# Update to Los Olivos Wastewater System Preliminary Engineering Report

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# 1. Introduction

## 1.1 Purpose

The purpose of this update to Los Olivos Wastewater System Preliminary Engineering Report is to revise the recommendations for a community wastewater collection, treatment and disposal system for the downtown core, as well as other parcels in the Los Olivos Special Problem Area (SPA) shown in **Figure 1.1**.

Under the direction of the County, AECOM developed the Los Olivos Wastewater System Preliminary Engineering Report (PER) in 2013. The PER supported the effort to address and recommend long-term solutions for the wastewater disposal issues of the Los Olivos SPA. The document also explored wastewater collection, treatment, and disposal options and provided an evaluation of two types of collection systems, four treatment system options, and four effluent disposal alternatives, as summarized below:

**Collection, Treatment, and Disposal Systems Evaluated in PER**

| System | Options Evaluated in PER |
|---|---|
| Collection System | · Gravity<br>· Pressurized |
| Treatment System | · Extended Aeration Activated Sludge Modified Ludzak-Ettinger (MLE)<br>· Sequencing Batch Reactor (SBR)<br>· Membrane Bioreactor (MBR)<br>· AdvanTex |
| Effluent Disposal System | · Infiltration<br>· Subsurface disposal (leach fields)<br>· Agricultural Reuse - Undisinfected Secondary<br>· Agricultural Reuse - Disinfected Tertiary |

During the 2013 effort, AECOM evaluated a collection and treatment system to serve the “downtown commercial core” only (Phase I), the commercial core and selected adjacent residential parcels (Phase II) and the entire community (Phase III). The PER also provided preliminary evaluation criteria for siting a wastewater treatment plant (WWTP) and an Engineer’s Opinion of Construction Cost for a new WWTP, effluent disposal facilities, and collection system for each alternative.

## 1.2 Scope

At the request of the Los Olivos Steering Committee, the County requested AECOM to fine tune the PER and obtain construction, operation and maintenance (O&M) costs for a wastewater collection, treatment, and disposal system for Los Olivos.

This update provides the following revisions to the PER:

- Rather than following the tiered approach used in the PER, the update will analyze a system that will serve the entire SPA.
- The update will include the MBR treatment process only.
- The update will evaluate two effluent disposal methods, infiltration and nonpotable reuse (NPR).
- The update will include an analysis of a “no action alternative” i.e. what would it cost an individual homeowner to continue to use an OWTS under the approved Local Agency Management Program rather than construct and connect to a public sewer system including an O&M analysis of an appropriate onsite treatment technology.

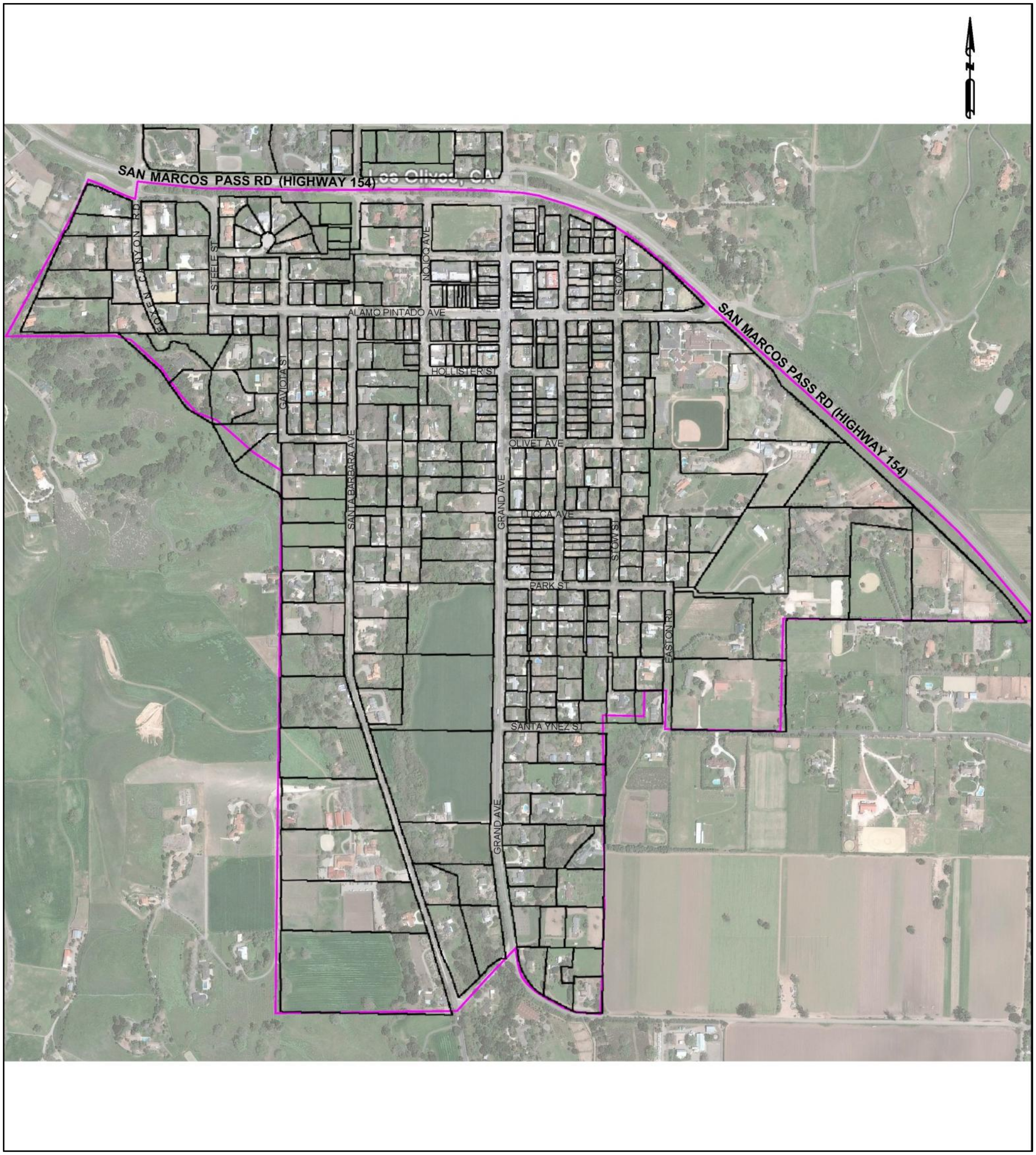


**Figure 1.1 Los Olivos Special Problem Area**

Sections of the PER which will be updated include:

- Collection System Evaluation and Cost (Section 5.7)
- MBR Evaluation and Cost (Sections 6.3.4 and 6.4.4)
- Effluent Disposal (Section 7)
- Engineer's Opinion of Cost (Section 9)

In addition to updating these sections, AECOM will also add a new section to provide analysis of a "no action alternative" to evaluate the cost for a homeowner to continue using an OWTS in accordance with current guidelines.

# 2. Basis of Design

## 2.1 Study Service Area

The service area for the wastewater collection system remains identical to what was presented as Phase III in the PER, including approximately 418 parcels with 340 located in the township of Los Olivos. The PER identifies 400 existing residential units in Los Olivos and 228,990 square feet (sf) of developed commercial area[1]. An additional 120,539 sf of commercial is included in this Basis of Design (BOD) to account for the 20-year (yr) buildout[1] of additional commercial area assumed in the Santa Ynez Valley 2009 Community Plan Environmental Impact Report (2009 EIR). Many of the commercial businesses are located in the downtown area and consist of restaurants, hotels, wine tasting rooms and retail shops that support the high volume of tourism the town experiences.

The service area is presented in Figure 1.1. The total acreage of service area is approximately 536 acres[2].

## 2.2 Population Projection (20 years)

The PER estimated a population of 1,000 residents in the Los Olivos community. However, the results of the 2010 United States Census Bureau (USCB) reported that Los Olivos has a population of 1,132[3]. This BOD will use the USCB data. Based on information presented in the Santa Barbara County Regional Growth Forecast, the unincorporated areas of the County are projected to experience an average population growth rate of 0.49% between 2015 and 2040. Assuming this growth rate for the Los Olivos SPA between 2010 and 2016, the current population is 1,166. The total population in 20 years (2036) would be 1,286 based on a constant growth rate model.

Weekends see an influx of visitors that can increase the population by up to 200%. These visitors include guests at the local hotels and patrons to the local retail stores, wine tasting rooms, and restaurants.

## 2.3 Projected Average, Maximum Month, Maximum Day, and Peak Flows

Estimates for average and peak flow conditions used in the PER were based on data provided in the Los Olivos Wastewater Management Plan (LOWMMP) and the 2009 EIR. Flow projections in the LOWMMP were developed based on assumed septic tank volumes and a percentage of anticipated potable water usage. Based on this method, a maximum daily flow (MDF) of 323,000 gallons per day (gpd) and average annual daily flow (AADF) of 180,000 gpd was determined. The 2009 EIR estimated residential wastewater flows assuming a factor of 215 gpd per connection. According to the Land Use Element of the Santa Barbara County Comprehensive General Plan[4], the approximate household size for urban areas with one unit per acre in the Los Alamos-Garey-Sisquoc area is 3.0 residents per household. Assuming a similar dwelling size for Los Olivos, the resulting per capita wastewater generation factor is 72 gpd. This factor is consistent with typical residential wastewater generation in the Central Coast of California. Commercial wastewater flows were estimated using a factor of 0.056 gpd per square foot of commercially-developed area. **Table 2.1** summarizes the AADF wastewater flow estimates from the PER revised using a 20-yr buildout of commercial properties. The average day maximum month flow (ADMMF) is summarized in **Table 2.2**, maximum daily flow (MDF) in **Table 2.3**, and peak hour flow (PHF) in **Table 2.4**.

Wastewater calculations for the Los Olivos study area were more recently estimated by Stantec in April 2015. Stantec's estimates were based on water use data (when available) provided by the local water

[1] Santa Ynez Valley Community Plan Environmental Impact Report (County of Santa Barbara, September 2009)

[2] PER

[3] 2010 US Census (http://www.census.gov/2010census/popmap/ipmtext.php?fl=06:0644168)

[4] County of Santa Barbara Comprehensive General Plan Land Use Element (Republished May 2010)

purveyor, the Santa Ynez River Water Conservation District. Water use and irrigation factors were applied to the metered water usage data to estimate wastewater flows. For areas of the special problems district that had no water use data, an assumption of water consumption was used. Estimates were only developed for the Phase II existing and build-out commercial and select residential properties. Flows for the remaining Phase III residential properties are not included in the calculations. However, the residential water use factor of 268.7 gpd per connection and 0.042 gpd per square foot of commercial estimated in Stantec's report can be used to calculate the total Phase III (remaining 389 residences and commercial buildout) wastewater flows. **Table 2.1** below summarizes the AADF wastewater flow from Stantec's analysis. The ADMMF is summarized in **Table 2.2**, MDF in **Table 2.3**, and PHF in **Table 2.4**.

Los Alamos is a community located approximately 11 miles northeast of Los Olivos. The community of Los Alamos has a similar mix of residential and commercial properties. In 2012 the population of Los Alamos was 1,800 and the AADF was 122,460 gpd. According to the Los Alamos Community Services District Wastewater Collection and Treatment Planning Study (Bethel Engineering, April 2012), the average residential flow is estimated to be 180 gpd per connection and commercial flow is estimated at 60 gpd per 1,000 $ft^2$. Due to the similarities between the two communities, Los Alamos's data will be used to generate a comparative wastewater flow estimate for Los Olivos. **Table 2.1** below summarizes the AADF wastewater flow from the Los Alamos data. The ADMMF is summarized in **Table 2.2**, MDF in **Table 2.3**, and PHF in **Table 2.4**.

This update uses the same flow factors as the PER.

**Table 2.1 Projected Average Annual Flows**

| | Residential | | | Commercial (20-yr Buildout) | | | |
|---|---|---|---|---|---|---|---|
| | **Total Connections** | **Factor (gpd/ connection)** | **AADF (gpd)** | **Total Area ($ft^2$)** | **Factor ($gpd/ft^2$)** | **AADF (gpd)** | **Total (gpd)** |
| PER | 400 | 215 | 86,000 | 349,529 | 0.056 | 19,574 | 105,574 |
| Stantec Report | 400 | 269 | 107,600 | 349,529 | 0.042 | 14,680 | 122,280 |
| Los Alamos Comparison | 400 | 180 | 72,000 | 349,529 | 0.060 | 20,972 | 92,972 |
| Composite | 400 | 221 | 88,400 | 349,529 | 0.053 | 18,409 | 106,942 |

**Table 2.2 Projected Average Daily Maximum Month Flows**

| | AADF (gpd) | | | | ADMMF (gpd) | | |
|---|---|---|---|---|---|---|---|
| | **Residential** | **Commercial** | **Total** | **AADF: ADMMF Factor** | **Residential** | **Commercial** | **Total** |
| PER | 86,000 | 19,574 | 105,574 | 1.1 | 94,600 | 21,531 | 116,131 |
| Stantec Report | 107,600 | 14,680 | 122,280 | 1.1 | 118,360 | 16,148 | 134,508 |
| Los Alamos Comparison | 72,000 | 20,972 | 92,972 | 1.1 | 79,200 | 23,069 | 102,269 |
| Composite | 88,400 | 18,409 | 106,942 | 1.1 | 97,387 | 20,249 | 117,636 |

**Table 2.3 Projected Maximum Day Flows**

| | AADF (gpd) | | | | MDF (gpd) | | |
|---|---|---|---|---|---|---|---|
| | Residential | Commercial | Total | AADF:MDF Factor | Residential | Commercial | Total |
| PER | 86,000 | 19,574 | 105,574 | 3.2 | 275,200 | 62,636 | 337,836 |
| Stantec Report | 107,600 | 14,680 | 122,280 | 3.2 | 344,320 | 46,977 | 391,297 |
| Los Alamos Comparison | 72,000 | 20,972 | 92,972 | 3.2 | 230,400 | 67,110 | 297,510 |
| Composite | 88,533 | 18,409 | 106,942 | 3.2 | 283,307 | 58,907 | 342,214 |

**Table 2.4 Projected Peak Hour Flows**

| | AADF (gpd) | | | | PHF (gpd) | | |
|---|---|---|---|---|---|---|---|
| | Residential | Commercial | Total | AADF:PHF Factor | Residential | Commercial | Total |
| PER | 86,000 | 19,574 | 105,574 | 4.5 | 387,000 | 88,081 | 475,081 |
| Stantec Report | 107,600 | 14,680 | 122,280 | 4.5 | 484,200 | 66,061 | 550,261 |
| Los Alamos Comparison | 72,000 | 20,972 | 92,972 | 4.5 | 324,000 | 94,373 | 418,373 |
| Composite | 88,533 | 18,409 | 106,942 | 4.5 | 398,400 | 82,838 | 481,238 |

Per the above tables, a composite flow using data from three different sources was generated. These composite flows are summarized in **Table 2.5**. The composite flows will be utilized going forward for sizing of collection and treatment facilities.

**Table 2.5 Composite Flows**

| AADF (gpd) | ADMMF (gpd) | MDF (gpd) | PHF (gpd) |
|---|---|---|---|
| 107,000 | 118,000 | 342,000 | 481,000 |

## 2.4 Sewer and Pump Station Preliminary Sizing and Layout

The PER recommends a gravity-type collection system to take advantage of the generally south-sloping topography of the area. The PER estimated that collection pipes will likely range from 8-inches to 15-inches in diameter, to accommodate commercial and residential build-out flows. The revisions to the flow estimates do not affect this assumption.

The PER provides design information for a single lift station as part of the Southern Route. Revisions to the flow estimates allow us to reduce the flow capacity of the station from 94 gallons per minute (gpm) to 80 gpm. The size of the force main can be reduced from 4-inches in diameter to 3-inches in diameter to maintain adequate velocity in the force main.

## 2.5 Wastewater Treatment Plant Sizing

The selected MBR treatment train will be sized to treat the ADMMF of 118,000 gpd. The sequence of installation for the membrane treatment trains and operations will be the same as outlined in the PER. A 300,000 gallon equalization tank or basin should be installed to smooth the spikes in flow during peak tourism days.

### 2.6 Land Requirements

Per the PER, the land requirement for the MBR treatment facility is estimated to be 0.30 acres. This assumption is not changing. A 300,000 gallon equalization tank or basin will add an additional 0.20 acres.

The PER assumes a total of 24-acres of infiltration basins (with an associated land requirement of 40 acres) would be needed for disposal of wastewater effluent. However, this sizing was based on a very conservative 0.20 inches/day infiltration rate. Research performed with the United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey found many areas to the north and southeast of Los Olivos with significantly higher infiltration rates. These areas have infiltration rates that range from 1.44 inches/day to 13.5 inches/day. Using the lower end of this range, the area required for the infiltration basins can be reduced to 5 acres.

### 2.7 Current Number of On-Site Wastewater Systems

According to the 2014 Onsite Wastewater Treatment Systems Local Agency Management Program (LAMP), there are approximately 343 septic systems within the Los Olivos specials problems district.

# 3. Treatment Alternatives Evaluation

This section of the report describes the recommended membrane bioreactor (MBR) wastewater treatment system components, approximate cost of the treatment plant and provides comparison to continuing on-site treatment by retrofitting existing septic systems.

## 3.1 Membrane Bioreactor Wastewater Treatment System

**Table 3.1** indicates the wastewater flow and characteristics used for sizing of the wastewater treatment plant (WWTP).

The WWTP is designed around MBR technology. In order to develop preliminary cost estimates for the wastewater treatment system the following equipment manufacturers presented in **Table 3.2** were consulted.

**Table 3.1 Basis of Design**

| | |
|---|---|
| Average Annual Daily Flow (gpd) | 107,000 |
| Average Day Maximum Month Flow (gpd) | 118,000 |
| Maximum Daily Flow (gpd) | 342,000 |
| Peak Hour Flow (gpd) | 481,000 |
| BOD | |
| (mg/L) | 435 |
| pounds per day (ppd) | 575 |
| TSS | |
| (mg/L) | 330 |
| (ppd) | 435 |
| TKN | |
| (mg/L) | 65 |
| (ppd) | 85 |

**Table 3.2 Basis for Evaluated Equipment Costs**

| Process | Manufacturer/Model |
|---|---|
| Screen & Grit | Roto Sieve Model RS-24 Screen |
| MBR Equipment | Econity |
| UV Disinfection Equipment | TrojanUVFit™ 18AL40 Reactor |

The following is a brief description of the equipment and processes selected for the WWTP.

### 3.1.1 Screen/Grit Facility

Screen and grit facility will be provided to prevent large particles from getting carried into the downstream treatment process. The screen opening will be 0.2 mm and sized to protect the membrane elements of the MBR. Two Rotosieve Model RS-24 screens, (one duty, one standby) will be provided. Compaction and bagging of the screenings will be included. Screenings will require disposal at a qualified landfill facility.

### 3.1.2 Wastewater Equalization Tank

The wastewater equalization tank will be sized at 300,000 gallons. The equalization tank will be a concrete tank and include a flat aluminum roof. The aluminum roof is provided to reduce the spread of odorous compounds into the atmosphere. Design of the tank will include odor control and internal wash down systems.

### 3.1.3 MBR Equipment

The MBR process consists of activated sludge reactors (aeration basins) that use membrane filtration for solids separation. Membrane filtration is a solids separation process which utilizes polymeric filtration media with small pore sizes ranging from 0.04 (hollow fiber) to 0.4 microns (flat sheet) to sieve and separate solids from the treated effluent. These systems are used to replace the secondary clarification and filtration steps normally associated with the activated sludge process. Without the limitations set by solids flux in conventional secondary clarification, the mixed liquor suspended solids (MLSS) concentration can be as high as 8,000 mg/L in the aeration basins and 10,000 mg/L in the membrane tanks, which is much higher than conventional suspended growth processes. The higher MLSS concentration and the elimination of secondary clarifiers reduce the footprint of the overall MBR process. A MBR also produces a higher-quality effluent compared to that produced by secondary clarification paired with tertiary filtration.

The biological process for an MBR system is controlled similarly to conventional activated sludge, where the solids retention time (SRT) is adjusted to achieve the desired removal efficiencies and sludge characteristics. **Figure 3.1** provides an illustration of the process.

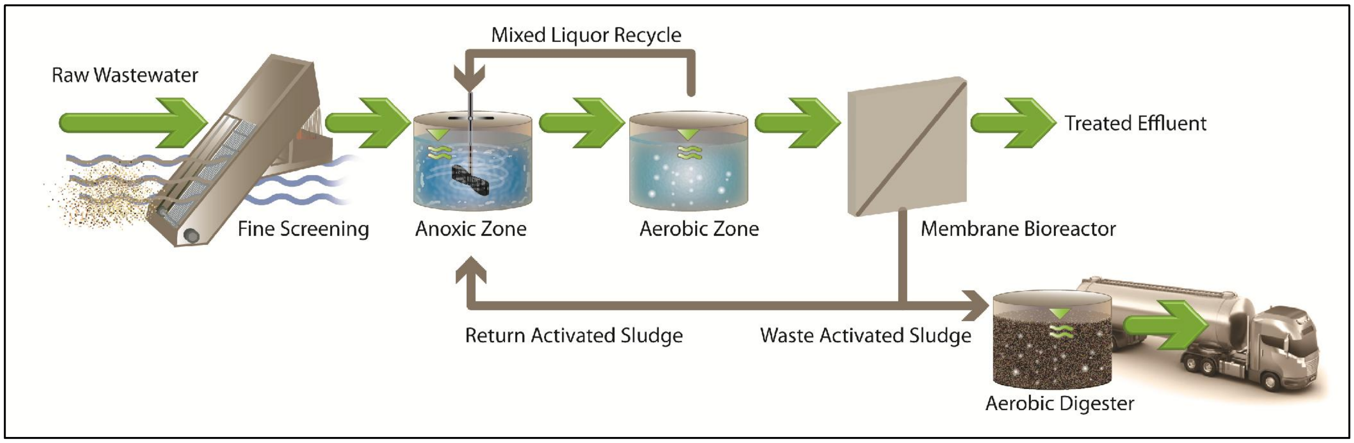


**Figure 3.1 Typical MBR System Flow Schematic**

For the Los Olivos WWTP, two biological treatment trains followed by two membrane trains would be constructed. Each biological treatment train will consist of pre-anoxic, aerobic, and post-anoxic zones. The anoxic zone is required to achieve denitrification. The post-anoxic zone is required to minimize the amount of dissolved air that is recycled to the pre-anoxic zone that could inhibit the denitrification process. **Figure 3.2** shows the simplified flow scheme of the MBR system proposed for Los Olivos.

The membrane system will be designed using hollow fiber membrane with pore sizes of 0.1 micron. Pertinent design features of the MBR system is provided in **Table 3.3**.

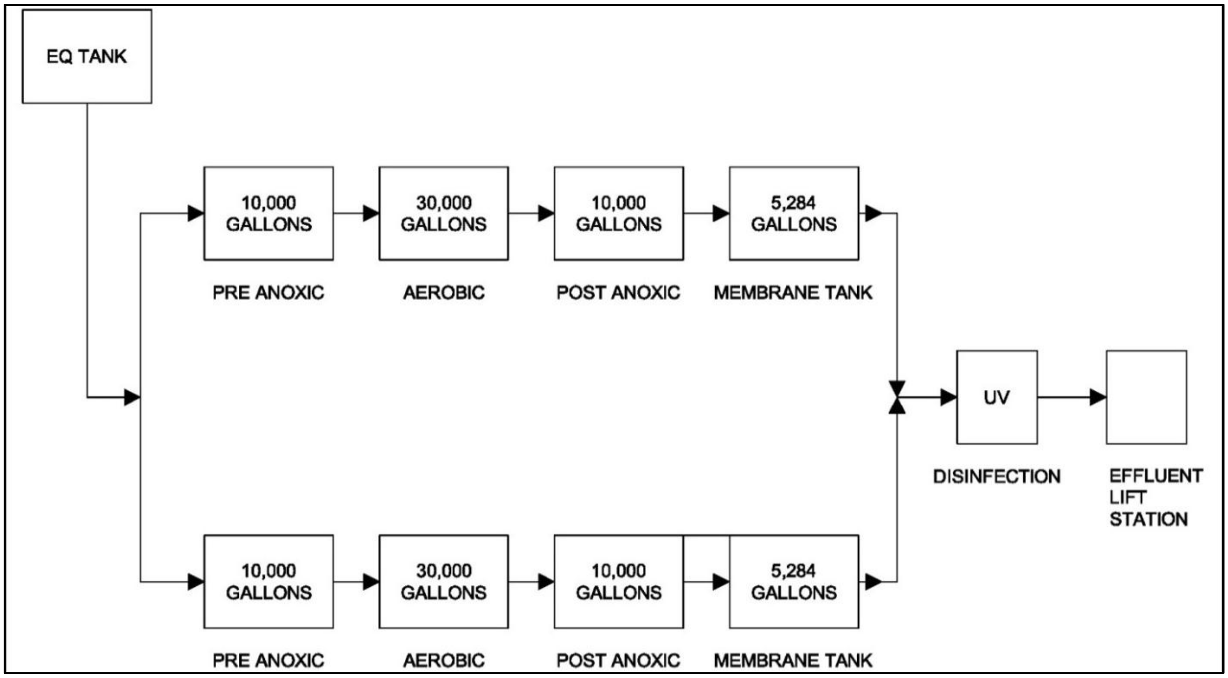


**Figure 3.2 MBR Flow Scheme**

### Table 3.3 Pertinent Design Features of the MBR System

| Membrane Bioreactor (MBR) | Capacity |
|---|---|
| Total Design Capacity (gpd) | 118,000 |
| Number of Treatment Units | 2 |
| Pre-Anoxic Zone | |
| Volume per Train (gal) | 10,000 |
| Total Volume (gal) | 20,000 |
| Aerobic Zone | |
| Volume per Train (gal) | 30,000 |
| Membrane Tank Volume (gal) | 5,284 |
| Total Volume (gal) | 70,568 |
| Post-Anoxic Zone | |
| Volume per Train (gal) | 10,000 |
| Total Volume (gal) | 20,000 |
| Hydraulic Retention Time (hours) | 22.4 |
| Solids Retention Time (days) | 15 - 30 |
| MLSS Aeration Basins, max (mg/L) | 8,000 |
| MLSS Membrane Tanks, max (mg/L) | 10,000 |
| F:M (lb BOD/lb MLSS x day) | 0.05 – 0.25 |
| Trains per Unit | 1 |
| Total Trains | 2 |
| Cassettes per Train | 3 |
| Total Cassettes | 6 |
| Modules per Cassette | 24 |
| Total Modules | 144 |
| Total Membrane Area (sf) | 32,544 |
| Flux at MDF (gallons/sf/day) | 10.51 |
| Flux at PHF (gallons/sf/day) | 14.8 |

The system will be configured in two trains as shown in **Figure 3.2**. Each train will have three cassettes of membranes. A cassette is a frame which holds several membrane cartridges. For Los Olivos each cassette will hold 24 membrane cartridges. Typical arrangement of cartridges in a cassette is shown in Figure 3.3. The total number of cartridges for the two trains will be 144. The total surface area for one membrane cartridge will be 226 sq. ft. The total membrane surface area will be 32,544 sq. ft.

### 3.1.4 System Controls

Process control and alarm notification will be provided through a preprogrammed PLC-based control system, fully factory pre-wired and installed in a NEMA 12 panel. The control panel will be housed in a container and will be installed at site. A human machine interface (HMI) touchscreen will allow the operator to control and monitor the complete system operation through operator inputs within preset limits.

### 3.1.5 Motor Control

Starters for the blowers and pumps, soft starts, variable frequency drives (VFDs), and power transformers will be housed in a NEMA 12 panel. The starters and VFD drives will be installed indoors.

### 3.1.6 UV Disinfection

Three 18AL40 Trojan UV units will be provided. Two of the units working in parallel will provide treatment at peak flow. The third unit will remain on standby. Should one UV unit fail, the standby unit will be brought on line. Each UV units will have 18 lamps each at 250 watts.

### 3.1.7 Sludge Disposal

About 1 percent of the volume of the raw wastewater will be generated as waste sludge at about 1.5 percent solids content. This amounts to 1,180 gallons of sludge generated per day. Sludge will be stored in a 10,000-gallon, aerated, aboveground, bolted-steel storage tank. Sludge will be hauled off site for disposal.

### 3.1.8 Effluent Lift Station

Two 100-gpm, 100-ft total dynamic head (TDH) pumps will be provided to send the treated wastewater to the disposal system. One pump will operate and the second pump will be a standby. Pumps will be provided with variable frequency drives. The lift station will have a wet well to store 30 minutes of effluent.

### 3.1.9 Odor Control System

Odor control system will be designed to remove odorous air from the wastewater equalization tank vapor space and will treat the air in a packed bed scrubber. The scrubber will be designed treat 2,000 CFM of odorous air.

### 3.1.10 Overhead Crane System

One electric chain hoist will be provided for the maintenance of the membranes inside the MBR.

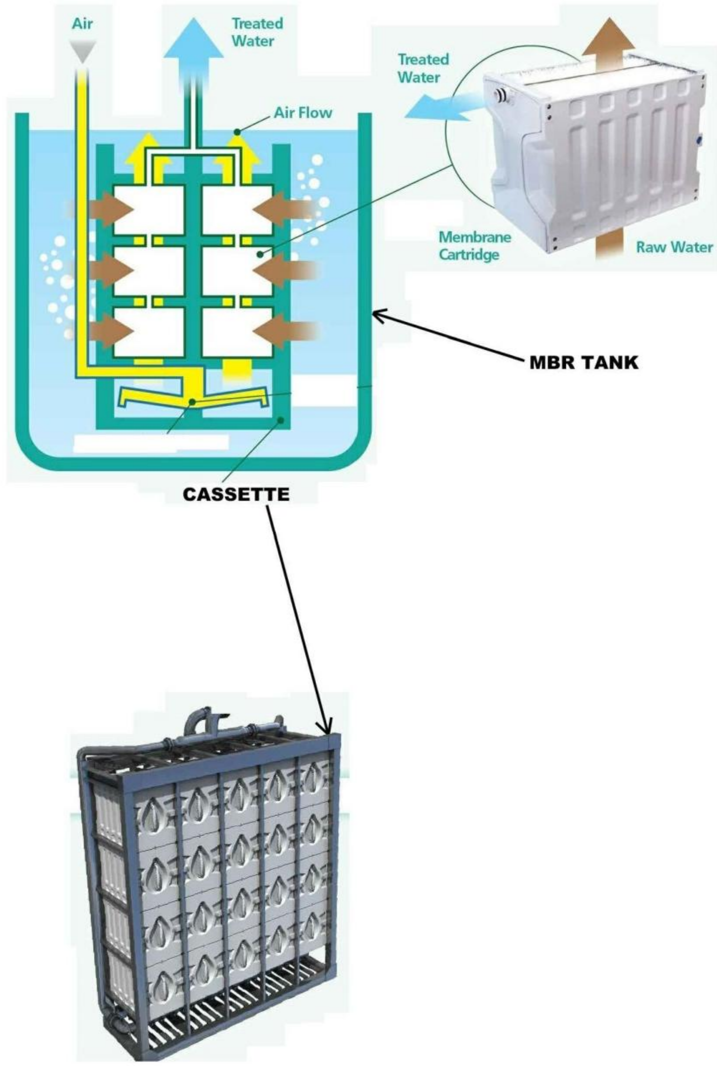


**Figure 3.3 Typical Cartridge Arrangement**

### 3.1.11 Opinion of Probable Costs Wastewater Treatment

Based on these design criteria, an opinion of probable cost (OPC) was developed for the WWTP using MBR. The MBR OPC is included in **Table 3.4**.

#### 3.1.12 Operations and Maintenance Cost Wastewater Treatment System

The O&M OPC for the MBR is included in **Table 3.5**.

### 3.2 On-Site Waste Treatment

On-site treatment of household sanitary waste can be performed using several treatment technologies that demonstrate some degree of nitrogen removal. These include suspended growth systems, such as pulse aeration or sequencing batch reactors (SBRs), as well as attached growth systems (or fixed-film systems) such as trickling filters, rotating biological contactors (RBCs), recirculating sand filters (RSF), peat filters, or combinations of both suspended and attached growth systems. Site-specific wastewater parameters and effluent requirements will drive the appropriate technology selection for a given area..

The recirculating sand filter (RSF) and the peat filter are viable candidate technologies for the SPA as they leverage use of the existing septic tanks which do remove some nitrogen. When one of these add-on technologies is combined with the existing septic tanks, up to 60 percent removal of total nitrogen may be achieved in addition to meeting typical secondary effluent standards for BOD and TSS. The peat filter system is described in more detail below as one viable on site treatment system.

The peat filter is a fixed film bioreactor system much like a trickling filter. Peat, however, has unique chemical, physical and biological properties, all of which contribute to the treatment process. Treatment within the peat filter is accomplished by a combination of physical filtration, chemical adsorption, and biological treatment by microorganisms. Peat fibers are polar, have a high surface area, and a highly porous structure (90 to 95 percent porosity). These properties enable the peat bed to hold a large amount of water, much like a sponge. As a result, effluent has a long residence time in the peat bed. As the wastewater is wicked through the peat it flows in a thin film over the surfaces of the peat fibers. This allows the effluent to become aerated and exposed to the acidic chemical environment of the peat as well as come in close contact with the microbiological community residing in the peat. The relatively constant moisture content of the peat filter also enables the survival of the natural microbial population in the peat even when the system is not being actively used. Moisture in the peat also helps keep the temperature of the peat bed relatively constant even when outside air temperatures change. Peat filters can reduce BOD to below 30 mg/L with an influent BOD of 300 mg/L. It is reported that most single pass peat filter systems remove, on average, approximately 30 percent nitrogen. **Figure 3.2** provides a schematic drawing showing how a typical peat filter system could be installed as an add-on to an existing septic system.

Additional testing and analysis would be required to determine the expected performance and costs associated with providing on-site waste treatment for the SPA.

**Table 3.4 Wastewater Treatment System OPC Summary**

| Equipment | Total |
|---|---|
| Equalization Tank | $430,000 |
| Aluminum Dome Cover | $552,000 |
| Screen & Grit Facility | $205,400 |
| MBR Equipment | $2,082,400 |
| Sludge Disposal Facilities | $70,000 |
| Disinfection UV system | $319,250 |
| Effluent Pump Station | $88,800 |
| Odor Control System | $121,500 |
| Site Piping | $200,000 |
| Aeration Blowers | $138,000 |
| MCC/Blower Building | $120,000 |
| Electrical/Instrumentation | $200,000 |
| Overhead Crane | $21,950 |
| **Subtotal** | **$4,549,300** |
| Contingencies (20%) | $909,860 |
| | |
| **Total Construction Cost** | **$5,459,000**[1] |
| Engineering, Administration, Legal (35%) | $1,910,650 |
| **Total Project Cost** | **$7,370,000** |

[1]AACE Class 4 planning level estimate. Expected accuracy range of -30 to +50 percent.

**Table 3.5 MBR Annual O&M OPC[1]**

| Component | Unit Cost | Unit | Quantity | Unit | Total |
|---|---|---|---|---|---|
| Sludge Disposal | $0.24 | $/gallon | 430,700 | gallons | $103,368 |
| Power | $0.16 | $/kWh | 1,138,800 | kWh | $182,208 |
| Maintenance[2] | 2.0 | % | $4,549,300 | - | $90,986 |
| Misc. Equipment Replacement[2] | 4.0 | % | $4,549,300 | - | $181,972 |
| **Total** | | | | | **$558,534** |

[1]Costs based on the first year of operation in 2017.
[2]Percentage of the total equipment cost.

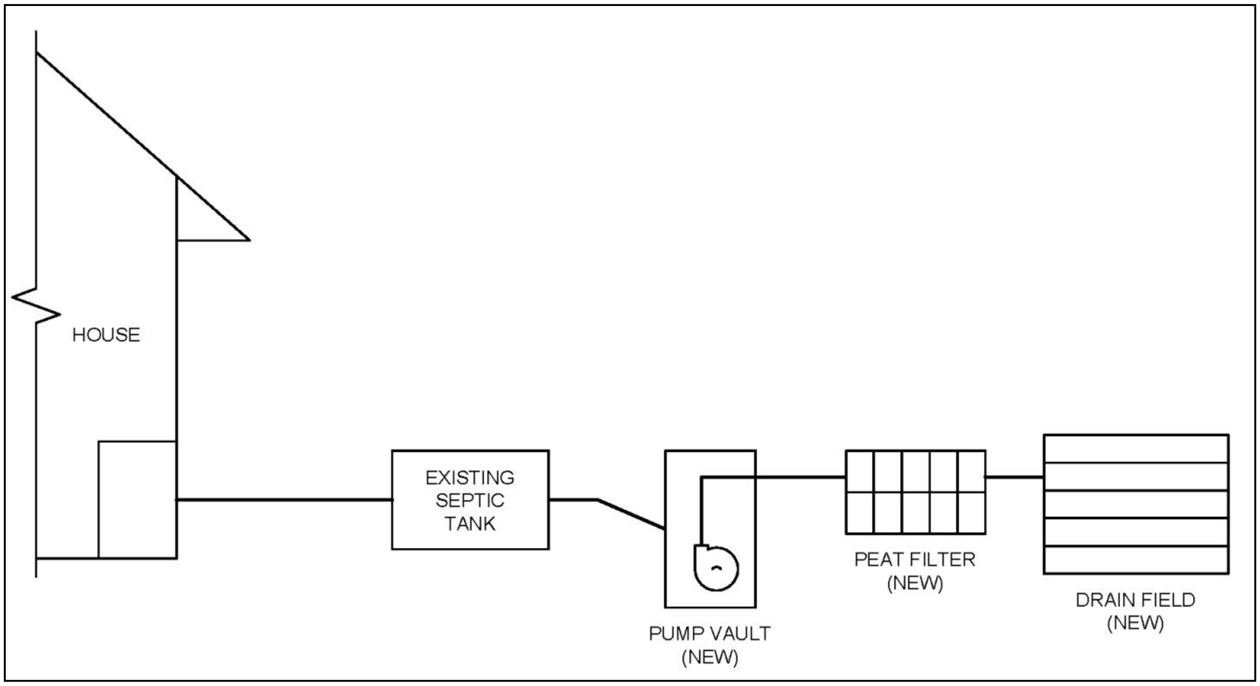


**Figure 3.2 Peat Filter Flow Schematic**

### 3.2.1 Peat Filter OPC

The following is the OPC for installation peat filters for 400 properties based on equipment supplied by Ecopure:

**Table 3.6 Peat Filter OPC**

| Peat Filter System | $/Unit | Units | Total |
|---|---|---|---|
| (a) Pump Vault (24" dia x 84" high) | $3,000 | 1 | $3,000 |
| (b) Peat Filter PBF4 (120" x 84") | $4,000 | 1 | $4,000 |
| (c )Drain field (12 feet x 24 feet) | $3,500 | 1 | $3,500 |
| **Subtotal** | | | **$10,500** |
| Tax and delivery @13% | | | $1,365 |
| Installation @15% | | | $1,575 |
| Electrical @10% | | | $1,050 |
| Manufacturer Services @10% | | | $1,050 |
| Contingencies (20%) | | | $2,100 |
| **Subtotal (one home)** | | | **$17,640** |
| **Total construction cost (400 properties)** | | | **$7,056,000** |

It should be noted that many houses may not have the required space to install the peat filter which would result in the need for a more compact and higher cost system.

### 3.2.2 Operations and Maintenance OPC for Peat Filter Beds

Cost Basis:

- One ¼ HP motor for each system
- 400 systems
- Maintenance cost/year is 2% of the installed cost
- Change of peat bed every 10 years
- Change of peat bed every 10 years

**Table 3.7 OWTS Annual O&M Cost Estimate**

| Component | Unit Cost | Unit | Quantity | Unit | Total |
|---|---|---|---|---|---|
| Power | $0.16 | $/kWh | 357,000 | kWh | $57,000 |
| Maintenance[1] | 2.0 | % | $7,056,000 | - | $141,000 |
| Peat Replacement[2] | $400 | $/yr per filter | 400 | Filters | $160,000 |
| **Total** | | | | | **$358,000** |

[1]Percentage of the total installed cost.
[2]Annualized cost per peat filter replacement which is required every 10 years.

# 4. Effluent Disposal

Since this revision addresses the implementation of a new WWTP utilizing MBR, an evaluation of recommended effluent disposal options needs to be provided. This revision evaluates the feasibility of two effluent disposal methods:

- Infiltration
- Nonpotable reuse

A summary of the recommended effluent disposal alternatives evaluated in this revision are presented in **Table 4.1**. A discussion of each of these alternatives is included in this section that considers pertinent issues such as anticipated regulatory requirements, siting and area requirements, design criteria, and construction cost opinions.

**Table 4.1 Summary of Viable Effluent Disposal Alternatives**

| Disposal/Reuse Alternative | Filtration Required | Disinfection Required | Nitrogen Removal Required |
|---|---|---|---|
| Infiltration | Yes | Yes | Yes |
| Nonpotable Reuse | Yes | Yes | Yes |
| Due to concerns with nitrate infiltration to the groundwater, denitrification to a TN of 10 mg/L has been assumed for both disposal options. | | | |

## 4.1 Infiltration

Infiltration ponds are reservoirs where water is stored and allowed to either infiltrate into the ground or evaporate. The pond bottoms are managed to maintain infiltration rates by periodically drying, ripping, and conditioning the soils.

Groundwater degradation is a major consideration for this type of disposal practice. Regulations are continually changing and becoming more restrictive to protect groundwater quality. Considerations such as distance to the nearest well, depth to groundwater, and mounding potential must all be considered in addition to water quality. Sizing and siting requirements for the infiltration pond depends on these groundwater issues, the types of soils, and infiltration capacity.

### 4.1.1 Regulatory Requirements

Advances in treatment technology which allow for the production of high quality recycled water have made infiltration a time-proven, sustainable method of replenishing groundwater and augmenting drinking water supplies. With an MBR treatment system, Los Olivos would be well positioned to implement infiltration. The system will need to comply with Title 22 of the Code of California Regulations.

As discussed previously, nitrate concentrations in the groundwater underlying the SPA and surrounding areas are increasing due to the use of OWTSs. In order to minimize future degradation from the Los Olivos WWTP, the concentration of nitrogen in the effluent would be reduced to within the primary drinking water MCL of 10 mg/L nitrate (as N) or 10 mg/L TN. The shallow groundwater in the SPA highlights the need for nitrogen removal with infiltration since natural nitrification/denitrification in the soil matrix is expected to be limited.

### 4.1.2 Design Criteria

The most important criterion for development of the infiltration disposal method is selecting a site with adequate area based on the site's infiltration rate. According to the Web Soil Survey, the soils northeast of the special problem area range from Salinas silty clay loam (SdA) with a permeability of 0.20 to 0.63 inches per hour to Ballard gravelly fine sandy loam (BhC) with a permeability of 2.0 to 6.3 inches per hour. Based on the soil data, a conservative infiltration rate of 1.44 inches per day (0.06 inches per hour) was selected. This document assumes that the infiltration basins will be located on the north side of Los Olivos to maximize groundwater recharge benefit. Therefore, an effluent pump station will be required.

In order to calculate the volume and area of infiltration basins necessary for each phase of the Los Olivos WWTP project, a water balance was developed. The water balance takes into account not only the water lost through infiltration, but also water lost from evaporation and the contribution of rainfall. **Table 4.2** summarizes the climatic characteristics used to develop the water balances for the infiltration alternative.

Detailed design criteria for the Los Olivos WWTP are provided in **Table 4.3**.

### 4.1.3 Siting and Area Requirements

As mentioned previously, infiltration basins should be located in areas with high infiltration rates such as coarse sandy soils while expansive clay soils should be avoided. Infiltration testing should be done at prospective sites to determine the applicability of infiltration and accurately determine the necessary basin capacity.

Based on a infiltration rate of 1.44 inches/day, approximately 2.6 acres of infiltration basins would be required. With accommodations for dikes and set-backs, roughly 5 acres of land would need to be aquired.

### 4.1.4 Opinion of Probable Costs

The OPC for the infiltration alternative are summarized in **Table 4.4**. For the purpose of this document it has been assumed effluent will be pumped to the infiltration basins.

**Table 4.2 Evaporation and Precipitation Data for the Los Olivos Area**

| Month | Pan Evaporation (inches/month)[1] | Evaporation (inches/month)[2] | Precipitation (inches/month)[3] |
|---|---|---|---|
| January | 2.44 | 1.83 | 3.10 |
| February | 3.53 | 2.65 | 3.14 |
| March | 4.41 | 3.31 | 2.55 |
| April | 6.01 | 4.51 | 1.12 |
| May | 7.55 | 5.66 | 0.27 |
| June | 8.56 | 6.42 | 0.03 |
| July | 9.50 | 7.13 | 0.02 |
| August | 8.98 | 6.74 | 0.03 |
| September | 7.00 | 5.25 | 0.18 |
| October | 5.42 | 4.07 | 0.52 |
| November | 3.49 | 2.62 | 1.53 |
| December | 2.79 | 2.09 | 2.27 |
| **Total** | **69.68** | **52.26** | **14.76** |

[1]Western Regional Climate Center – Cachuma Lake (1952 – 2002).
[2]Pan Evaporation (inches/month) x 0.75.
[3]Western Regional Climate Center – Lompoc (1917 – 2010).

**Table 4.3 Infiltration Design Criteria**

| Parameter | |
|---|---|
| <u>Influent Characteristics</u> | |
| Average Annual Daily Flow (gpd) | 107,000 |
| Average Day Maximum Month Flow (gpd) | 118,000 |
| Maximum Daily Flow (gpd) | 342,000 |
| Peak Hour Flow (gpd) | 481,000 |
| <u>Pump Station</u> | |
| Maximum Capacity (gpd) | 342,000 |
| Forcemain Diameter (in) | 6 |
| Pump Horsepower (each) | 5 |
| Number of Pumps | 2 |
| <u>Infiltration Basins</u> | |
| Infiltration Rate (in/day) | 1.44 |
| Total Infiltration Area (acres) | 2.6 |
| Total Basin Area (acres) | 4.5 |
| Total Volume (AF) | 14.2 |
| Number of Basins | 2 |
| Basin Dimensions | |
| Length (ft) | 498 |
| Width (ft) | 198 |
| Side Water Depth (ft) | 4 |
| Freeboard (ft) | 2 |
| Side Slope (H:V) | 4 |

**Table 4.4 Infiltration Project Cost Summary**

| Component | Total |
|---|---|
| Infiltration Basins including Land Acquisition | $700,000 |
| Pump Station and Forcemain | $1,660,000 |
| Subtotal | $2,360,000 |
| Contingency (20 percent) | $472,000 |
| Total Construction Cost | $2,832,000 |
| Engineering, Administration, Legal (35 percent) | $991,000 |
| **Total Cost** | **$3,823,000** |

## 4.2 Nonpotable Reuse

Construction of a Nonpotable Reuse (NPR) system will require a distribution network, pump stations, and a monitoring and controls system to demonstrate compliance with regulations.

Significant improvements will be required depending on how Los Olivos chooses to ultimately utilize the nonpotable water. These could include:

- Securing enough demand for the recycled water.
- Infrastructure to store and distribute the NPR water.

Identifying demand for NPR water could be challenging, especially considering the minimal demand for irrigation during the winter season. Lack of demand would require Los Olivos to provide storage for the treated effluent. The Los Olivos area does not currently, and is not likely in the foreseeable future, anticipated to host industrial users which require a large water demand. Thus, expansion of the NPR system is likely to have only limited benefits.

### 4.2.1 NPR Feasibility

NPR could prove to be feasible if a suitable number of users could be identified. There could also be some cost savings in constructing the NPR distribution lines in a common trench (with required clearance) with the new sewer collection system lines. Unfortunately, due to the lack of potential industrial and commercial users, as well as parks and golf courses, NPR is not considered a feasible option for Los Olivos. Costs to construct and maintain storage facilities to store the effluent during the non-irrigation season also make NPR unfeasible.

# 5. Recommendations and Engineer's Opinion of Cost

This section presents recommendations and a revised planning-level engineer's OPC for a new wastewater treatment plant (WWTP), effluent disposal facilities, and collection system for the community of Los Olivos. For cost estimating purposes a treatment site has been assumed south of town and disposal site has been assumed to be north of town. Due to the elevation of the service area in relation to the assumed WWTP location, it is assumed a gravity collection system will be used with a lift station to convey treated effluent flows to the disposal site. It is important to note that the WWTP site is conceptual and is only used as a basis to evaluate the overall project cost.

## 5.1 Recommended Cost Basis

### 5.1.1 Membrane Bioreactor

Cost basis for the Membrane Bioreactor system is described in **Section 3**.

### 5.1.2 Infiltration Ponds

Cost basis for the infiltration ponds is described in Section 4.

### 5.1.3 Proposed WWTP Layout

**Figure 5.1** provides a sample layout for the Los Olivos WWTP. The initial layout would take into consideration requirements for future plant expansion.

### 5.1.4 Collection System

A typical gravity collection system is recommended for the community wastewater system. Since the terrain in and around Los Olivos slopes to the south, and the disposal site is assumed to be to the north, lift stations will be required to convey wastewater collected in gravity lines located throughout the community. Initially, one lift station would be required for the collection system as outlined in the PER. The collection system layout used to develop estimated costs is provided on **Figure 5.2**.

### 5.1.5 Operations and Maintenance (O&M)

#### 5.1.5.1 Staffing Requirements

Due to the relatively small size of the WWTP, it has been assumed that one operator would be required at the plant for half of the day, 5 days a week. For one of these days an additional operator would likely be required to assist in performing maintenance functions.

According to Section 3675, Chapter 26, Title 23 of the California Code of Regulations the Los Olivos WWTP would be considered a Class III plant. Section 3680 of the same chapter also states that for a Class III plant, the Chief Plant Operator would have to possess at a minimum a valid Grade III license. Supervisors and shift supervisors would have to possess a Grade II license while operators would be required to have a valid Grade 1 or operator-in-training certificate.

#### 5.1.5.2 Treatment and Disposal

Operations and maintenance of the treatment and disposal systems would include material replacements including membranes and UV bulbs, maintenance items, and power usage of the facility. The impacts of the aeration and disposal of this material have also been accounted for in the O&M cost estimates.

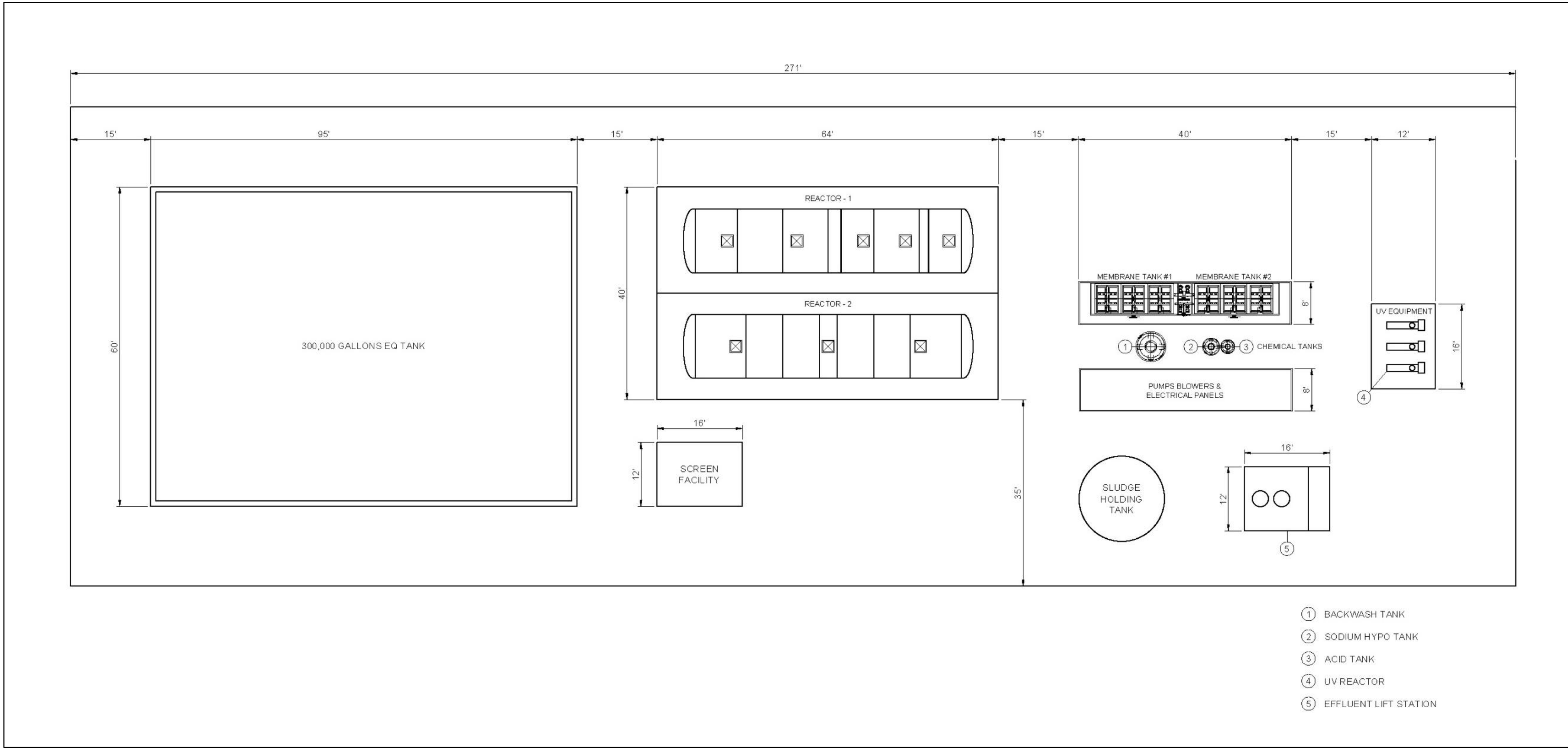


**Figure 5.1 Conceptual WWTP Site Layout**

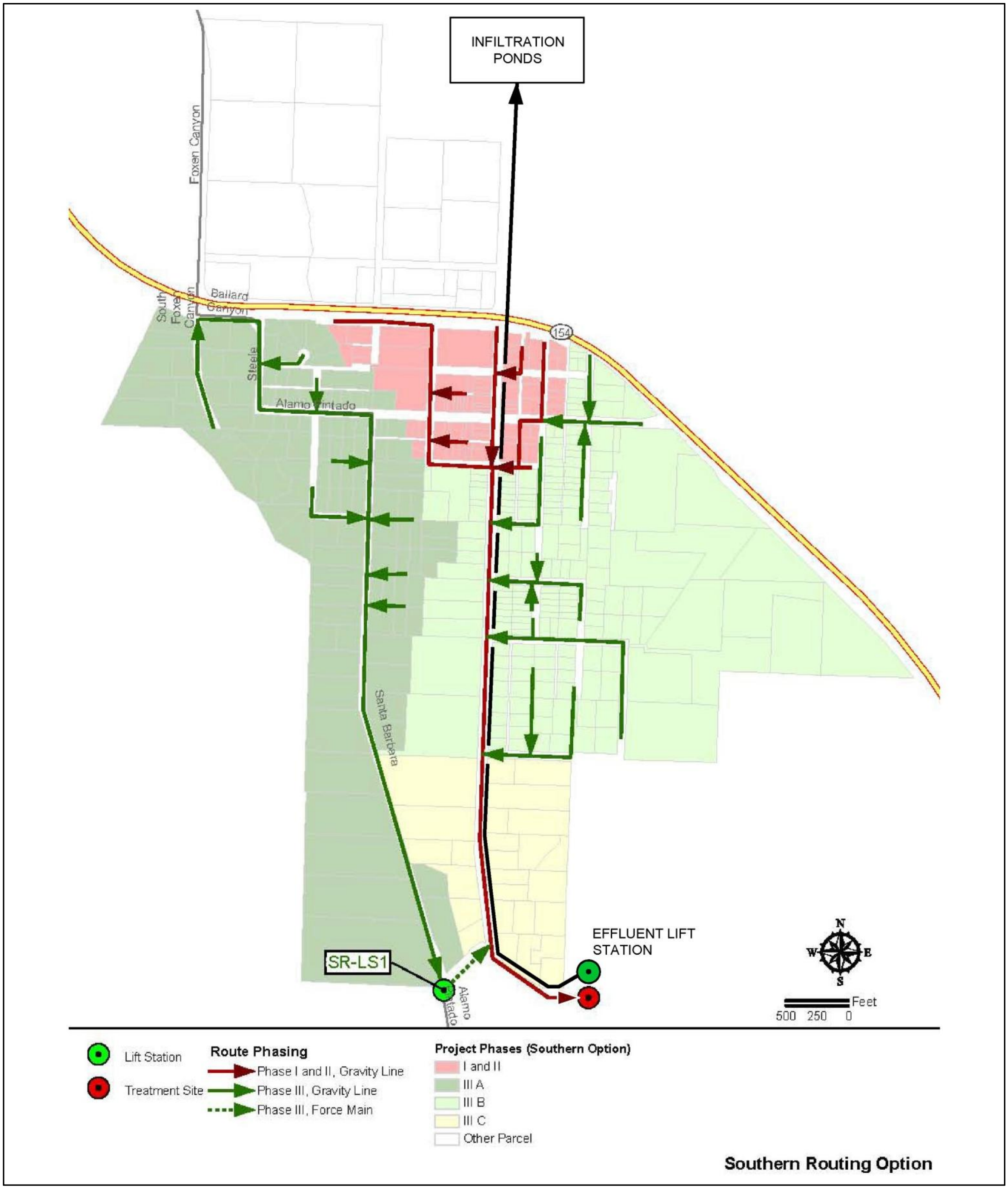


**Figure 5.2 Collection Routes**

#### 5.1.5.3 Collection System

It is assumed that typical O&M associated with a gravity collection system with lift stations would be required for Los Olivos. This would include periodic cleaning and inspection of the sewer lines and maintenance of the pumps at the lift stations. Collection system cleaning and inspection is typically recommended for 20 percent of the system each year. Periodic inspection and cleaning of lift stations would also be required. Inspection of lift stations identifies potential problems not detected by the control system.

## 5.2 Project Costs

### 5.2.1 General Cost Parameters

These OPCs will be revised and refined as the project proceeds. The following assumptions were made to develop planning-level cost opinions:

- Except where other data is available, construction cost opinions are generally derived using bid prices from similar wastewater projects, with adjustments for inflation, size, complexity, and location.
- Except where other data is available, operations and maintenance cost opinions are generally derived using information from product venders, utility rates and personnel costs provided by the County, and costs from similar wastewater projects, with adjustments for inflation, size, complexity, and location.
- 20 percent construction contingency.
- Engineering, administration, and legal costs were assumed to be 35 percent of the total construction costs.
- Cost opinions are AACE Class 4 planning level with an accuracy range of -30 to +50 percent.
- Construction cost opinions are in 2016 dollars.
- Operations and maintenance cost opinions are in 2017 dollars.
- When budgeting for future years, appropriate escalation factors should be applied.
- Cost opinions are “budget-level” and may not fully account for site-specific conditions that will affect the actual costs.

The OPCs prepared by AECOM represent our judgment and are supplied for the general guidance of the County. Since AECOM has no control over the cost of labor and material, or over competitive bidding or market conditions, AECOM does not guarantee the accuracy of such opinions as compared to contractor bids or actual costs.

### 5.2.2 Collection System

It is assumed that conventional excavation depths of five to six feet can be maintained along the majority of the alignments. Opinions of probable construction cost for the collection system were developed based on conventional excavation and estimated costs of materials, preparation, earthwork, installation, and roadwork. Costs for the collection system were increased based on the ENR Construction Cost Index increase from January 2013 to August 2016. This increase was 8.5 percent. Cost criteria are summarized in **Table 5.1**.

**Table 5.1 Sewer Improvement Cost Criteria**

| Item Description | Estimated Construction cost | Including Contingency (20 Percent) | With Engineering/Administration (35 Percent) |
|---|---|---|---|
| 3-inch Force Main | $108/LF | $130/LF | $176/LF |
| 8-inch Gravity Sewer | $171/LF | $205/LF | $277/LF |
| 10-inch Gravity Sewer | $193/LF | $232/LF | $313/LF |
| 12-inch Gravity Sewer | $215/LF | $258/LF | $348/LF |
| 15-inch Gravity Sewer | $248/LF | $298/LF | $402/LF |

Preliminary sizing of the collection system lines were calculated for the “southern route” as described in the PER. These pipe sizes and the estimated line lengths shown on **Figure 5.2** were used in calculating construction costs for the collection system. Lift station OPCs are based on actual cost of recent lift station projects in the area of similar size. **Table 5.2** provides a cost summary for the collection system.

**Table 5.2 Southern Route –Collection System Project Cost Summary**

| Component | Quantity | Value |
|---|---|---|
| 3-in Force Main | 500 LF | $54,000 |
| 8-in Gravity Sewer | 23,900 LF | $4,087,000 |
| 12-in Gravity Sewer | 3,700 LF | $795,000 |
| 15-in Gravity Sewer | 500 LF | $124,000 |
| Lift Station #1 | 1 | $488,000 |
| **Subtotal** | | **$5,548,000** |
| Contingency (20 Percent) | | $1,110,000 |
| **Total Construction** | | **$6,658,000** |
| Engineering, Administration, Legal (35 Percent) | | $2,330,000 |
| **Total Project** | | **$8,988,000** |

### 5.2.3 Treatment

Based on the design criteria presented in Section 2, project OPCs were developed for the recommended treatment alternative.

In order to develop OPCs for the recommended treatment alternative, major equipment manufacturers were consulted. These manufacturers were presented in **Table 3.1**.

**Table 5.3** provides an OPC for the treatment facility. Subtotals are provided for the treatment process and for the disinfection equipment.

### 5.2.4 Disposal

For the purpose of this report, AECOM has assumed effluent will flow by pumping to the infiltration basins. Additional costs for pumping effluent off site including a pump facility and pipelines are also included. For calculation of the unrestricted reuse pipe length, an area north of State Highway 154 (Figueroa Mt. Rd. and Acampo Rd.) was assumed as the end point. An OPC for the disposal system is provided in **Table 5.4**.

**Table 5.3 Wastewater Treatment System Cost Summary**

| Component | Total |
|---|---|
| Equalization Tank | $430,000 |
| Aluminum Dome Cover | $552,000 |
| Screen & Grit Facility | $205,400 |
| MBR Equipment | $2,082,400 |
| Sludge Disposal Facilities | $70,000 |
| Disinfection UV system | $319,250 |
| Effluent Pump Station | $88,800 |
| Odor Control System | $121,500 |
| Site Piping | $200,000 |
| Aeration Blowers | $138,000 |
| MCC/Blower Bldg | $120,000 |
| Electrical/Instrumentation | $200,000 |
| Overhead Crane | $21,950 |
| **Subtotal** | **$4,549,300** |
| Contingencies (20%) | $909,860 |
| **Total Construction Cost** | **$5,459,000** |
| Engineering, Administration, Legal (35%) | $1,910,650 |
| **Total Project Cost** | **$7,370,000** |

**Table 5.4 Infiltration Project Cost Summary**

| Component | Total |
|---|---|
| Infiltration Basins including Land Acquisition | $700,000 |
| Pump Station and Forcemain | $1,660,000 |
| **Subtotal** | **$2,360,000** |
| Contingency (20 percent) | $472,000 |
| **Total Construction Cost** | **$2,832,000** |
| Engineering, Administration, Legal (35 percent) | $991,000 |
| **Total Cost** | **$3,823,000** |

## 5.3 Operations and Maintenance Costs

### 5.3.1 Collection System

O&M OPC for the collection system is provided in **Table 5.5**. This opinion provides general items typically required such as line inspection, cleaning, and lift station maintenance.

**Table 5.5 Collection System Annual O&M OPC[1]**

| Component | Unit Cost | Unit | Quantity | Unit | Total |
|---|---|---|---|---|---|
| Power | $0.16 | $/kWh | 9,499 | kWh | $1,520 |
| Line Cleaning | $0.69 | $/ft | 7,334 | ft | $5,060 |
| Line Inspection (CCTV) | $1.16 | $/ft | 7,334 | ft | $8,507 |
| Line Replacement[3] | $16.30 | $/ft | 367 | ft | $5,982 |
| Labor | $63.33 | $/hour | 1,252 | hours | $79,289 |
| Maintenance[2] | 2.0 | % | $450,000 | - | $9,000 |
| Misc. Equipment Replacement[2] | 4.0 | % | $450,000 | - | $18,000 |
| **Total** | | | | | **$127,400** |

[1]Costs based on the first year of operation in 2017.
[2]Percentage of the total equipment cost.
[3]Percentage of total average pipeline cost.

### 5.3.2 Treatment and Disposal

The O&M OPC for the WWTP is provided in Table 5.6. Offsite effluent disposal O&M OPCs are not included in these tables.

**Table 5.6 MBR Annual O&M OPC[1]**

| Component | Unit Cost | Unit | Quantity | Unit | Total |
|---|---|---|---|---|---|
| Sludge Disposal | $0.24 | $/gallon | 430,700 | Gal | $103,368 |
| Power | $0.16 | $/kWh | 1,138,800 | kWh | $182,208 |
| Maintenance[2] | 2.0 | % | $4,549,300 | - | $90,986 |
| Misc. Equipment Replacement[2] | 4.0 | % | $4,549,300 | - | $181,972 |
| **Total** | | | | | **$558,534** |

[1]Costs based on the first year of operation in 2017.
[2]Percentage of the equipment cost.

## 5.4 Summary

**Table 5.7** provides a summary of project costs.

**Table 5.7 Total Project Cost Summary**

| Component | Total |
|---|---|
| Land Purchase Cost | $688,000 |
| Construction Cost | $14,949,000 |
| Additional Project Costs | $5,232,000 |
| **Total Capital Cost Opinion** | **$20,869,000** |

Land purchase cost based on market price of available parcels around Los Olivos construction cost includes 20% contingency. Additional project costs include engineering, administration and legal cost (35% of construction costs)

An estimated land value has been included in the total project cost summary. This figure has been calculated based on listing prices per acre of agricultural parcels currently on the market and the total acreage required for the assumed treatment and disposal methods. Depending on the actual treatment and disposal method, final WWTP site location, and market conditions at the time of land acquisition this price may be significantly different.