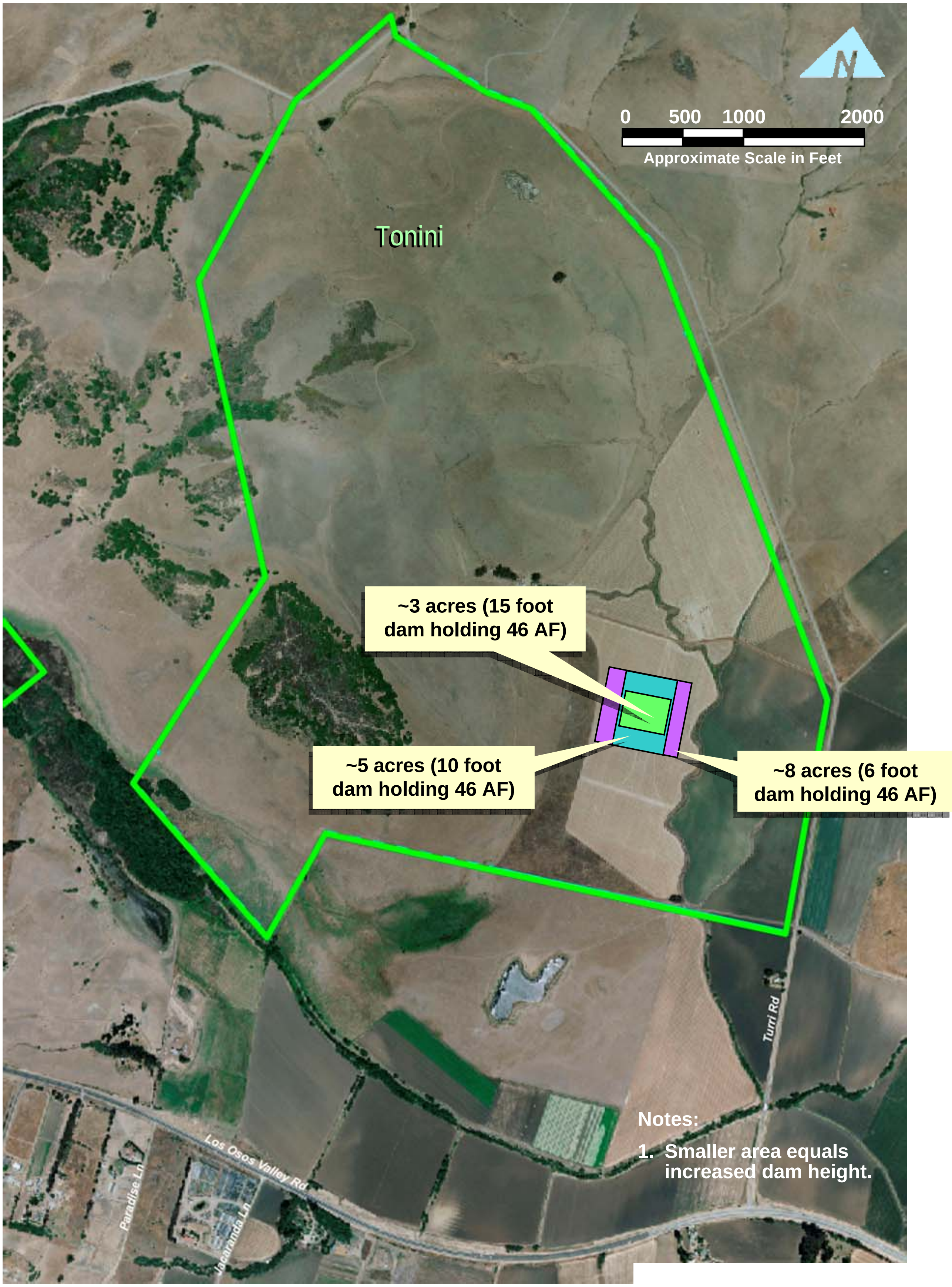
Figure 7-2

Alternative 1 - Possible Storage Pond Footprints on Cemetery

Legend

Property boundary

Los Osos Wastewater Project EIR

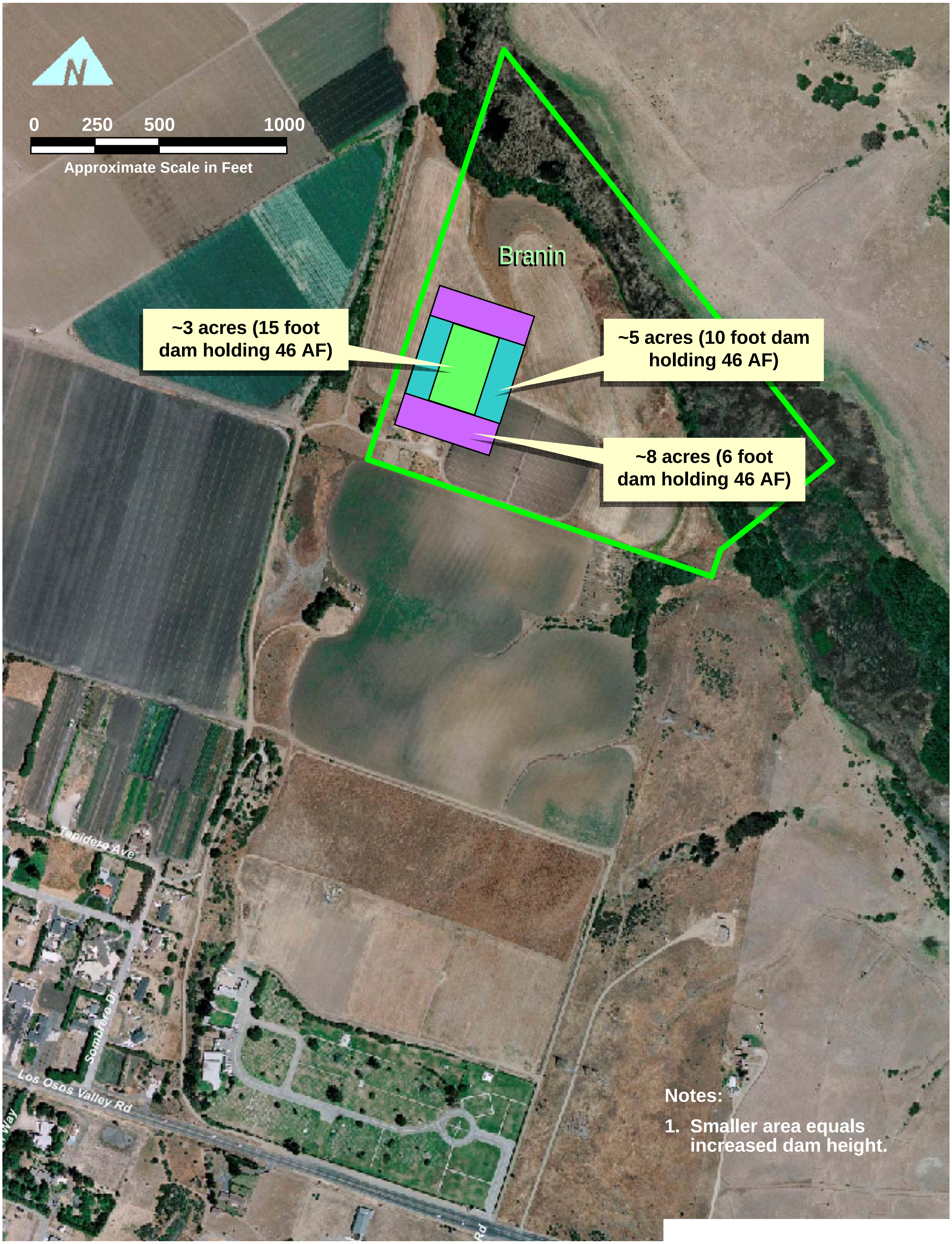


Legend

Property boundary

Figure 7-3

Alternatives 2 & 4 - Possible Storage Pond Footprints on Tonini



Legend

Property boundary

Figure 7-4

Alternative 3 - Possible Storage Pond Footprints on Branin

Los Osos Wastewater Project EIR