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Project: Chevron Tank Farm Development

SUBJECT: **WASTEWATER TREATMENT AND DISPOSAL FEASIBILITY ASSESSMENT**

Purpose

The purpose of this Technical Memorandum (TM) is to provide a feasibility analysis for an onsite wastewater treatment and disposal facility to process wastewater generated by the proposed Chevron Restoration and Redevelopment Project, located on Tank Farm Road in San Luis Obispo, California (Tank Farm Development). Figure 1 shows the project vicinity and location.

Background

For the Tank Farm Development, Chevron is proposing to construct a development consisting of 803,000 ft^2 of various land uses within a 53 acre portion of its 332 acre property along Tank Farm Road, in San Luis Obispo County, California (Figure 2). If the property is not annexed by the City of San Luis Obispo, the development project requires onsite wastewater treatment and disposal facilities. The development project is currently phased over 25 years, and planned to be developed in five separate stages.

The development project includes extensive remediation to address soil and groundwater contamination that pose potential human health and/or ecological risks on the Tank Farm site. The proposed remediation includes long term monitoring of groundwater to observe migration of petroleum products in the local groundwater, excavation of near surface soils that pose a risk of wildlife entrapment, and the installation of earthen caps to insulate impacted materials from potential human and ecological receptors (1).

Treatment and Disposal Concept

The proposed wastewater facilities include a gravity collection system, wastewater treatment plant, and on-site reuse and/or disposal systems. To minimize the amount of disposal required, the proposed concept includes extensive reuse of the treated effluent on-site. Accordingly, the treatment process includes tertiary treatment and disinfection systems sufficient for reuse consistent with California Department of Public Health Title 22 regulations. The proposed concept also includes a recycled water distribution system to deliver recycled water to meet landscape irrigation and dual plumbing demands for the proposed development. Additionally, due to the seasonal nature of the irrigation demands for recycled water and an overall surplus of recycled water supply

relative to projected demand during wet years, the project also requires provisions for treated wastewater or recycled water disposal. This TM evaluates numerous disposal methods, ranging from spray fields to live stream discharge into San Luis Obispo Creek. The disposal calculations presented in this TM are based on the projected wastewater generation and required disposal at full build-out.

Figure 1. Tank Farm Development project location (1)

Figure 2. Proposed Tank Farm Development (1)

Wastewater Flows and Loads

WSC estimated average annual wastewater flows from the proposed Tank Farm Development using a water use report developed by the City of San Luis Obispo (Water Use Report) (2) and the proposed land uses for the Tank Farm development (1). The Water Use Report provides estimations of water use per unit area, percentage of indoor water use, and percentage of indoor water use for toilets and urinals for various land use types in a non-drought year[1]. For the purposes of this analysis, WSC assumed that the quantity of wastewater generated equals the quantity of water used indoors. Using this methodology, the proposed development project will generate an average daily flow (ADF) of approximately 49,000 gallons per day (Table 1) at full build-out. The wastewater flows were assumed to be constant throughout the year since indoor water use typically does not vary seasonally, and the system will be designed to prevent excessive inflow and infiltration.

In an earlier report, Cleath & Associates analyzed the source water for the proposed development and developed estimates for the expected concentrations of numerous constituents in the untreated wastewater by incorporating mineral pickup (3). The estimated untreated wastewater constituent concentrations account for the constituent concentrations in the source water and minerals dissolved into the water as it is used throughout the development (Table 2) (4). Concentrations for constituents not included in the previous report were assumed to have a composition similar to that of domestic wastewater (5).

[1] The Water Use Report provides water use factors based on "several non-drought years" (2). WSC used these factors to estimate Average Daily Flow (ADF) as described above.

Manufacturing and industrial park land uses comprise much of the development area. However, without specific details on the type of businesses that will occupy these facilities, it is difficult to anticipate their impacts on the wastewater constituents. Pretreatment may be required for specific businesses depending upon the characteristics of their wastewater streams.

Table 1. Estimated wastewater flows for the Tank Farm Development, non-drought year

Column	*A*	*B*	*C*	*D*	*E*	*F*
Calculation			*=A*B/1000*		*=C*D/100*	*=E/365*325,828*
Proposed Land Uses	**Proposed Development Area (ft^2)**	**Water Use Factor (AFY/1000 ft^2)[1]**	**Water Use (AF/yr)**	**% Indoor Use (% of Total)[1]**	**Wastewater Generated (AFY)**	**Wastewater Generated (gal/day)**
Manufacturing[2]	180,000	0.22	39.6	90	35.6	31,817
Industrial Park[2]	180,000	0.06	10.8	70	7.6	6,749
Retail Sales[2]	15,000	0.088	1.3	80	1.1	943
Office Park[2]	428,000	0.032	13.7	70	9.6	8,559
Ball Field[3]	435,600	0.032	14.0	5[4]	0.7	625
Total			79.4		54.5	48,693

[1] From Water Use Report (2)
[2] Based on square feet of floor space and obtained from the Chevron Tank Farm Project EIR-Administrative Draft (1)
[3] Based on 10 acres of ball field area including irrigated turf and restrooms. If ball fields are not constructed, then predicted recycled water demands will decrease and recycled water surplus will increase accordingly.
[4] Assumed 5% of water use would be indoors

Table 2. Estimated wastewater loads for the Tank Farm development

Column		*A*	*B*	*C*
Calculation				*=(A*B*8.34) /10^6*
Constituents	Units	Concentration (mg/L)	Average Daily Flow Rate (gal/d)	Loading Rate (lb/day)
Total Dissolved Solids (TDS)[1]	mg/L	860	49,000	351.4
Total Hardness[1]	mg/L	502	49,000	205.1
Bicarbonate[1]	mg/L	404	49,000	165.1
Calcium[1]	mg/L	61	49,000	24.9
Magnesium[1]	mg/L	87	49,000	35.6
Sodium[1]	mg/L	149	49,000	60.9
Potassium[1]	mg/L	11.1	49,000	4.5
Sulfate[1]	mg/L	56	49,000	22.9
Chloride[1]	mg/L	223	49,000	91.1
Nitrate as N[1]	mg/L	31	49,000	12.7
Boron[1]	mg/L	0.41	49,000	0.2
Total Suspended Solids (TSS)[2]	mg/L	210	49,000	85.8
5-d BOD 20°C (BOD)[2]	mg/L	190	49,000	77.6
Total Organic Carbon (TOC)[2]	mg/L	140	49,000	57.2
Phosphorous (total as P)[2]	mg/L	7	49,000	2.9
Total Coliform[2]	No./100 mL	10^7-10^9	49,000	NA
Fecal Coliform[2]	No./100 mL	10^4-10^6	49,000	NA

Recycled Water Demand

To maximize demand for recycled water and limit wastewater disposal for the Tank Farm Development, the proposed recycled water system serves two primary demands: 1) landscape irrigation; and 2) toilet/urinal flushing in dual plumbed buildings. The proposed recycled water system will also be capable of serving non-potable industrial demand; however non-potable industrial demand cannot be accurately estimated at this time without details on the businesses that will occupy the development. For the purposes of this analysis, non-potable industrial demand is assumed to be zero.

Typical Non-Drought Year

The landscape irrigation demand for recycled water, for a non-drought year[3], was assumed equal to the total outdoor water use. WSC estimated outdoor water use by applying the indoor water use percentages presented

[1] Estimate values obtained from Preliminary Environmental Impacts Study for Water Resources report (3)
[2] Typical constituent concentrations for domestic wastewater (5)
[3] A non-drought year is defined as the climatic conditions over a period of several non-drought years (2)

in Water Use Report to the total water use estimates. WSC estimated recycled water demand for the dual plumbed facilities by applying the indoor water use percentage and the percentage of indoor water used for toilets to the total estimated water use (2). The dual plumbing demand for recycled water was assumed to be constant throughout the year (Table 3).

Table 3. Tank Farm Development recycled water demand, non-drought year

Column	*A*	*B*	*C*	*D*	*E*	*F*
Calculation				*=A*B/100*C/100*	*=A*((100-B)/100)*	*=D+E*
Proposed Land Uses	**Water Use (AFY)[1]**	**% Indoor Use (% of Total)[2]**	**% Toilet Use (% of Indoor)[2]**	**Dual Plumbing Recycled Water Demand (AFY)**	**Landscape Irrigation Demand (AFY)**	**Total Recycled Water Demand (AFY)**
Manufacturing	39.6	90	40	14.3	4.0	18.2
Industrial Park	10.8	70	80	6.0	3.2	9.3
Retail Sales	1.3	80	70	0.7	0.3	1.0
Office Park	13.7	70	75	7.2	4.1	11.3
Ball Field	14.0	5	80[3]	0.6	13.3	13.9
Total	79.4			28.8	24.9	53.7

During a non-drought year, the total demand for recycled water (53.7 AFY) approximately equals the volume of recycled water produced (54.5 AFY) for the proposed Tank Farm Development. However, due to the climate conditions at the project site, the landscape irrigation would be highest during the summer (dry) months, and there would be minimal demand for landscape irrigation during the winter (wet) months. For the purposes of quantifying the seasonal recycled water demand, WSC developed monthly demand projections for landscape irrigation using "typical year" evapotranspiration and precipitation values from CIMIS Station Central Coast Valleys – San Luis Obispo #52 (6), which is located approximately 4 miles from the project site and has been active since April 1986.

WSC selected the "typical year" by calculating the monthly surplus ET_o, equal to the difference between evapotranspiration and precipitation for that month. Surplus ET_o represents the amount of water that is lost through evapotranspiration that must be replaced through irrigation or precipitation. Months where the precipitation exceeded the evapotranspiration were assumed to have a surplus ET_o of 0. The monthly surplus ET_o values were then summed to create annual surplus ET_o values. The average annual surplus ET_o for the

[1] Obtained from Table 1
[2] From the Water Use Report (2)
[3] Assumed 80% of indoor water use would be for toilets and urinals at the ball field complex

period of record was determined to be 38.83 in. Calendar year 1993 was then selected as the "typical year" as it had an annual surplus ET_o (38.55 in), closest to the average[1]. The surplus ET_o calculations and the monthly precipitation and evapotranspiration data for CIMIS Site #52 can be found in Appendix A.

Using the typical year surplus ET_o values, the monthly surplus ET_o was divided by the annual surplus ET_o for the entire year to calculate the percentage of total surplus ET_o for each month. Each month's percentage of total surplus ET_o was then multiplied by the non-drought year annual landscape irrigation demand to estimate the landscape irrigation demand for each month of a typical non-drought year (Table 4).

WSC then estimated total recycled water demand for each month, for a typical non-drought year, by adding the seasonal demand for landscape irrigation and the constant baseline demand for dual plumbing (Table 5). During the winter (wet) months, the quantity of recycled water produced exceeds recycled water demand. During the summer (dry) months, recycled water demand exceeds the quantity of recycled water produced (Figure 3).

[1] Data from 1988 was eliminated from the data set due to errors in the precipitation readings.

Table 4. Seasonal demand for landscape irrigation recycled water, typical non-drought year

Column	*A*	*B*	*C*	*D*	*E*
Calculation			*=B-A (≥0)*	*=C/Sum(C)*	*=non-drought year landscape irrigation demand [1]*D*
Month	**Typical Year Precipitation (in)[2]**	**Typical Year Reference Evapotranspiration Et_o (in)[2]**	**Surplus ET_o (in)**	**% of total surplus ET_o**	**Estimated Monthly Landscape Irrigation Demand (AF)**
January	10.79	1.69	0	0	0.0
February	8.78	1.87	0	0	0.0
March	3.46	3.69	0.23	1	0.1
April	0.28	5.85	5.57	14	3.6
May	0.2	6.09	5.89	15	3.8
June	0.2	6.94	6.74	17	4.3
July	0	5.69	5.69	15	3.7
August	0.28	5.81	5.53	14	3.6
September	0	4.71	4.71	12	3.0
October	0.24	3.73	3.49	9	2.3
November	2.01	2.61	0.6	2	0.4
December	2.17	2.27	0.1	0	0.1
Annual					24.9

[1] Obtained from Table 3
[2] Precipitation and evapotranspiration values from a "typical year" for CIMIS Station #52 (6)

Table 5. Seasonal recycled water supply and demand, typical non-drought year

Column	*A*	*B*	*C*	*D*
Calculation				*=A-(B+C)*
Month	**Recycled Water Supply (AF)[1]**	**Dual Plumbing WW Demand (AF)[2]**	**Landscape Irrigation Demand (AF)[3]**	**Surplus (Deficit) Recycled Water Supply (AF)**
January	4.5	2.4	0.0	2.1
February	4.5	2.4	0.0	2.1
March	4.5	2.4	0.1	2.0
April	4.5	2.4	3.6	(1.4)
May	4.5	2.4	3.8	(1.7)
June	4.5	2.4	4.3	(2.2)
July	4.5	2.4	3.7	(1.5)
August	4.5	2.4	3.6	(1.4)
September	4.5	2.4	3.0	(0.9)
October	4.5	2.4	2.3	(0.1)
November	4.5	2.4	0.4	1.8
December	4.5	2.4	0.1	2.1
Annual	54.5	28.8	24.9	0.9

[1] Equals Wastewater Generated (AFY) from Table 3 divided by 12 months/yr
[2] Equals Dual Plumbing Recycled Water Demand (AFY) from Table 3 divided by 12 months/yr
[3] Obtained from Table 4

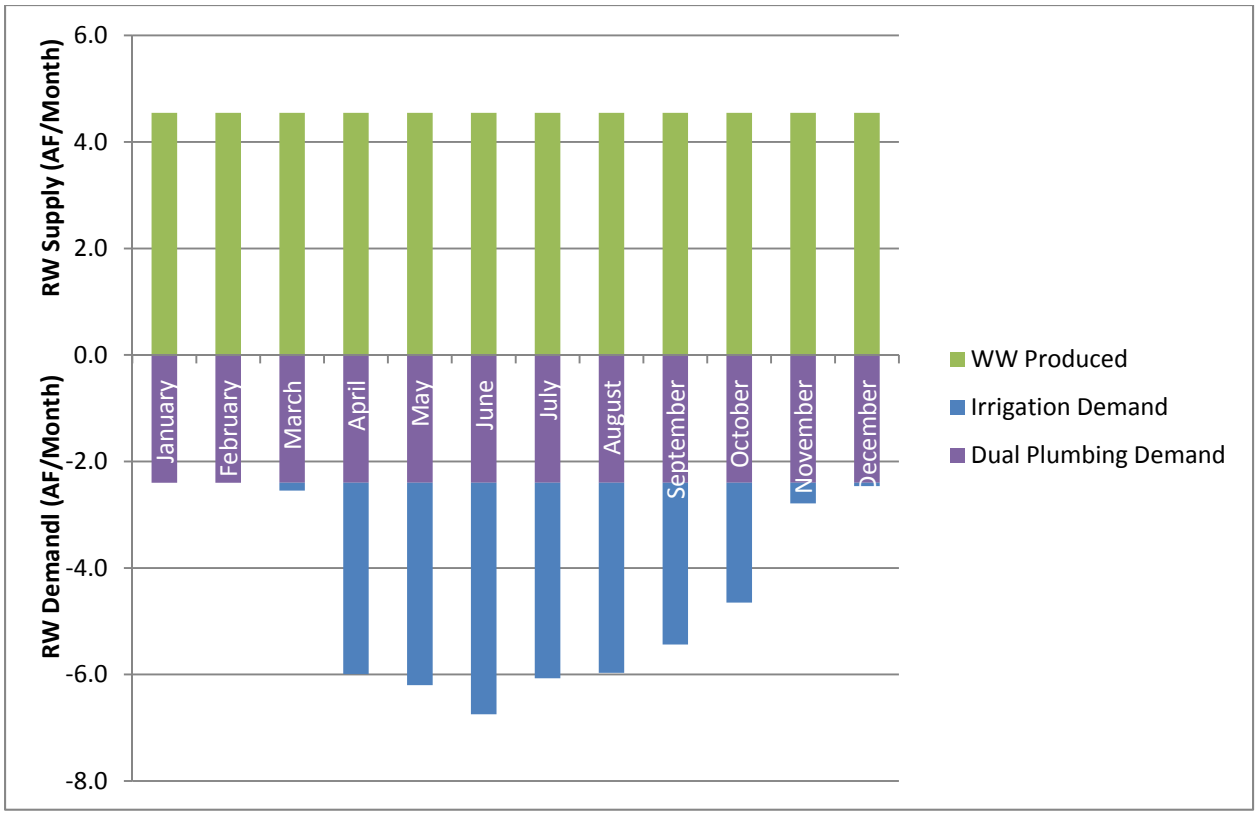

Figure 3. Seasonal supply and demand for recycled water, typical non-drought year

Wet Year

To account for annual variations in precipitation, WSC estimated the decreased landscape irrigation demand and increased recycled water disposal requirements during a "wet year". WSC defined "wet year" as the year with smallest annual surplus ET_o or the year with the least landscape irrigation demand. Of the 23 years of record, 1987 had the lowest annual surplus ET_o (33.43 in). It was assumed that the wastewater generated and the dual plumbing demand would be unaffected by increased precipitation. The decreased landscape irrigation demand during a wet year was calculated by multiplying the non-drought year irrigation demand (24.9 AFY) by the percentage difference in surplus ET_o for a wet year (33.43 in) versus surplus ET_o for a typical year (38.55 in) (6). This analysis resulted in a wet year landscape irrigation demand of 21.6 AFY, which was used to estimate the seasonal demand for recycled water (Table 6) and the surplus recycled water (Table 7) requiring disposal during a wet year (Figure 4).

Table 6. Seasonal demand for landscape irrigation recycled water, wet year

Column	*A*	*B*	*C*	*D*	*E*
Calculation			*=B-A (≥0)*	*=C/Sum(C)*	*=wet year landscape irrigation demand[1]*D*
Month	**Wet Year Precipitation (in)[2]**	**Wet Year Reference Evapotranspiration Et_o (in)[2]**	**Surplus ET_o (in)**	**% of total surplus ET_o**	**Estimated Monthly Landscape Irrigation Demand (AF)**
January	2.56	2.71	0.15	0	0.1
February	3.03	2.75	0	0	0.0
March	4.96	3.72	0	0	0.0
April	0.2	5.37	5.17	15	3.3
May	0.2	5.73	5.53	17	3.6
June	0.08	6.23	6.15	18	4.0
July	0.24	5.92	5.68	17	3.7
August	0.16	5.33	5.17	15	3.3
September	0.08	4.61	4.53	14	2.9
October	4.29	3.42	0	0	0.0
November	1.34	2.39	1.05	3	0.7
December	5.08	1.9	0	0	0.0
Annual					21.6

[1] Equal to 21.6 AFY as calculated in preceding paragraph
[2] Precipitation and evapotranspiration values for the wet year (1987) as defined in the preceding paragraph (6)

Table 7. Seasonal recycled water supply and demand, wet year

Column	*A*	*B*	*C*	*D*
Calculation				*=A-(B+C)*
Month	**Recycled Water Supply (AF)[1]**	**Dual Plumbing WW Demand (AF)[2]**	**Landscape Irrigation Demand (AF)[3]**	**Surplus (Deficit) Recycled Water Supply (AF)**
January	4.5	2.4	0.1	2.0
February	4.5	2.4	0.0	2.1
March	4.5	2.4	0.0	2.1
April	4.5	2.4	3.3	(1.2)
May	4.5	2.4	3.6	(1.4)
June	4.5	2.4	4.0	(1.8)
July	4.5	2.4	3.7	(1.5)
August	4.5	2.4	3.3	(1.2)
September	4.5	2.4	2.9	(0.8)
October	4.5	2.4	0.0	2.1
November	4.5	2.4	0.7	1.5
December	4.5	2.4	0.0	2.1
Annual	54.5	28.8	21.6	4.2

[1] Equals Wastewater Generated (AFY) from Table 3 divided by 12 months/yr
[2] Equals Dual Plumbing Recycled Water Demand (AFY) from Table 3 divided by 12 months/yr
[3] Obtained from Table 6

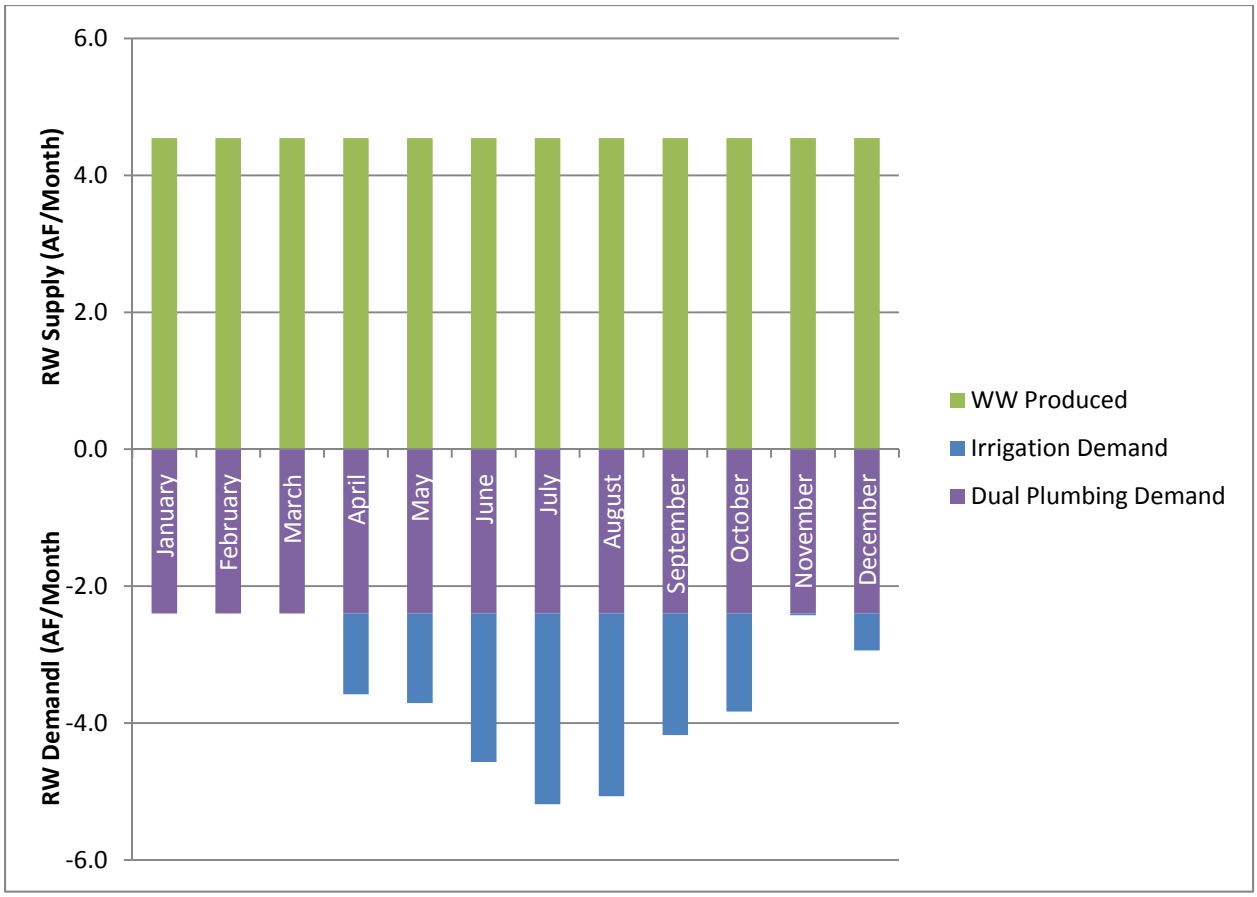

Figure 4. Seasonal supply and demand for recycled water, wet year

Regulatory and Jurisdictional Requirements

Wastewater Treatment & Discharge

Wastewater discharges within California are regulated by the Environmental Protection Agency (EPA), the State Water Resources Control Board (SWRCB), and the Regional Water Quality Control Board (RWQCB). The 1972 Federal Clean Water Act (CWA) directs the EPA to oversee and approve all state water quality standards. The SWRCB oversees nine Regional Water Quality Control Boards (RWQCBs); the RWQCBs are responsible for monitoring and enforcing the state and federal plans, policies, and regulations within their regions. The Tank Farm Development is located within the jurisdiction of the Central Coast RWQCB (Region 3). Discharging treated wastewater into waters of the state would require a National Pollution Discharge Elimination System (NPDES) permit from the RWQCB. Discharges to land, including sprinkler systems, would require a Report of Waste Discharge and potentially the adoption of Waste Discharge Requirements (7).

The Central Coast Region Basin Plan is the master water quality control planning document for the region. It designates beneficial uses and water quality objectives for waters of the state within the Central Coast Region. The Central Coast Region Basin Plan includes Surface Water Quality Objectives (SWQOs) for specific water bodies (8). The SWQOs are intended to serve as the water quality baseline for evaluating water quality management in the basin. The effluent disposal options for the proposed Tank Farm Development wastewater treatment facility include direct and indirect discharges into San Luis Obispo Creek, which is designated a water of the state. The SWQOs for San Luis Obispo Creek are presented as mean annual values (Table 8).

Table 8. Surface water quality objectives (SWQOs) for San Luis Obispo Creek (units in mg/L)

Sub-Basin/Sub-Area	TDS	Cl	SO_4	B	Na
San Luis Obispo Creek	650	100	100	.2	50

The CWA requires states to identify water bodies that do not meet water quality objectives and are not supporting their beneficial use (9). San Luis Obispo Creek is included on the Central Coast RWQCB's CWA list of water quality limited segments (303d list). By placing San Luis Obispo Creek on the 303d List, the RWQCB has identified specific pollutants that are impairing the water body and require the development of total maximum daily loads (TMDLs). A TMDL is the maximum amount of a pollutant that a body of water can receive while still meeting its water quality objectives. The specific requirements for a TMDL can be a mass loading limit or a maximum concentration limit. Currently, San Luis Obispo Creek has EPA approved TMDLs for nitrates and pathogens (Table 9) (10). TMDLs for sodium, chlorphyrifos, and chloride are expected to be approved by 2021. Discharges into San Luis Obispo creek must comply with existing and potentially future TMDLs.

Table 9. EPA Total maximum daily loads (TMDLs) regulations for San Luis Obispo Creek

Constituent	TMDL
Nitrate as N	10 mg/L
Pathogens (fecal coliform)	No less than 5 samples for any 30-day period, shall exceed a log mean of 200 MPN per 100ml, nor shall >10% of total samples collected exceed 400 MPN per 100ml

Recycled Water

Recycled water systems within the state of California are regulated by the California Department of Public Health (CDPH) and the RWQCB. The SWRCB developed a Recycled Water Policy (RWP) in 2009 with the intent of increasing the use of recycled water from municipal wastewater sources. When recycled water is used within compliance of the RWP, CDPH Title 22 Regulations, and all applicable state and federal water quality laws, the SWRCB supports the implementation of recycled water projects for approved uses (i.e. landscape irrigation, toilet flushing, industrial use, etc.) as a safe alternative to potable water (11).

The role of the SWRCB is to establish general policies governing the permitting of recycled water projects consistent with its role of protecting water quality and sustaining water supplies. The SWRCB provides general oversight over recycled water projects, leads the effort to meet the recycled water use goals established in the

RWP, and reviews all RWQCB permitting practices. The RWQCB is responsible for the protection of surface and groundwater sources from recycled water projects and for issuing permits that implement the CDPH recommendations.

The CDPH is charged with the protection of public health and drinking water supplies and for the development of usage criteria for recycled water. CDPH establishes the treatment requirements for each approved use of recycled water and is responsible for the development of backflow prevention and cross connection control programs requirements. CDPH regulations related to recycled water projects are found in the Title 17 and Title 22 of the California Code of Regulations. CDPH has approved the use of disinfected tertiary recycled water for landscape irrigation and for dual plumbed systems (12).

Airport Land Use Plan

Due to the proximity of the Tank Farm Development to the San Luis Obispo County Regional Airport, the proposed wastewater treatment and disposal facility must comply with the Airport Land Use Plan (ALUP). The Airport Land Use Commission developed the ALUP in 1973 in response to mandates included within the State Aeronautics Act. The ALUP is intended to protect the long-term economic viability of the airport by ensuring compatible land uses in the vicinity of the airport (13).

Policy A-1 of the ALUP states that any proposed developments will be determined to be inconsistent with the ALUP if they lack sufficient provisions to ensure that no structure, landscaping, apparatus, or other feature, whether temporary or permanent in nature shall constitute an “obstruction to air navigation” or a “hazard to air navigation”. An “obstruction to air navigation” is defined as an object that is greater than 200 feet above ground level or is above 409 feet MSL, whichever is greater. A “hazard to air navigation” is defined as any object which entails characteristics which would potentially interfere with takeoff, landing, or maneuvering of aircraft at the airport, including:

a. creation of electrical interference with navigation signals or radio communication between the aircraft;
b. lighting which is difficult to distinguish from airport lighting;
c. glare in the eyes of pilots using the airport;
d. uses which attract birds and create bird strike hazards;
e. uses which produce visually significant quantities of smoke;
f. uses which entail a risk of physical injury to operators or passengers of aircraft (e.g., exterior laser light demonstrations or shows)

In addition, the ALUP provides a Land Use Compatibility Table that specifies the allowable land uses and maximum permissible densities of development within the airport planning area. The following land uses, which could potentially be applicable to the proposed wastewater treatment facility, are prohibited within the Runway Protection Zone (RPZ): 1) manufacturing and processing; and 2) warehousing. Above ground piping is allowed within the RPZ as long as it does not convey flammable liquids. Figure 5 shows the location of the RPZ relative to the Tank Farm site.

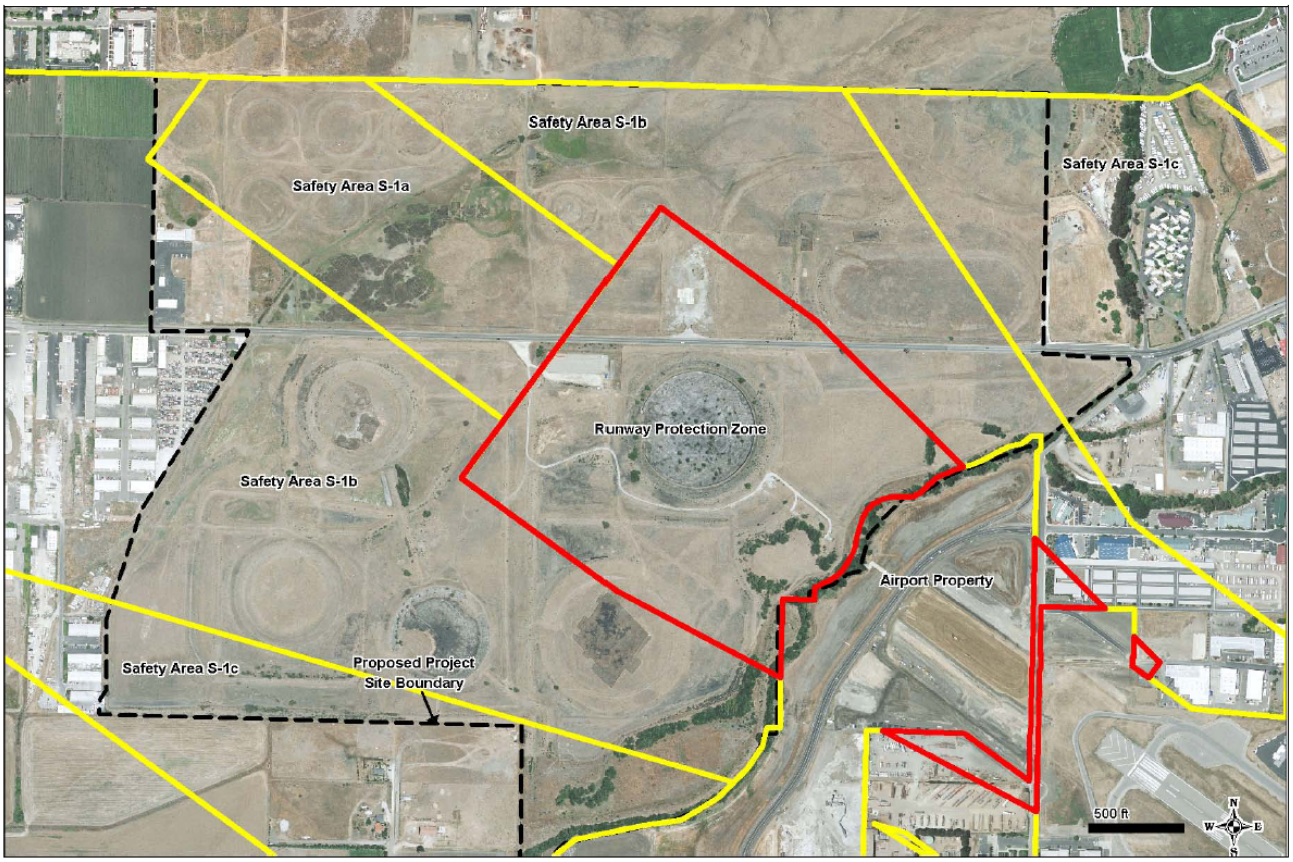

Figure 5. San Luis Obispo Regional Airport safety zones relative to the Tank Farm Development (1)

Wastewater Treatment Facility Siting

The placement of the proposed wastewater treatment and disposal facility is restricted by the Airport Land Use Plan. The entire Tank Farm Development falls within designated airport safety areas and certain portions of the project are within the restrictive Runway Protection Zone (RPZ) as shown in Figure 5. To avoid conflicts with the ALUP, the wastewater treatment facility was sited outside of the RPZ. Additionally, the wastewater treatment facility was sited near the proposed development to minimize sewer and recycled water pipeline lengths. The location of the proposed wastewater treatment facility is shown on Appendix B.

Project Phasing

The Tank Farm Development is scheduled to be completed over 25 years in five different development phases. Wastewater flows and recycled water demand will increase with development during each phase of the project. WSC developed estimates for wastewater generation and disposal based on the type and amount of land use planned for each phase of the project (Figure 6).

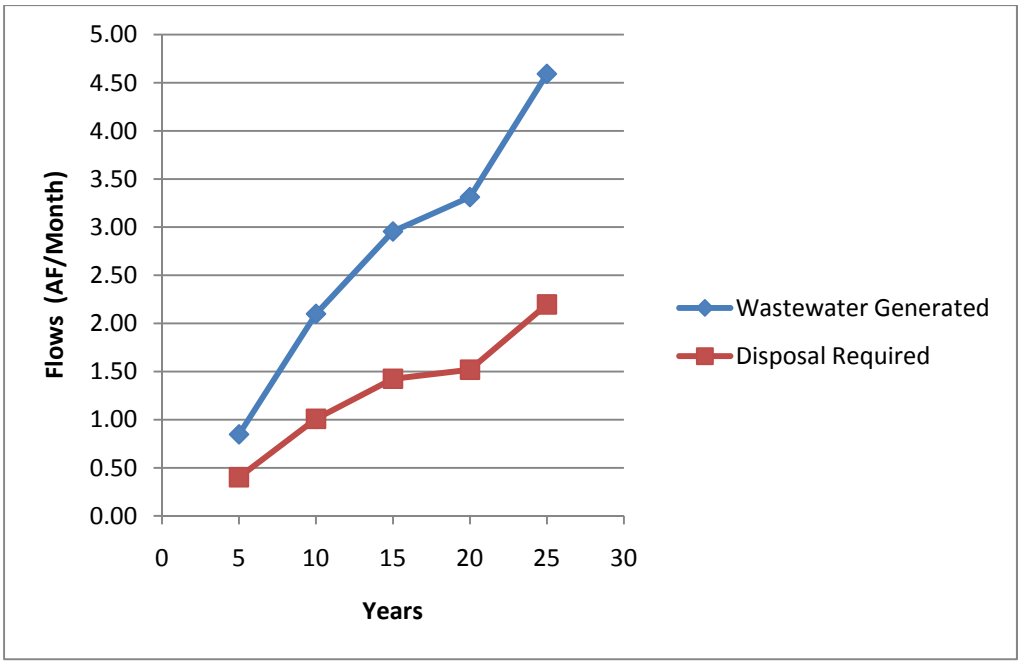

Figure 6. Wastewater generation and disposal projections, maximum month, wet year

The wastewater treatment facility would initially be designed for low flows and would be expandable to accommodate the increased wastewater treatment capacity required with the completion of each successive project phase. The capacity upgrades would be accomplished by adding parallel modular biological treatment trains. Each treatment train would have a capacity of 10,000 gpd or 0.9 AF/Month (Table 10). Phase 4 of the Tank Farm Development would not require a capacity upgrade as sufficient capacity would already be available from Phase 3 upgrade. If necessary, additional capacity could be provided through the installation of an additional treatment train. The facility headworks and process upset storage basin would initially be installed for build-out and would not increase incrementally with each project phase. The process upset storage basin would be sized to contain wastewater flows for two days.

Table 10. Incremental capacity analysis for the proposed wastewater treatment and disposal facility

Phase	Year	Wastewater Treatment Facility Capacity (AF/Month)
1	5	0.9
2	10	2.8
3	15	3.7
4	20	3.7
5	25	4.7

Wastewater Treatment Facility

The analysis of the treatment system of the proposed Tank Farm Development included an evaluation of the contaminants present in the source water and the potential regulatory requirements for the tertiary treated effluent discharged to land or to San Luis Obispo creek. The current technologies available for wastewater treatment are more than capable of ensuring that the tertiary treated effluent discharged from the Tank Farm Development wastewater treatment facility complies with RWQCB regulations for wastewater discharges and existing TMDLs and SWQOs for San Luis Obispo Creek. Discharges into San Luis Obispo Creek may not be required to meet the concentration limits stated in the SWQOs. Depending on how the NPDES permit is written, the constituent concentrations in discharged water may exceed the SWQO as long as the blended concentration of the water body does not exceed the SWQO. However, to demonstrate feasibility, discharges from the treatment processes proposed in this report are capable of meeting constituent concentrations limits outlined in the RWQCB SWQOs.

Biological Treatment

Two different biological treatment processes were analyzed for the Tank Farm Development wastewater treatment facility: 1) conventional activated sludge; and 2) membrane biological reactor (MBR). Both technologies are suspended growth aerobic treatment processes and are effective for the reduction of biological oxygen demand (BOD), total suspended solids (TSS), and nitrogen.

Each proposed wastewater treatment process is capable of producing treated effluent that complies with existing RWQCB regulations for wastewater treatment. Discharges into San Luis Obispo Creek must also comply with the existing RWQCB TMDLs. Both technologies can achieve nitrification and denitrification (NDN), by incorporating an anoxic zone and mixed liquor recycle into the suspended growth reactors, to ensure that the treated effluent complies with the TMDL requirement for nitrate (10 mg/L as Nitrogen) within San Luis Obispo Creek (5).

Conventional Activated Sludge

The conventional activated sludge treatment process includes an aerated continuous stirred tank reactor, a secondary clarifier, and a recycle system for returning waste activated sludge to the treatment process. The complete treatment plant includes the following unit processes: screening; flow equalization; process upset storage; activated sludge; clarification; solids thickening; dewatering; coagulation; filtration; chlorine disinfection; dechlorination; and reverse osmosis (Figure 7).

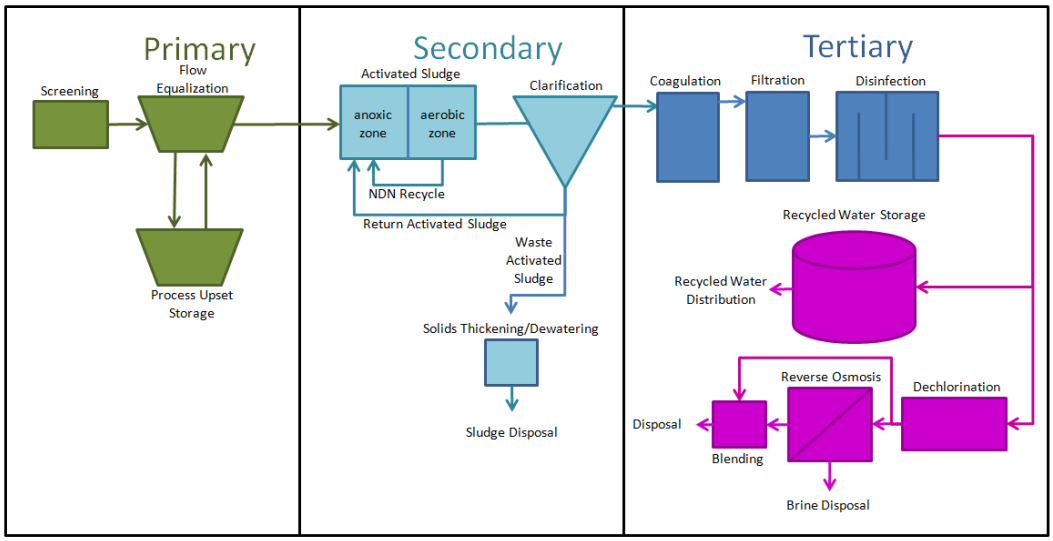

Figure 7. Activated sludge process flow diagram

To meet treatment regulations for disinfected tertiary recycled water, an activated sludge treatment process must be followed by coagulation, filtration, and disinfection. A coagulation basin and multi-media filter followed by a chlorine contact tank would used to meet the filtration and disinfection requirements. Numerous manufactures produce package activated sludge treatment plants designed to accommodate flow rates from 10,000 to 500,000 gallons per day. To minimize the footprint of these facilities, many of the treatment process are combined into one treatment unit. These package treatment plants can be installed above or below grade and are readily scalable to handle increased flow rates. Product specifications for an example activated sludge package plant are included in Appendix C. A plan view diagram of the example activated sludge wastewater treatment facility is located in Appendix D.

Membrane Bio-Reactor

A membrane biological reactor (MBR) consists of an aerated continuous stirred tank reactor followed by a membrane microfiltration separation process (Figure 8). To limit the footprint of the MBR process, the microfiltration membranes can be immersed in the biological reactor tank. One of the primary benefits of the MBR process is that the effluent quality produced is equivalent to what can be achieved with an activated sludge process, secondary sedimentation, and microfiltration process. Thus, the MBR can achieve a high quality effluent with a minimal footprint.

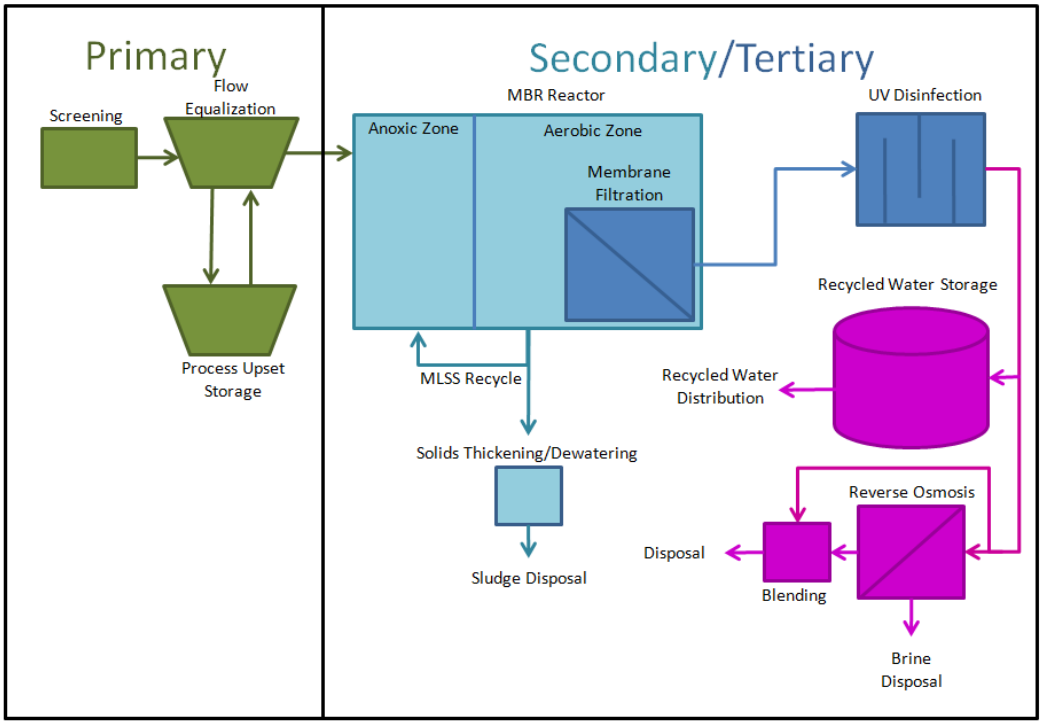

Figure 8. MBR process flow diagram

The microfiltration membranes provide solids separation and tertiary filtration. For the MBR treatment system, ultraviolet (UV) disinfection could be used to meet the disinfection requirements for disinfected tertiary recycled water due to the high UV transmittance of the product water. Product specifications and a plan view diagram for an example package MBR plant are included in Appendix E and Appendix F, respectively.

Reverse Osmosis

Due to the levels of Total Dissolved Solids (TDS), Sodium (Na), Chloride (Cl), and Boron (B) in the source water, the proposed treatment facility includes a reverse osmosis (RO) treatment system to remove these dissolved constituents from a portion of the effluent stream. Including RO ensures that the effluent discharged from the wastewater treatment facility does not exceed the RWQCB SWQOs for San Luis Obispo Creek. For the purposes of demonstrating feasibility, the RO treatment system was sized to treat a portion of the treatment facility effluent sufficient to ensure that the blended effluent concentration of the above listed contaminants do not exceed the SWQOs for San Luis Obispo Creek, as a “worst case” scenario. Actual sizing and operation of the RO system would be based upon discharge requirements defined by the RWQCB for this facility. Detailed calculations on the portion of the recycled water that would require treatment through the reverse osmosis system can be found in Appendix G.

Brine from the reverse osmosis treatment process would be stored onsite. Periodically the brine would be trucked to the South San Luis Obispo Community Services District (SSLOCSD) for disposal. The SSLOCSD currently offers a brine disposal service that allows participants to discharge their brine waste into the Pacific Ocean through the SSLOCSD’s ocean outfall. The SSLOCSD anticipates that there is sufficient capacity to dispose of the brine produced at the Tank Farm Development (14). Based on the “worst case” discharge scenario

described above, WSC calculated that at full build out the Tank Farm Development would require approximately 17 truck trips per month to dispose of the brine, assuming a disposal capacity of 4,000 gallons per trip.

Due to the TDS, Na, and Cl discharge restrictions, it may be necessary restrict the use of self-regenerating water softeners (SRWS) within the Tank Farm Development. SRWS are used to soften water through the removal calcium and magnesium. However, during the regeneration process a brine solution, composed of NaCl, is used to remove the calcium, magnesium, and other minerals. This brine waste is typically discharged to the wastewater collection system and can increase the salinity of the treated wastewater. The California State Assembly recently passed legislation (AB 1366) that allows local governments to ban residential water softeners within community water systems. Similar restrictions could be incorporated into the developer's agreement, covenants conditions and restrictions (CC&Rs), and/or leasing agreements for the Tank Farm Development.

Solids Management

Waste activated sludge (WAS) from the treatment process would be thickened on-site using gravity thickeners. The supernatant from the gravity thickeners would be decanted and returned to the headworks of the wastewater treatment facility. The thickened WAS could be dewatered onsite using a centrifuge or belt filter press and disposed of offsite or trucked off in liquid form. The biosolids disposal must comply with EPA regulations for municipal solid waste landfills as specified in 40 CFR 258. Dewatered biosolids are accepted at several of the local landfills and are used for landfill cover or compost production (15). WSC estimates that biosolids removal will require 2-3 truck trips per month, assuming a load capacity of 2 tons and solids dewatering on-site.

Disinfection

UV and chlorine disinfection are proven technologies and both capable of ensuring the tertiary treated effluent does not exceed the TMDL for pathogens in San Luis Obispo creek. UV disinfection has the advantage of not requiring de-chlorination of the effluent prior to disposal. However, chlorination would be required for the recycled water system to prevent bacterial re-growth within the distribution system.

Effluent Disposal Evaluation

The recycled water analysis performed on the Tank Farm Development indicates that during wet years the recycled water supply exceeds the recycled water demand. Therefore, the wastewater disposal facilities must be sized to accommodate the increased disposal requirements, due to decreased landscape irrigation demands during wet years. Multiple wastewater disposal options were evaluated using the wet year disposal requirements for the Tank Farm Development. These disposal options were divided into two primary categories: land disposal and surface discharge.

Land Disposal

Three different land disposal options were evaluated for wastewater treatment and disposal facility: spray fields; leach fields; and constructed wetlands. Leach fields were eliminated as a possible alternative due to the poor soil permeability and the high groundwater level found at the Tank Farm site.

Spray Fields

Spray fields rely upon evapotranspiration for wastewater disposal. Disposal is achieved by spraying recycled water on designated land areas where grasses or other crops uptake and release the wastewater through transpiration or it evaporates from the soil. Soil percolation can add disposal capacity in a typical spray field. However, given the poor percolation conditions at the Tank Farm site, it was assumed that wastewater percolation was negligible for the spray field calculations.

The disposal rates for spray fields are related to evapotranspiration and vary by climate, season, and type of plant cover. Spray fields can only be effectively utilized during the months when evapotranspiration exceeds precipitation. Therefore, in order for spray fields to be considered a viable disposal alternative, they must be operated seasonally, and seasonal storage is required.

A water balance, using recycled water supply, precipitation, seasonal storage, and crop specific evapotranspiration was created to calculate the area of spray field required for disposal (Appendix H). During the dry months, evapotranspiration and recycled water demand exceeds the precipitation and recycled water supply, allowing for disposal of stored recycled water. During the wet months, the volume of recycled water in storage increases as the recycled water supply and precipitation exceed the evapotranspiration and recycled water demand (Figure 9).

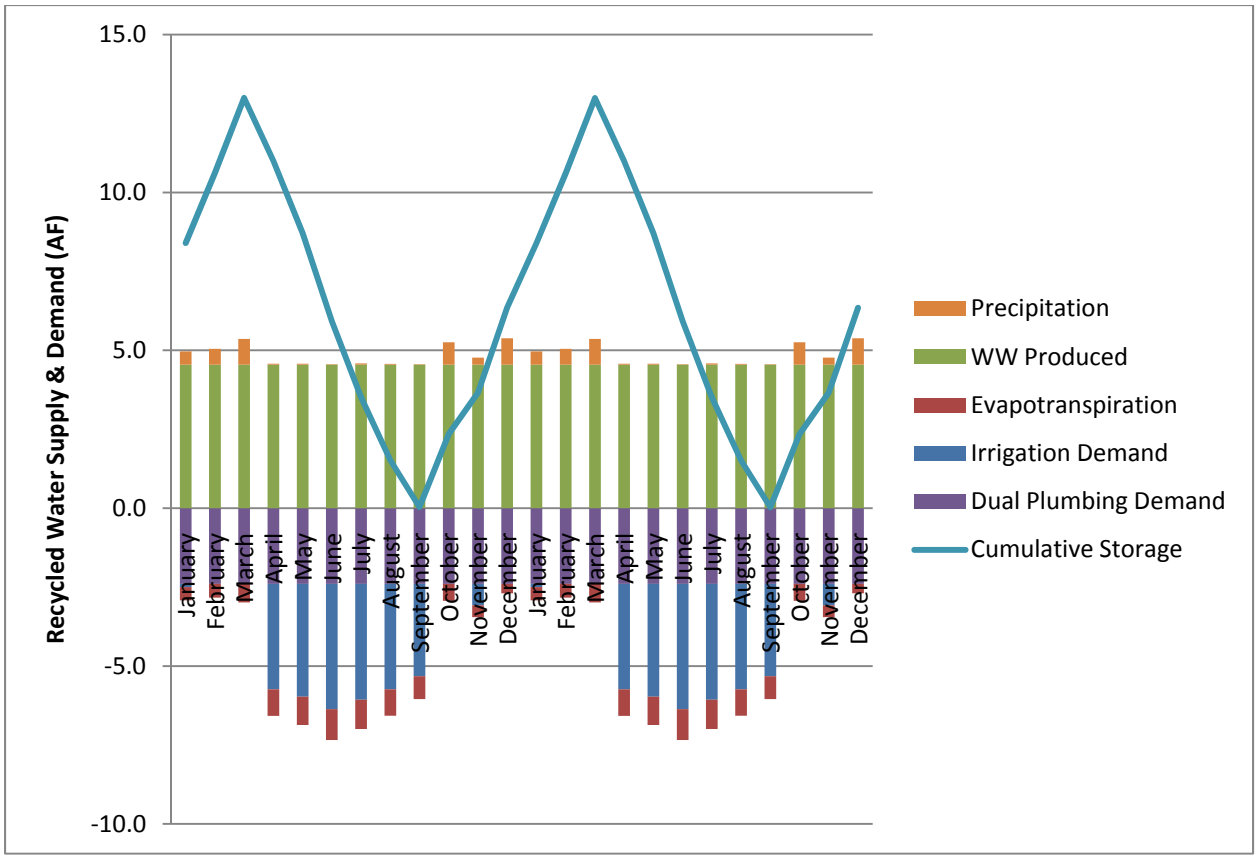

Figure 9. Water Balance - spray field disposal using wet year precipitation and evapotranspiration data

For the water balance, WSC used the evapotranspiration and precipitation data for a wet year to develop an estimate of the spray field area required. Turf grass, which has an evapotranspiration coefficient of 0.95 (16), was selected as the crop type for the spray fields. The area required for disposal of the wastewater using spray fields during a wet year is approximately 2.4 acres[1].

WSC calculated that the seasonal storage requirement for a spray field to be 15.6 AF or 5.1 MG. Seasonal storage would require an above or below ground storage tank. Supplemental disinfection would be required to ensure that bacterial re-growth did not occur for the storage tank. A 5.1 MG circular storage tank would be roughly 170 to 210 feet in diameter and from 20 to 30 feet deep.

The spray field disposal option was eliminated as a possible alternative due to the extensive seasonal storage requirements and footprint requirements. The size of the storage tank and spray field area are prohibitive and not feasible for the Tank Farm Development.

Constructed Wetlands

Evapotranspiration is the primary wastewater disposal mechanism for constructed wetlands utilized for complete disposal. As with spray fields, soil percolation can provide additional disposal, but was assumed to be

[1] A 20% safety factor was included in spray field sizing to account for extreme wet years, performance variability and operational considerations such as maintenance downtime.

negligible for this analysis. A separate water balance, using recycled water supply, precipitation, seasonal storage, and crop specific evapotranspiration was created to calculate the area of wetlands required for complete disposal (Figure 10) (Appendix I). WSC selected a crop coefficient of 1.20 for the constructed wetlands (16).

Allowing the water level within to the constructed wetland to fluctuate in depth could provide seasonal and extreme wet year storage, without the need for a seasonal storage tank. To provide seasonal storage within the proposed wetland would require the water level to fluctuate approximately 3-4 ft during a wet year. However, by utilizing the wetlands as seasonal storage requires a larger footprint than the spray field as recycled water stored in the wetlands cannot be used to fulfill the recycled water deficit in the dry summer months. The constructed wetland water balance indicated that 3.8 acres of wetland area is needed to dispose of the excess recycled water produced at the Tank Farm Development during a wet year.

The constructed wetlands were eliminated as a disposal option because of the footprint requirements and incompatibility with the ALUP. Constructed wetlands could pose a hazard to air navigation as they attract birds and create bird strike hazards. The only areas within the project site with sufficient space for the constructed wetland were within the RPZ.

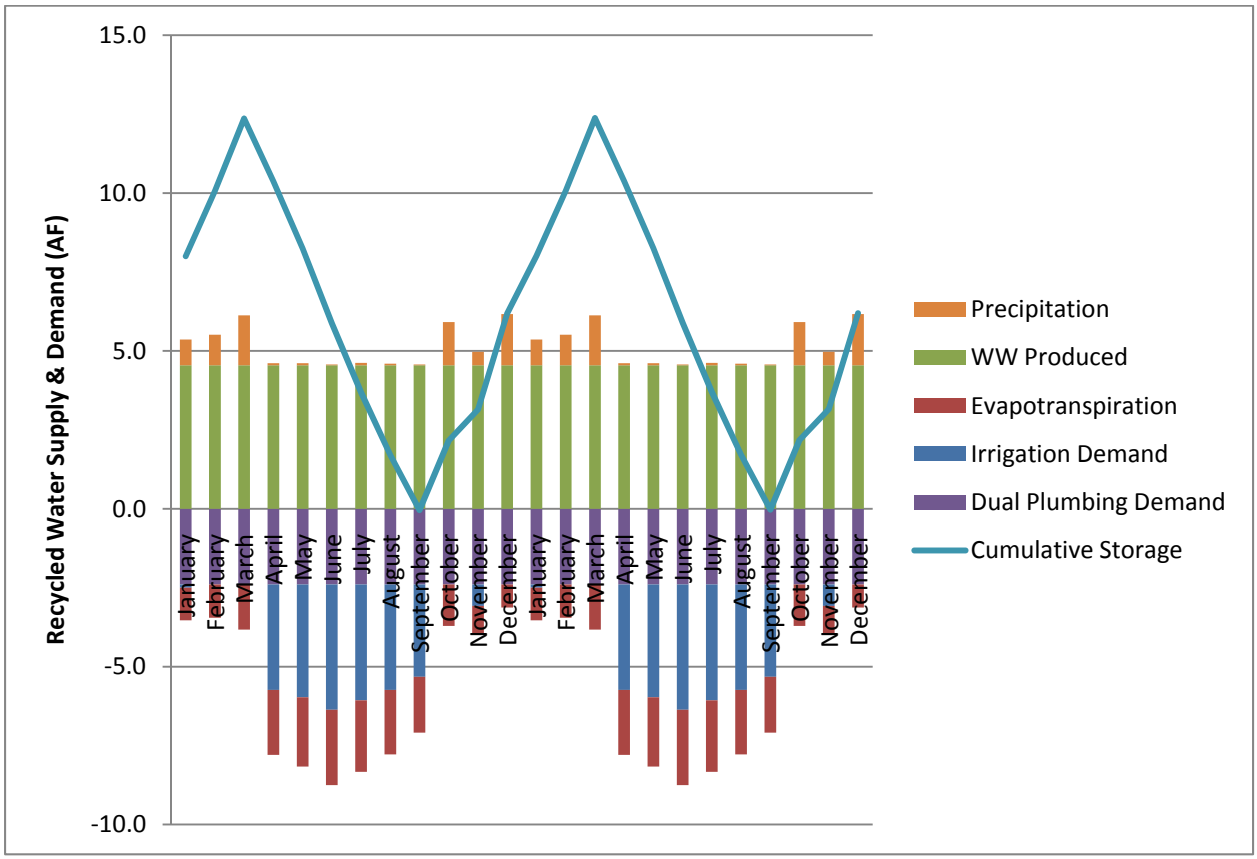

Figure 10. Water Balance - constructed wetlands disposal using wet year precipitation and evapotranspiration data

Surface Discharge

WSC evaluated two surface discharge options for the Tank Farm wastewater treatment facility: 1) polishing wetlands discharge; and 2) live stream discharge. Neither option includes nor requires seasonal storage.

Polishing Wetlands

In the polishing wetland discharge option, blended tertiary treated effluent would be discharged into a constructed wetland designed for polishing and/or supplemental treatment, not complete disposal. After flowing through the polishing wetlands, the treated effluent would flow into the existing onsite wetlands, into Tank Farm Creek, and ultimately discharge into San Luis Obispo Creek. The wetland could be utilized for polishing of the tertiary treated effluent for further nitrogen removal; minimal amounts of nitrogen will remain after the NDN process. This remaining nitrogen would be in the fully nitrified form (NO_3) and could then be denitrified and removed from the effluent within several days in an appropriately designed and maintained polishing wetland (17). The polishing wetland was sized to have a hydraulic residence time (HRT) of 10 days. At a maximum month flow rate of approximately 23,000 gpd or 2.1 AF/Month and a depth of 1.0 ft, the wetland area necessary to achieve a HRT of 10 is approximately 0.7 acres. A plan view diagram for the polishing wetlands discharge is located in Appendix J.

Discharge of the blended tertiary treated effluent into the polishing wetland would be highest during the winter months due to the decreased demand for landscape irrigation recycled water. Thus, discharges would mimic natural systems with the higher flows occurring during the wet winter months, and minimal to no discharge during the dry summer months.

Live Stream Discharge

The live stream discharge option would include an outfall directly into San Luis Obispo Creek. The maximum month discharge into San Luis Obispo Creek was calculated to be approximately 23,000 gpd or 2.1 AF/Month. Treated effluent discharge into San Luis Obispo Creek would follow the same pattern as the polishing wetland discharges and would mimic natural systems. The live stream discharge alternative has the advantage of not creating an environment that would attract waterfowl and create potential hazard to air navigation. A plan view diagram for the live stream discharge alternative is located in Appendix K.

Preferred Treatment and Disposal Alternative

WSC developed a decision matrix for the different treatment and disposal methods to determine the preferred alternative(s) for the Tank Farm Development wastewater treatment and disposal facility. The decision matrix for the selection of biological treatment process includes the following categories: footprint; effluent quality; process complexity; and operational stability (Table 11). The matrix is color-coded with red representing a poor option, yellow representing an average option, and green representing a good option. As illustrated in the decision matrix, a MBR treatment process is the preferred alternative for wastewater treatment. MBRs have a smaller footprint and produce a higher quality of effluent than an activated sludge treatment system.

Table 11. Decision matrix - wastewater treatment process

Treatment Process	Footprint	Effluent Quality	Process Complexity	Operational Stability
Conventional Activated Sludge	Moderate Process Footprint	Medium Quality Effluent	Moderate Complexity	Very Stable
Membrane Biological Reactor (MBR)	Compact Process Footprint	High Quality Effluent	Moderate Complexity	Moderately Stable

A separate decision matrix was developed for the selection of the preferred alternative for effluent disposal. The disposal alternatives were evaluated using the following criteria: footprint; seasonal storage requirement; process reliability; airport compatibility; and regulatory requirements (Table 12).

Table 12. Decision matrix - effluent disposal system

Effluent Disposal System	Footprint (Acres)	Seasonal Storage Requirement	Process Reliability	Airport Compatibility	Regulatory Requirements
Land Disposal					
Spray Fields	2.4	Significant Storage Requirement	Moderate Reliability	Potential Incompatibility	Minimal Regulatory Requirements
Constructed Wetlands	3.8	Moderate Storage Requirement	Moderate Reliability	Significant Incompatibility	Minimal Regulatory Requirements
Surface Discharge					
Polishing Wetlands	0.7	Negligible Storage Requirement	High Reliability	Minimal Incompatibility	Significant Regulatory Requirements
Live Stream Discharge	Negligible	Negligible Storage Requirement	High Reliability	Minimal Incompatibility	Significant Regulatory Requirements

As shown in the decision matrix, a polishing wetland and the live stream discharge are the preferred alternatives for effluent disposal from the Tank Farm Development. The polishing wetland and live stream discharge disposal options would have a minimal footprint, negligible storage requirement, high level of reliability, and minimal incompatibility with the ALUP. However, these options would face significant regulatory requirements, as they would require a NPDES permit approved by the RWQCB and the EPA.

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Appendix A

CIMIS Site #52 Surplus ET_0 Calculations

CIMIS Station Data

Central Coast Valleys - San Luis Obispo - #52

Year	Month Year	Tot ETo(in)	Tot Precip(in)	Monthly Surplus Eto (>0)
1987	Jan-87	2.71	2.56	0.15
	Feb-87	2.75	3.03	0.00
	Mar-87	3.72	4.96	0.00
	Apr-87	5.37	0.20	5.17
	May-87	5.73	0.20	5.53
	Jun-87	6.23	0.08	6.15
	Jul-87	5.92	0.24	5.68
	Aug-87	5.33	0.16	5.17
	Sep-87	4.61	0.08	4.53
	Oct-87	3.42	4.29	0.00
	Nov-87	2.39	1.34	1.05
	Dec-87	1.90	5.08	0.00
1987 Total		**50.08**	**22.22**	**33.43**
1989	Jan-89	2.62	0.98	1.64
	Feb-89	2.17	1.73	0.44
	Mar-89	3.66	2.09	1.57
	Apr-89	4.84	0.63	4.21
	May-89	5.82	0.08	5.74
	Jun-89	6.13	0.00	6.13
	Jul-89	7.06	0.00	7.06
	Aug-89	5.68	0.00	5.68
	Sep-89	4.72	1.65	3.07
	Oct-89	3.95	1.81	2.14
	Nov-89	3.38	0.55	2.83
	Dec-89	2.61	0.00	2.61
1989 Total		**52.64**	**9.52**	**43.12**
1990	Jan-90	2.44	3.27	0.00
	Feb-90	2.74	3.03	0.00
	Mar-90	3.51	0.63	2.88
	Apr-90	4.78	0.39	4.39
	May-90	5.57	1.54	4.03
	Jun-90	6.97	0.00	6.97
	Jul-90	6.66	1.73	4.93
	Aug-90	6.20	0.04	6.16
	Sep-90	5.32	0.59	4.73
	Oct-90	4.54	0.00	4.54
	Nov-90	3.40	0.39	3.01
	Dec-90	2.66	0.51	2.15
1990 Total		**54.79**	**12.12**	**43.79**
1991	Jan-91	2.30	0.71	1.59
	Feb-91	2.88	3.62	0.00
	Mar-91	3.31	12.36	0.00

	Apr-91	5.55	0.39	5.16
	May-91	6.02	0.00	6.02
	Jun-91	5.39	0.79	4.60
	Jul-91	5.75	0.00	5.75
	Aug-91	5.38	0.04	5.34
	Sep-91	4.76	0.00	4.76
	Oct-91	4.01	0.59	3.42
	Nov-91	3.83	0.75	3.08
	Dec-91	2.43	4.21	0.00
1991 Total		**51.61**	**23.46**	**39.72**
1992	Jan-92	2.73	3.50	0.00
	Feb-92	2.60	10.04	0.00
	Mar-92	3.11	3.27	0.00
	Apr-92	6.02	0.04	5.98
	May-92	5.51	1.34	4.17
	Jun-92	6.11	1.85	4.26
	Jul-92	6.27	0.35	5.92
	Aug-92	6.44	0.04	6.40
	Sep-92	4.79	0.00	4.79
	Oct-92	3.47	1.30	2.17
	Nov-92	3.00	0.00	3.00
	Dec-92	1.81	5.59	0.00
1992 Total		**51.86**	**27.32**	**36.69**
1993	Jan-93	1.69	10.79	0.00
	Feb-93	1.87	8.78	0.00
	Mar-93	3.69	3.46	0.23
	Apr-93	5.85	0.28	5.57
	May-93	6.09	0.20	5.89
	Jun-93	6.94	0.20	6.74
	Jul-93	5.69	0.00	5.69
	Aug-93	5.81	0.28	5.53
	Sep-93	4.71	0.00	4.71
	Oct-93	3.73	0.24	3.49
	Nov-93	2.61	2.01	0.60
	Dec-93	2.27	2.17	0.10
1993 Total		**50.95**	**28.41**	**38.55**
1994	Jan-94	2.36	2.91	0.00
	Feb-94	2.31	6.14	0.00
	Mar-94	4.03	1.46	2.57
	Apr-94	4.80	1.46	3.34
	May-94	5.21	0.79	4.42
	Jun-94	6.89	0.00	6.89
	Jul-94	6.02	0.00	6.02
	Aug-94	6.10	0.20	5.90
	Sep-94	4.38	3.11	1.27
	Oct-94	3.82	0.91	2.91
	Nov-94	2.43	2.60	0.00

	Dec-94	1.90	1.10	0.80
1994 Total		**50.25**	**20.68**	**34.12**
1995	Jan-95	1.37	16.22	0.00
	Feb-95	2.40	2.56	0.00
	Mar-95	3.52	18.66	0.00
	Apr-95	4.55	1.14	3.41
	May-95	4.53	0.59	3.94
	Jun-95	6.02	0.79	5.23
	Jul-95	6.86	0.00	6.86
	Aug-95	6.41	0.00	6.41
	Sep-95	4.85	0.08	4.77
	Oct-95	4.06	0.00	4.06
	Nov-95	2.72	0.00	2.72
	Dec-95	1.97	3.82	0.00
1995 Total		**49.26**	**43.86**	**37.40**
1996	Jan-96	2.11	6.10	0.00
	Feb-96	1.93	7.20	0.00
	Mar-96	3.84	0.04	3.80
	Apr-96	5.40	1.89	3.51
	May-96	6.11	1.02	5.09
	Jun-96	6.17	0.00	6.17
	Jul-96	6.72	0.00	6.72
	Aug-96	6.12	0.00	6.12
	Sep-96	4.60	0.04	4.56
	Oct-96	3.90	6.10	0.00
	Nov-96	2.21	4.45	0.00
	Dec-96	1.69	11.18	0.00
1996 Total		**50.80**	**38.02**	**35.97**
1997	Jan-97	1.67	13.86	0.00
	Feb-97	2.69	1.18	1.51
	Mar-97	3.96	0.00	3.96
	Apr-97	5.31	0.04	5.27
	May-97	6.63	0.16	6.47
	Jun-97	6.23	0.00	6.23
	Jul-97	6.05	0.00	6.05
	Aug-97	6.13	0.00	6.13
	Sep-97	5.53	0.00	5.53
	Oct-97	4.68	0.00	4.68
	Nov-97	2.46	4.92	0.00
	Dec-97	1.71	4.92	0.00
1997 Total		**53.05**	**25.08**	**45.83**
1998	Jan-98	1.76	6.85	0.00
	Feb-98	1.74	15.75	0.00
	Mar-98	3.64	4.96	0.00
	Apr-98	4.58	2.40	2.18
	May-98	5.15	2.32	2.83
	Jun-98	5.68	0.00	5.68

	Jul-98	7.12	0.00	7.12
	Aug-98	7.08	0.00	7.08
	Sep-98	4.97	0.35	4.62
	Oct-98	4.45	0.39	4.06
	Nov-98	2.81	2.48	0.33
	Dec-98	2.64	0.63	2.01
1998 Total		**51.62**	**36.13**	**35.91**
1999	Jan-99	2.99	3.86	0.00
	Feb-99	3.33	2.36	0.97
	Mar-99	3.87	1.81	2.06
	Apr-99	4.47	0.00	4.47
	May-99	5.45	0.00	5.45
	Jun-99	5.79	0.00	5.79
	Jul-99	6.69	0.00	6.69
	Aug-99	6.19	0.00	6.19
	Sep-99	4.81	0.00	4.81
	Oct-99	4.47	0.00	4.47
	Nov-99	2.83	0.00	2.83
	Dec-99	2.98	0.00	2.98
1999 Total		**53.87**	**8.03**	**46.71**
2000	Jan-00	2.22	0.22	2.00
	Feb-00	1.84	0.13	1.71
	Mar-00	3.18	0.00	3.18
	Apr-00	4.38	0.56	3.82
	May-00	5.71	0.10	5.61
	Jun-00	5.72	0.29	5.43
	Jul-00	5.94	0.00	5.94
	Aug-00	5.65	0.00	5.65
	Sep-00	4.45	0.07	4.38
	Oct-00	3.08	2.80	0.28
	Nov-00	2.78	0.02	2.76
	Dec-00	2.32	0.20	2.12
2000 Total		**47.27**	**4.39**	**42.88**
2001	Jan-01	2.12	7.46	0.00
	Feb-01	2.22	5.03	0.00
	Mar-01	3.66	4.38	0.00
	Apr-01	4.56	1.62	2.94
	May-01	6.41	0.00	6.41
	Jun-01	7.06	0.00	7.06
	Jul-01	5.71	0.01	5.70
	Aug-01	5.83	0.00	5.83
	Sep-01	4.82	0.00	4.82
	Oct-01	3.46	0.42	3.04
	Nov-01	2.02	5.28	0.00
	Dec-01	1.68	3.51	0.00
2001 Total		**49.55**	**27.71**	**35.80**
2002	Jan-02	2.22	1.11	1.11

	Feb-02	3.11	1.21	1.90
	Mar-02	3.72	2.13	1.59
	Apr-02	4.42	1.08	3.34
	May-02	5.79	0.79	5.00
	Jun-02	6.43	0.00	6.43
	Jul-02	6.78	0.00	6.78
	Aug-02	5.72	0.00	5.72
	Sep-02	4.85	0.00	4.85
	Oct-02	3.38	0.00	3.38
	Nov-02	2.80	0.00	2.80
	Dec-02	1.61	6.76	0.00
2002 Total		**50.83**	**13.08**	**42.90**
2003	Jan-03	2.54	0.30	2.24
	Feb-03	2.47	2.83	0.00
	Mar-03	4.33	3.11	1.22
	Apr-03	4.46	1.56	2.90
	May-03	5.87	1.26	4.61
	Jun-03	5.30	1.66	3.64
	Jul-03	5.56	0.04	5.52
	Aug-03	5.13	0.00	5.13
	Sep-03	4.94	0.13	4.81
	Oct-03	3.63	0.00	3.63
	Nov-03	2.22	1.86	0.36
	Dec-03	1.61	3.65	0.00
2003 Total		**48.06**	**16.40**	**34.06**
2004	Jan-04	2.02	1.05	0.97
	Feb-04	2.04	5.96	0.00
	Mar-04	4.33	0.57	3.76
	Apr-04	5.49	0.00	5.49
	May-04	6.59	0.00	6.59
	Jun-04	6.03	0.00	6.03
	Jul-04	5.33	0.00	5.33
	Aug-04	5.02	0.00	5.02
	Sep-04	4.96	0.00	4.96
	Oct-04	3.31	2.34	0.97
	Nov-04	2.17	2.54	0.00
	Dec-04	2.00	5.27	0.00
2004 Total		**49.29**	**17.73**	**39.12**
2005	Jan-05	1.82	2.69	0.00
	Feb-05	1.94	5.75	0.00
	Mar-05	3.31	4.05	0.00
	Apr-05	4.75	1.76	2.99
	May-05	5.82	1.96	3.86
	Jun-05	5.69	0.00	5.69
	Jul-05	6.08	0.00	6.08
	Aug-05	5.23	0.00	5.23
	Sep-05	4.30	0.00	4.30

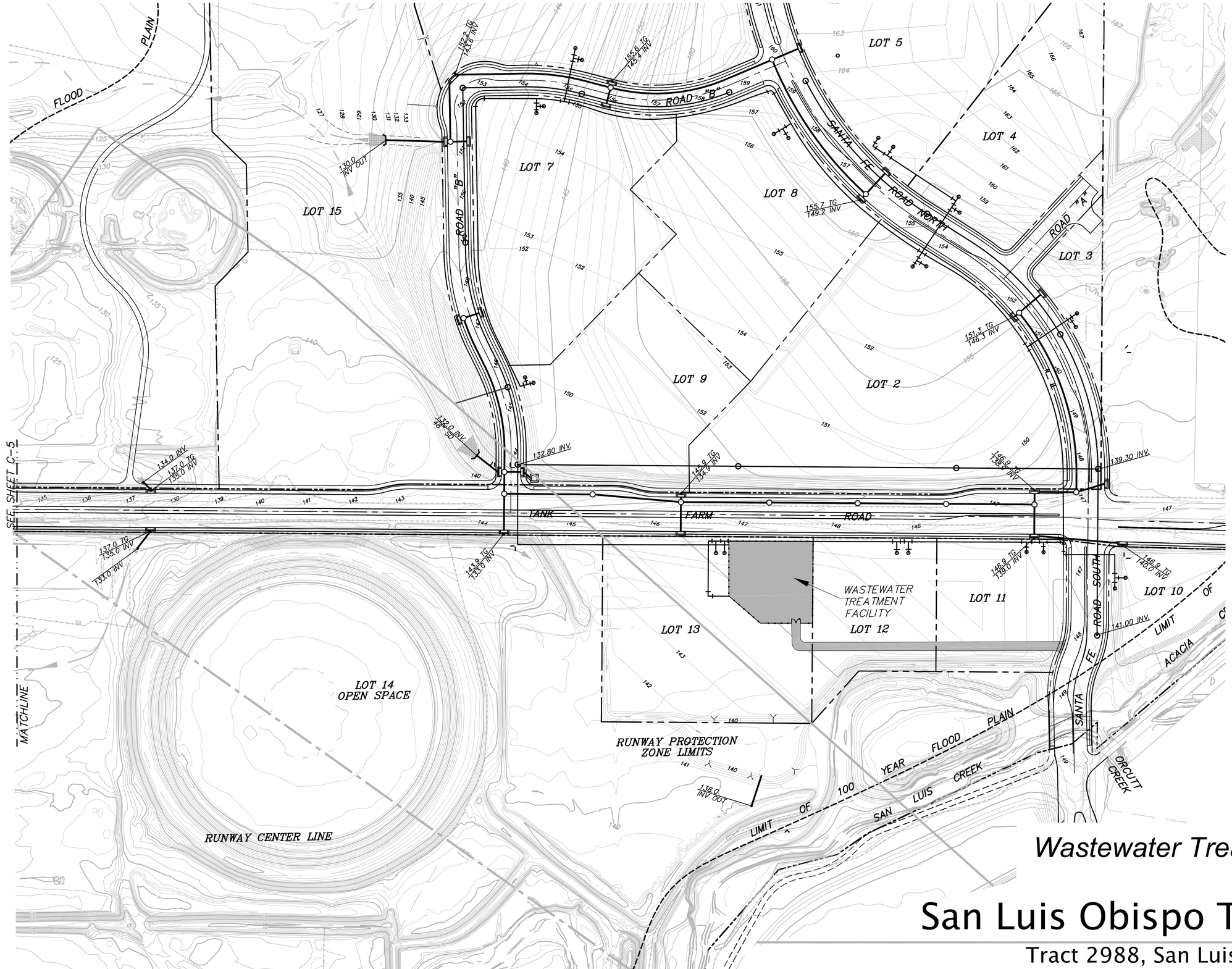
	Oct-05	3.51	0.00	3.51
	Nov-05	2.54	0.00	2.54
	Dec-05	2.14	0.00	2.14
2005 Total		**47.13**	**16.21**	**36.34**
2006	Jan-06	2.06	0.90	1.16
	Feb-06	2.81	1.48	1.33
	Mar-06	2.66	5.17	0.00
	Apr-06	2.89	2.39	0.50
	May-06	5.14	1.58	3.56
	Jun-06	5.75	0.00	5.75
	Jul-06	5.94	0.00	5.94
	Aug-06	5.24	0.00	5.24
	Sep-06	4.35	0.00	4.35
	Oct-06	3.59	0.01	3.58
	Nov-06	2.82	0.42	2.40
	Dec-06	2.44	2.85	0.00
2006 Total		**45.69**	**14.80**	**33.81**
2007	Jan-07	2.56	0.14	2.42
	Feb-07	2.17	0.87	1.30
	Mar-07	4.06	0.48	3.58
	Apr-07	4.57	0.59	3.98
	May-07	3.85	0.08	3.77
	Jun-07	6.23	0.00	6.23
	Jul-07	6.35	0.00	6.35
	Aug-07	5.86	0.10	5.76
	Sep-07	4.79	0.00	4.79
	Oct-07	4.07	0.15	3.92
	Nov-07	3.00	0.01	2.99
	Dec-07	2.39	3.72	0.00
2007 Total		**49.90**	**6.14**	**45.09**
2008	Jan-08	1.91	8.70	0.00
	Feb-08	2.80	3.71	0.00
	Mar-08	4.57	0.12	4.45
	Apr-08	5.59	0.48	5.11
	May-08	5.58	0.05	5.53
	Jun-08	6.20	0.00	6.20
	Jul-08	6.05	0.00	6.05
	Aug-08	5.74	0.00	5.74
	Sep-08	4.68	0.00	4.68
	Oct-08	4.55	0.00	4.55
	Nov-08	2.76	0.69	2.07
	Dec-08	2.20	2.09	0.11
2008 Total		**52.63**	**15.84**	**44.49**
2009	Jan-09	3.04	0.96	2.08
	Feb-09	2.02	5.40	0.00
	Mar-09	4.02	1.38	2.64
	Apr-09	4.77	0.49	4.28

	May-09	5.51	0.28	5.23
	Jun-09	5.20	0.00	5.20
	Jul-09	6.26	0.00	6.26
	Aug-09	5.60	0.00	5.60
	Sep-09	4.86	0.00	4.86
	Oct-09	4.03	5.90	0.00
	Nov-09	2.91	0.00	2.91
	Dec-09	1.73	3.77	0.00
2009 Total		**49.95**	**18.18**	**39.06**
2010	Jan-10	1.96	6.96	0.00
	Feb-10	2.07	5.18	0.00
	Mar-10	3.96	1.72	2.24
	Apr-10	4.62	2.74	1.88
	May-10	5.75	0.27	5.48
	Jun-10	6.11	0.00	6.11
	Jul-10	5.58	0.06	5.52
	Aug-10	5.60	0.04	5.56
	Sep-10	5.20	0.13	5.07
	Oct-10	3.58	2.13	1.45
	Nov-10	2.69	2.32	0.37
	Dec-10	1.64	11.98	0.00
2010 Total		**48.76**	**33.53**	**33.68**

Minimum Surplus ETo	33.43
Average Surplus Eto	39.06

Appendix B

Wastewater Treatment Facility Proposed Location



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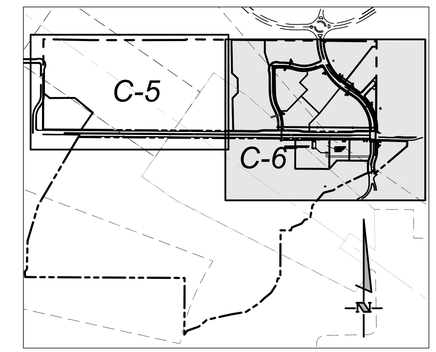
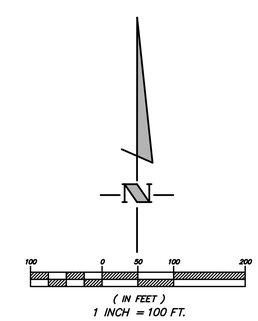
A California Corporation | Victor Montgomery, Architect #C11050 | Larry Michael, PE #36895, LS #6278 | Jeff Ferber, LA #2844

WSC
WATER SYSTEMS CONSULTING, INC.



KEY MAP



Wastewater Treatment Facility

San Luis Obispo Tank Farm

Tract 2988, San Luis Obispo County

June 18, 2008 revised Jan 24, 2011 SHEET: 6 of 8

STP

Job No.: 2008020

Appendix C

Activated Sludge Package Plant – Product Specification Sheets

SMITH & LOVELESS INC.

ADDIGEST® Wastewater Treatment System

Factory-Built ADDIGEST® Delivers Economical Wastewater Treatment

The factory-built **ADDIGEST®** is an aerobic wastewater treatment system designed for both municipal and industrial applications. The trade name **ADDIGEST®** is derived from "add-on-digestion" and attests to the versatility of this system. It offers treatment from basic BOD and TSS removal to nutrient removal and advanced treatment arranged in a single factory-built tank.

Design Flexibility

- Customize the system for any level of treatment -ranging from basic BOD removal to advanced treatment suitable for water reuse.
- Handles treatment for extended aeration loadings up to 56,000 gpd (212 cmd) in a single manufactured tank. *For larger capacity, see Factsheet 1246-2, which features the Field-Erected **ADDIGEST®** wastewater treatment system.*
- Add either hopper bottom type clarifiers or all steel circular clarifiers with rotating sludge collectors.
- Choose either above or below grade installation.
- Meet space requirements with end-to-end or side-by-side installation, ensuring an efficient footprint for multiple tank installations.
- Simplify restrictive shipping limitations with the availability of component and weld together units.

The Benefits

- Design offers virtually unlimited capacity and wastewater treatment capabilities.
- Design makes the factory built **ADDIGEST®** easy to install and operate with little routine maintenance.
- Inspection occurs on every factory built **ADDIGEST®** prior to shipment, ensuring quality.
- V-crimped structural walls create greater volume per unit-dimension than a circular cross section, reducing corrosion compared to plants with I-beams for structural reinforcement.
- V-crimp also provides greater rigidity and economy in manufacturing, while minimizing weight.
- **VERSAPOX®** coating on all surfaces ensures the best resistance against corrosion and abrasion.

*The **ADDIGEST®** proves itself in hundreds of installations.*

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Online: smithandloveless.com • Phone: 913.888.5201 • FAX: 913.888.2173

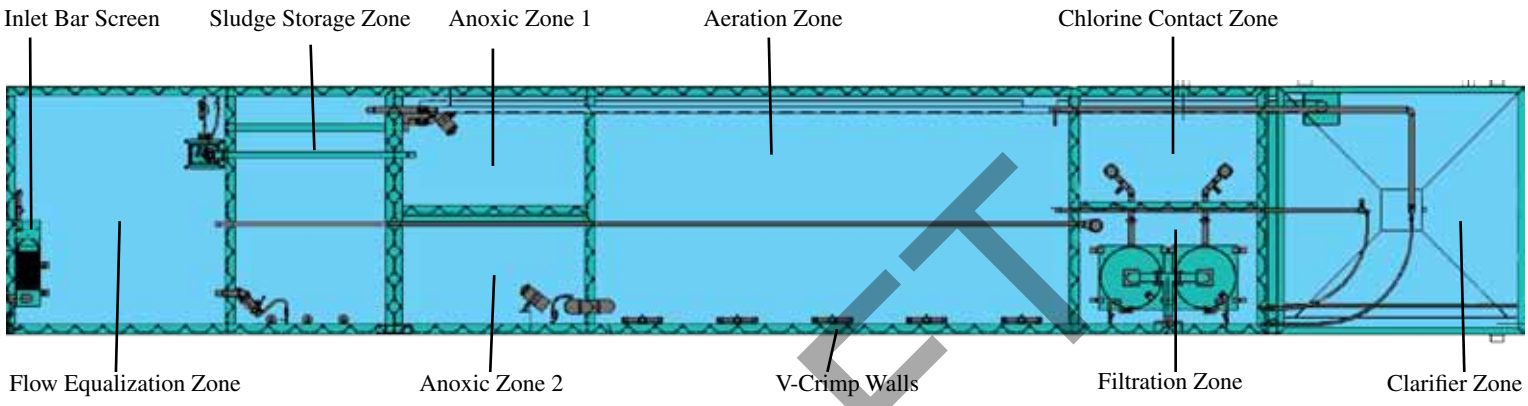
SMITH & LOVELESS INC.

ADDIGEST® Wastewater Treatment System

Factory-Built ADDIGEST® Provides Versatile Treatment Options

Various treatment configurations can he achieved with the versatile factory-built **ADDIGEST®** to meet particular effluent requirements — ranging from pretreatment to effluent water reuse. The factory-built **ADDIGEST®** also comes in full hopper clarifier and circular clarifier configurations. *For membrane additions, request S&L bulletin 4000 for **TITAN MBR®**.*

Top View



Add-On-Digestion

Flexibility is the key to the factory-built **ADDIGEST®**. The basic system comes equipped with an aeration zone and a clarifier. To this, several components can be added to meet effluent requirements including:

- Flow Equalization
- Sludge Storage
- Filtration
- Disinfection (Chlorination or UV)
- Post Aeration
- Dechlorination
- Nutrient Removal (Nitrogen and Phosphorus)
- Nitrification

Additional System Benefits

- Electrical controls and instrumentation, air blowers, walkways, grating, access ladders and other accessories are readily available to provide a complete installation.
- Installation ready, the factory-built **ADDIGEST®** can be installed upon arrival, reducing standard delivery time, erection time and installation costs.
- Smith & Loveless provides single-source responsibility, from design and process engineering to manufacturing and installation.

*Earth-insulated, this factory-built **ADDIGEST®** is installed below grade, as shown above.*

*Multi-train factory-built **ADDIGEST®** installations are available as seen in this picture.*

Contact us today for drawings, specifications and other technical assistance.

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Brochure 1246-1 © Smith & Loveless Inc., 2009

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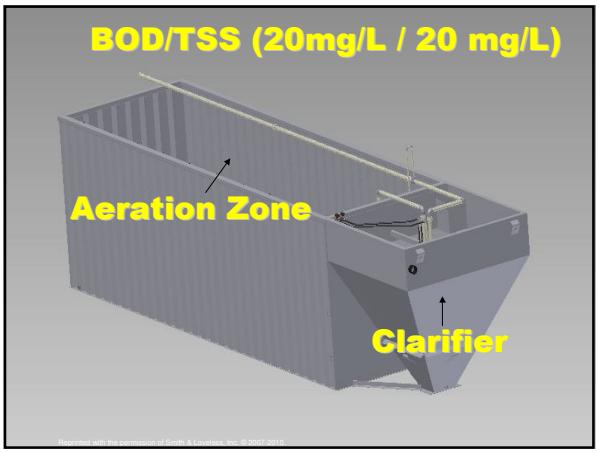
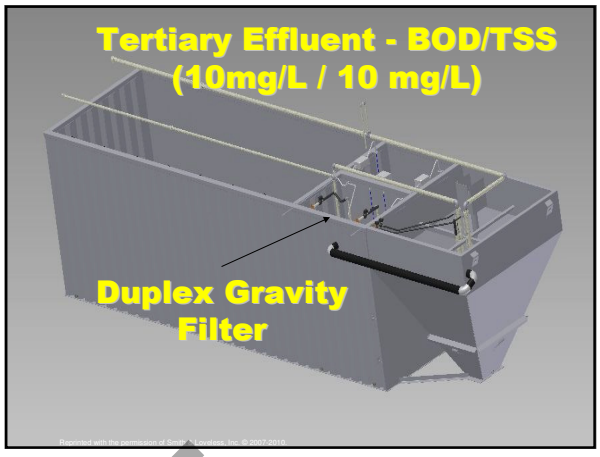
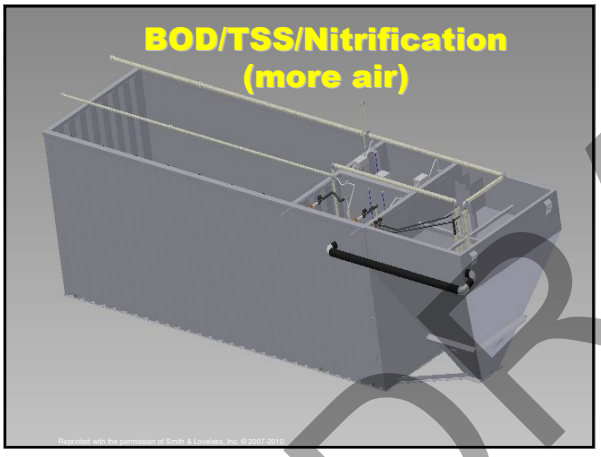
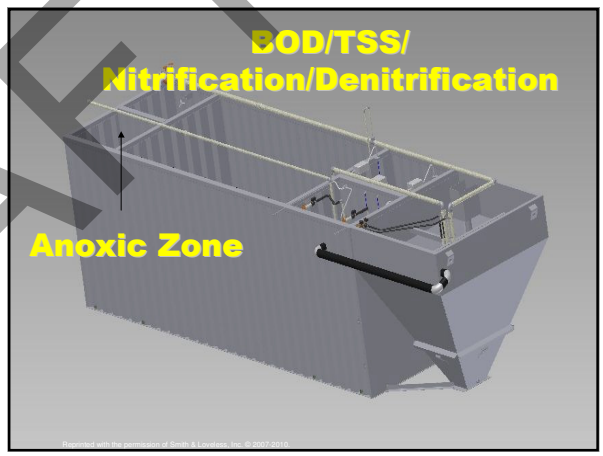
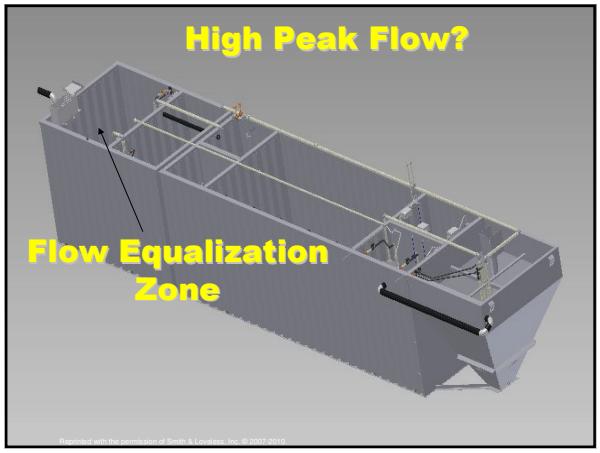

BOD/TSS (20mg/L / 20 mg/L)
Aeration Zone
Clarifier


Tertiary Effluent - BOD/TSS
(10mg/L / 10 mg/L)
Duplex Gravity
Filter


BOD/TSS/Nitrification
(more air)


BOD/TSS/
Nitrification/Denitrification
Anoxic Zone

Need Sludge Holding Zone?
Sludge Holding
Zone


High Peak Flow?
Flow Equalization
Zone

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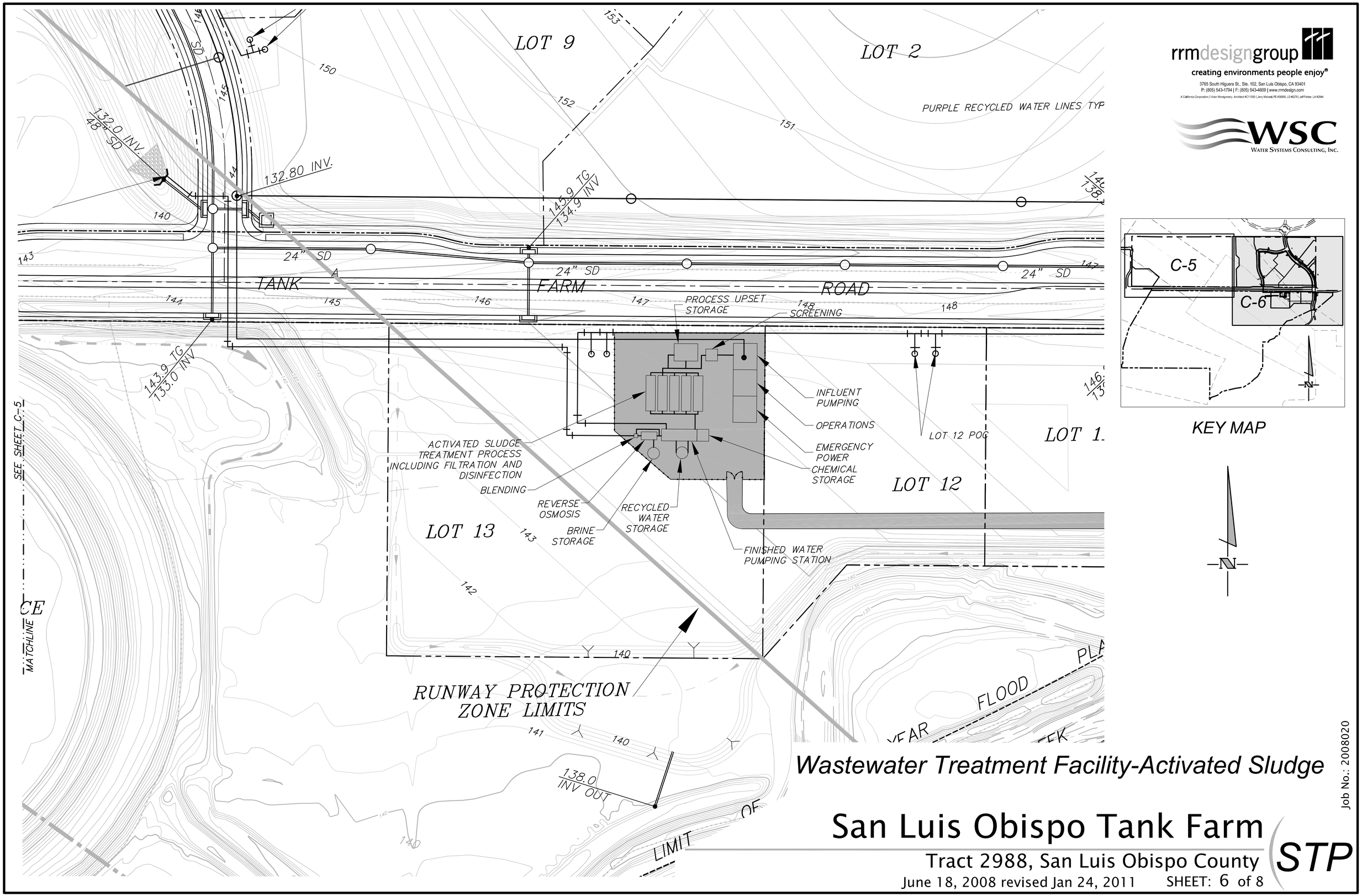
Appendix D

Activated Sludge Package Plant – Plan View Diagram



Wastewater Treatment Facility-Activated Sludge

Job No.: 2008020

San Luis Obispo Tank Farm

Tract 2988, San Luis Obispo County

June 18, 2008 revised Jan 24, 2011 SHEET: 6 of 8

STP

Appendix E

Membrane Biological Reactor (MBR) Package Plant – Product Specification Sheets

SMITH & LOVELESS INC.

TITAN™ MBR

DESIGN & SPECIFICATION CATALOG

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TITAN MBR™ TREATMENT SYSTEM CATALOG INDEX

DESCRIPTION	DATE	PAGE
Introduction	Oct. 2005	3 - 4
Testing	Oct. 2005	5
Sizing & Selection Tables	Oct. 2005	6 - 7
Specifications	Oct. 2005	8 - 15
Plan & Profile Drawings	Oct. 2005	16 - 19
Wiring Schematics	Oct. 2005	20 - 36
Project Questionnaire	Oct. 2005	37

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TITAN MBR™

Membrane BioReactor System

SMITH & LOVELESS INC.

Known globally for superior engineering and manufacturing capabilities, Smith & Loveless is one of the most recognized water and wastewater pumping and treatment groups in the world. With locations on every continent, our innovative group includes Smith & Loveless Inc., its affiliated companies, licensees, and representatives. Together as one source, we bring to the marketplace some of the most innovative and cost-effective system solutions.

Backing this group is our technical team. These highly trained professionals assure product and process performance by providing a strong level of support throughout the extended life of the equipment. A full complement of machinery and facilities allows us to fabricate component parts and finished products for all types of commercial and industrial applications. Our combination of highly skilled factory craftsmen, knowledgeable engineering staff and more than 50 years of steel fabrication and manufacturing experience provides tangible solutions.

Contact Us:

Locate a Representative: (800) 898-9122 Toll-Free
Main Offices (913) 888-5201
E-mail: answers@smithandloveless.com
Website: www.smithandloveless.com

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INTRODUCTION

Smith & Loveless Inc. knows wastewater treatment systems. With nearly six decades of engineering, manufacturing, erecting and servicing thousands of pre-engineered biological treatment systems and 30 years of membrane system integration, we understand customers' preferences for performance, minimal operational costs, and long-term durability. With several patented treatment processes to our credit, we are proud of the knowledge and experience we bring to the table. Thus, we continue to deliver new wastewater treatment process solutions that surpass expectations.

We are pleased to present **TITAN MBR™**, our latest innovative pre-engineered wastewater treatment system: **TITAN MBR™** marries the wastewater treatment engineering expertise of Smith & Loveless with exciting submerged membrane technology. The combination yields a *dynamic* membrane biological reactor (MBR), a system that provides end-users with high-quality treatment performance, minimal operational requirements, and a robust design that will stand the test of time.

In addition to the high engineering and fabrication standards of the S&L treatment plant design, **TITAN MBR™** offers several distinct advantages compared to other systems in its class. Most importantly, **TITAN MBR™** employs S&L's *Flat-Plate Membrane* Design. Submerged in the aeration section of the **TITAN MBR™** tank, our Flat-Plate Membrane—rated at the microfiltration level—maintains high permeability and flux rates even at peak-day rates. Because the system employs air scouring to prevent fouling, it does not require back-pulsing or the associated equipment and chemical costs typical of other systems. Because of its robust support, Flat-Plate units also experience less wear and tear than hollow-fiber types and can easily be cleaned in place.

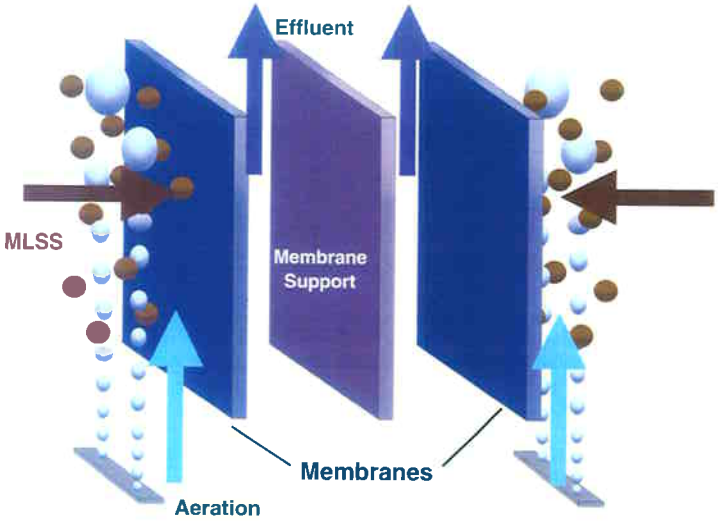
Plants come in standard and custom designs, and result in smaller footprints than conventional systems. The submerged membrane eliminates clarifers and sand filters while still producing *significantly better* effluent quality. Integral zones can be added to meet particular effluent goals, including nutrient removal, disinfection and post-aeration. Consult Smith & Loveless to review process options for municipal, industrial or retrofit applications.

TITAN MBR™ Design & Technical Data

Flow Capacities:	5,000 GPD and larger
Effluent Quality:	<3 mg/l BOD & < 1 mg/l TSS
Turbidity:	<0.2 NTU
TKN:	<2 mg/l
NH_3:	<1 mg/l

S&L FLAT-PLATE MEMBRANES

TITAN MBR's Flat-Plate (MF) membranes stack within a fully submerged module inside the aeration zone. Sufficient transmembrane pressure created by gravity drives the flow through the membrane. Clean water discharges into a clearwell while blocked solids remain suspended in the aeration zone. Diffusers beneath the module scour the membranes *while also* providing air supply to the bacteria. Chemical cleaning occurs efficiently in-place—typically on a semi-annual basis—with simple chemical injection.



Composed of PVDF and non-woven polyester fabric, the S&L Flat-Plate Membrane provides long-term durability and consistent flux rates over time because the membranes don't contact each other during operation. Hair and other problem constituents are not factors. Additionally, less chemicals and equipment are required for cleaning.

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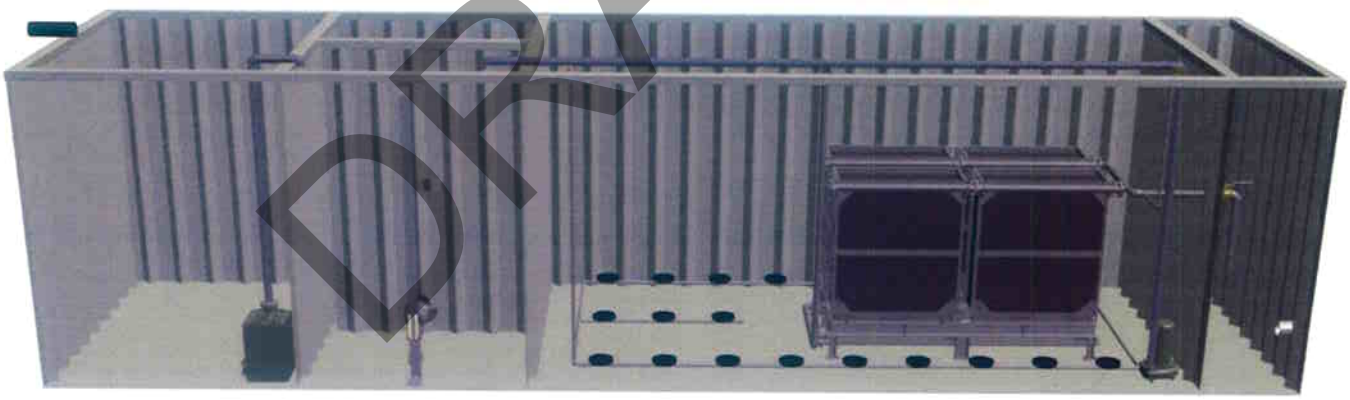
TITAN MBR™ SYSTEM STRUCTURE & DESIGN

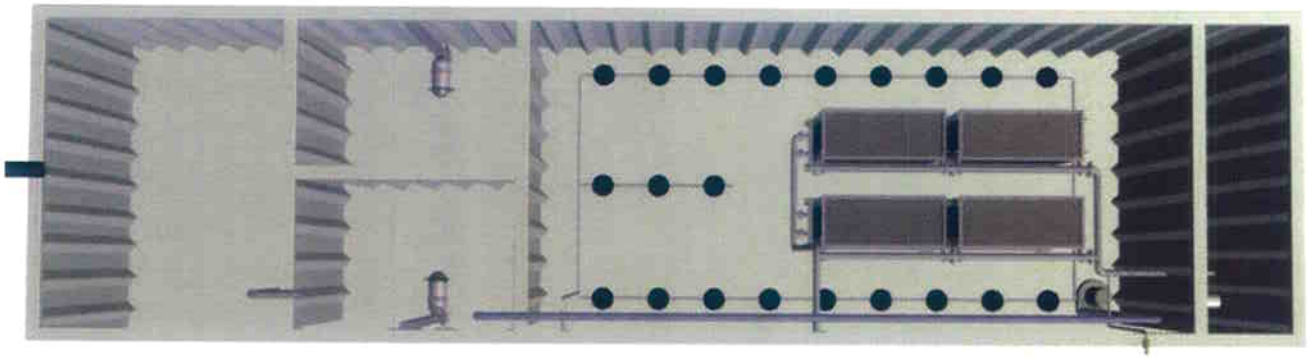
Innovations developed by Smith & Loveless include a unique type of reinforcing for rectangular package treatment plants, called **V-CRIMP**. "V" shapes that are formed in the tank's outer walls replace labor-intensive welding of reinforcing beams to the sides and ends of the plants. This rigid design also allows rounded corners that facilitate adhesion of the protective coatings administered by Smith & Loveless during assembly. Additionally, the **V-CRIMP** area creates greater volume for the same outer dimensions of typical, flat wall designs. Thus Smith & Loveless can pass on capital cost savings and slightly reduce the space required for installation.

See further in this catalog: Specifications and P&IDs.

3-D VIEWS & CROSS-SECTIONS



Flow Equalization Zone | **Anoxic Zones for Nitrification/Denitrification** | **Aeration Zone with Submerged Flat-Plate Membranes & Typical Fine Bubble Diffusion** | **Clearwell Zone**



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TITAN MBR™
Factory-Built
Treatment System
Test Data
October 2005
Page 5

TESTING SUMMARY

*S&L Research & Development operates two **TITAN MBR™** demonstration systems, including a full-scale 10,000 GPD unit.*

APPROACH

The base **TITAN MBR™** was sampled once a week to characterize the wastewater and to evaluate the MBR operation. Grab samples were taken from the influent, effluent, and mixed liquor. Recent samples are shown in the table at right. Analytical testing of the samples was done in accordance with *Standard Methods for the Examination of Water and Wastewater* and/or *Methods for Chemical Analysis of Water and Wastes* (EPA-600/4-79-020).

The samples were taken on various days of the week to provide an evaluation of the wastewater variations from day to day. The base demonstration system did not have the necessary unit processes to achieve denitrification at the time of this testing; however complete nitrification was achieved from the very start of the operation and testing of the **TITAN MBR™**.

As can be seen in the table summary, very low BOD, TKN, and NH_3 were achieved throughout this phase of the testing. The effluent TSS was below detectable limits and actually was consistently zero due to the membrane pore size being significantly smaller than the smallest suspended particle including bacteria.

SAMPLE RESULTS

	Influent Totals			Effluent Totals			
Weekly Sample	BOD mg/l	TSS mg/l	TKN mg/l	BOD mg/l	TSS mg/l	TKN mg/l	NH_3 mg/l
Sam. 1	276	148	36	NA	BDL	NA	0.30
Sam. 2	270	224	36	NA	BDL	0.90	0.40
Sam. 3	359	178	53	1.2	BDL	0.80	1.30
Sam. 4	228	204	28	1.7	BDL	0.71	0.03
Sam. 5	275	157	43	0.6	BDL	0.38	0.05
Sam. 6	246	157	37	0.0	BDL	0.53	0.03
Sam. 7	126	244	21	4.0	BDL	0.15	0.65
Sam. 8	195	244	47	4.0	BDL	0.64	0.10
Sam. 9	330	139	58	2.0	BDL	0.69	0.87
Sam. 10	70	202	29	0.9	BDL	0.81	0.02
Sam. 11	294	230	34	0.0	BDL	0.62	0.02
Sam. 12	35	196	47	0.0	BDL	0.39	0.12
Sam. 13	336	127	47	0.0	BDL	0.34	0.07
Sam. 14	360	210	34	0.0	BDL	0.19	0.02
Sam. 15	265	174	31	1.5	BDL	0.00	0.22
Sam. 16	270	244	40	0.0	BDL	0.20	0.02
Sam. 17	375	226	65	1.0	BDL	0.34	0.75
Sam. 18	340	218	60	2.0	BDL	0.47	0.06
AVG.	258	196	41	1.2	BDL	0.48	0.28

NA = Results Not Available • BDL = Below Detectable Limits

MEMBRANE DATA

Type:	Submerged, PVDF+PET Flat-Plate
Design Flux:	15 gpd/sf
Pore Sizing:	.08 microns [MF]
TMP Range:	1.03 - 2.90 psi

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TITAN MBR™
Factory-Built
Treatment System
System Sizing
October 2005
Page 6

TITAN MBR™ SYSTEM SIZING (Base System)

Based on the Following Wastewater Characteristics:
250 mg/l BOD
250 mg/l TSS

Parameter	Volume (Gallons)			
Design Flow GPD	Flow EQ Zone	Aeration Zone	Clearwell Zone	Plant Length (Ft.)
5,000	1,700	1,700	1,750	8' – 0"
10,000	3,400	3,400	1,750	12' – 0"
20,000	6,900	6,900	1,750	20' – 0"
50,000	17,100	14,800	1,750	41' – 0"
100,000	33,100	29,700	1,750	76' – 0"

BLOWER SIZING

Design Flow GPD	Process Blower (HP)	EQ Blower (HP)
5,000	2	0.5
10,000	3	0.5
20,000	5	1
50,000	15	2
100,000	25	5

DRAFT

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ENGINEERING DATA

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Lenexa, Kansas 66215-1284

TITAN MBR™ SYSTEM SIZING (Denitrification)

Based on the Following Wastewater Characteristics:
250 mg/l BOD
250 mg/l TSS
45 mg/l TKN

Parameter	Volumes (Gallons)				
Design Flow GPD	Flow EQ Zone	Anoxic Zone	Aeration Zone	Clearwell Zone	Plant Length (Ft.)
5,000	1,700	3,400	1,700	1,750	12' – 0"
10,000	3,400	3,400	3,400	1,750	16' – 0"
20,000	6,900	5,700	6,900	1,750	26' – 0"
50,000	17,100	12,600	14,800	1,750	54' – 0"
100,000	33,100	25,100	29,700	1,750	104' – 0"

BLOWER SIZING

Design Flow GPD	Process Blower (HP)	EQ Blower (HP)
5,000	2	0.5
10,000	3	0.5
20,000	5	1
50,000	15	2
100,000	25	5

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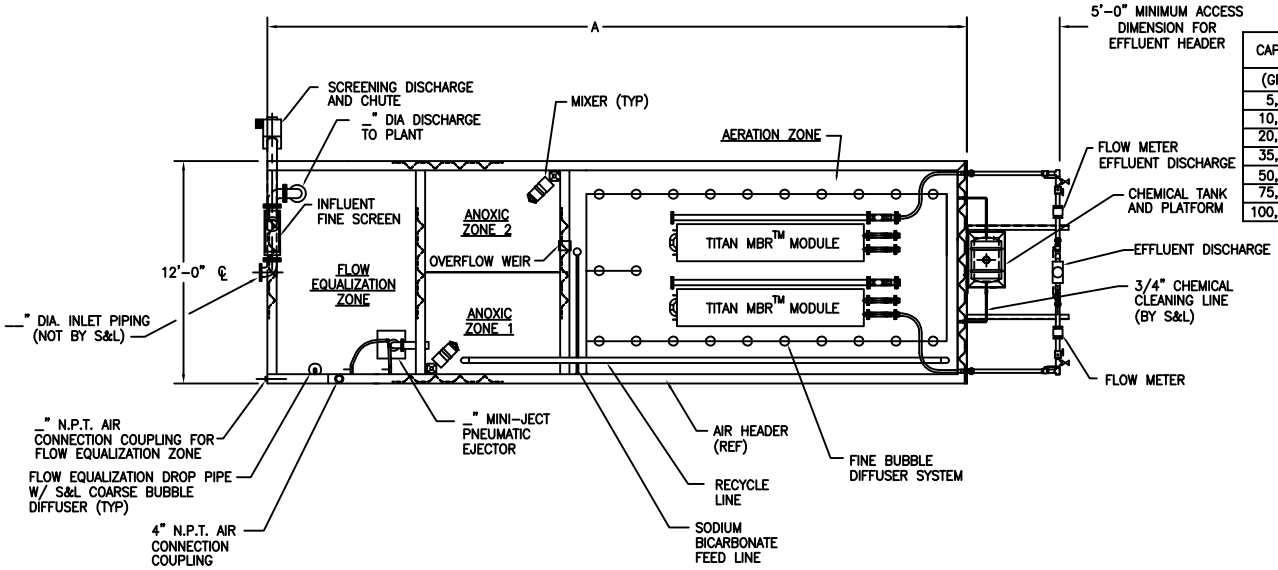


PLAN VIEW

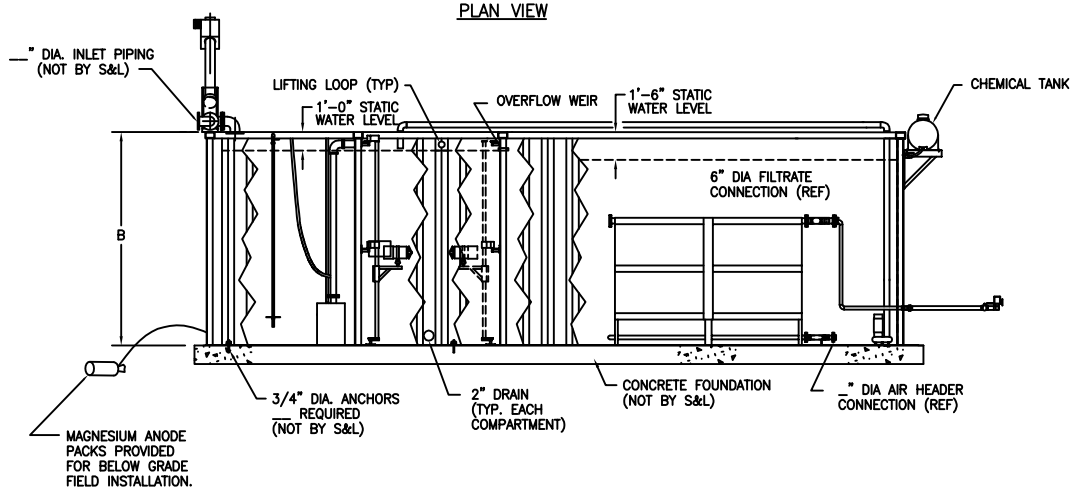
SIZING CHART FOR TITAN MBR™ TREATMENT PLANT W/ ANOXIC ZONE

CAPACITY	"A" DIM	NOMINAL VOLUME PER ZONE (GALS)			BLOWER HP		"B" DIM
(GPD)	(FT)	EQ. ZONE	ANOXIC ZONE	AERATION ZONE	EQ. ZONE	PROCESS	(FT)
5,000	15	3,630	3,630	5,730	2.0	3.0	11'-6"
10,000	15	3,630	3,630	5,730	2.0	3.0	11'-6"
20,000	23	4,820	8,500	6,900	2.0	5.0	11'-6"
35,000	39	9,630	13,300	12,620	2.0	10.0	11'-8"
50,000	55	12,100	19,400	17,200	2.0	10.0	11'-8"
75,000(2)	83	19,300	29,100	25,200	2.0	15.0	11'-8"
100,000(2)	107	26,650	37,500	29,900	3.0	20.0	11'-8"

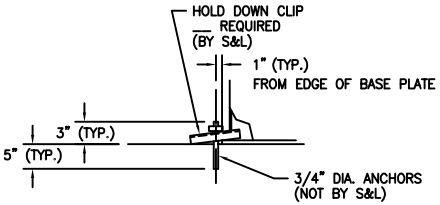
(1) THE SIZING CHART IS BASED ON TYPICAL DOMESTIC WASTEWATER, WITH THE FOLLOWING MAXIMUM WASTE CONCENTRATIONS:

BOD 250 mg/L
TSS 250 mg/L
TKN 45 mg/L

(2) PLANT WILL BE PROVIDED IN TWO SEPARATE SECTIONS THAT WILL REQUIRE FIELD WELDING OF TANKS AND FIELD PIPING TO INSTALL



SECTIONAL SIDE ELEVATION



ANCHOR DETAIL

(SEE NOTE 1)

NOTES:

1. WATER TABLE MUST BE BELOW SLAB WHEN TANK IS DEWATERED. IF NOT, ADDITIONAL BOTTOM REINFORCEMENT AND ANCHORS ARE REQUIRED.
2. DRAWING DEPICTS TWO TITAN MBR™ MODULE UNITS FOR REFERENCE ONLY. THE PLANT SIZE AND WASTE LOAD WILL DEFINE THE ACTUAL NUMBER OF UNITS TO BE INSTALLED.
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53B1072/F

LET	ECN NO	DATE	BY APPV'D
E	N2009-26	3/2009	ADB RSM
D	N2009-12	2/2009	RGD
C	N2008-71	8/2008	JLC ADB JLC
B	N2005-55	11/2005	RGD RSM
F	N2009-39	6/2009	ADB FHA

DRAWN BY: KWC — DATE: 9/22/2005 — ALLOWABLE TOLERANCES
CHECKED BY: JLC — DATE: 10/2005 — FRACTIONS –
APPROVED BY: CGM — DATE: 10/2005 — DECIMALS –
SCALE: NTS — CODE: — ANGLES –

FOR: FACTORY BUILT TITAN MBR™ TREATMENT SYSTEM WITH ANOXIC ZONE PLAN & ELEVATION VIEW

SIZE — U/M EA — WT.
FILE NAME \SALES\53B1072F — PLOT SCALE 1=64.000

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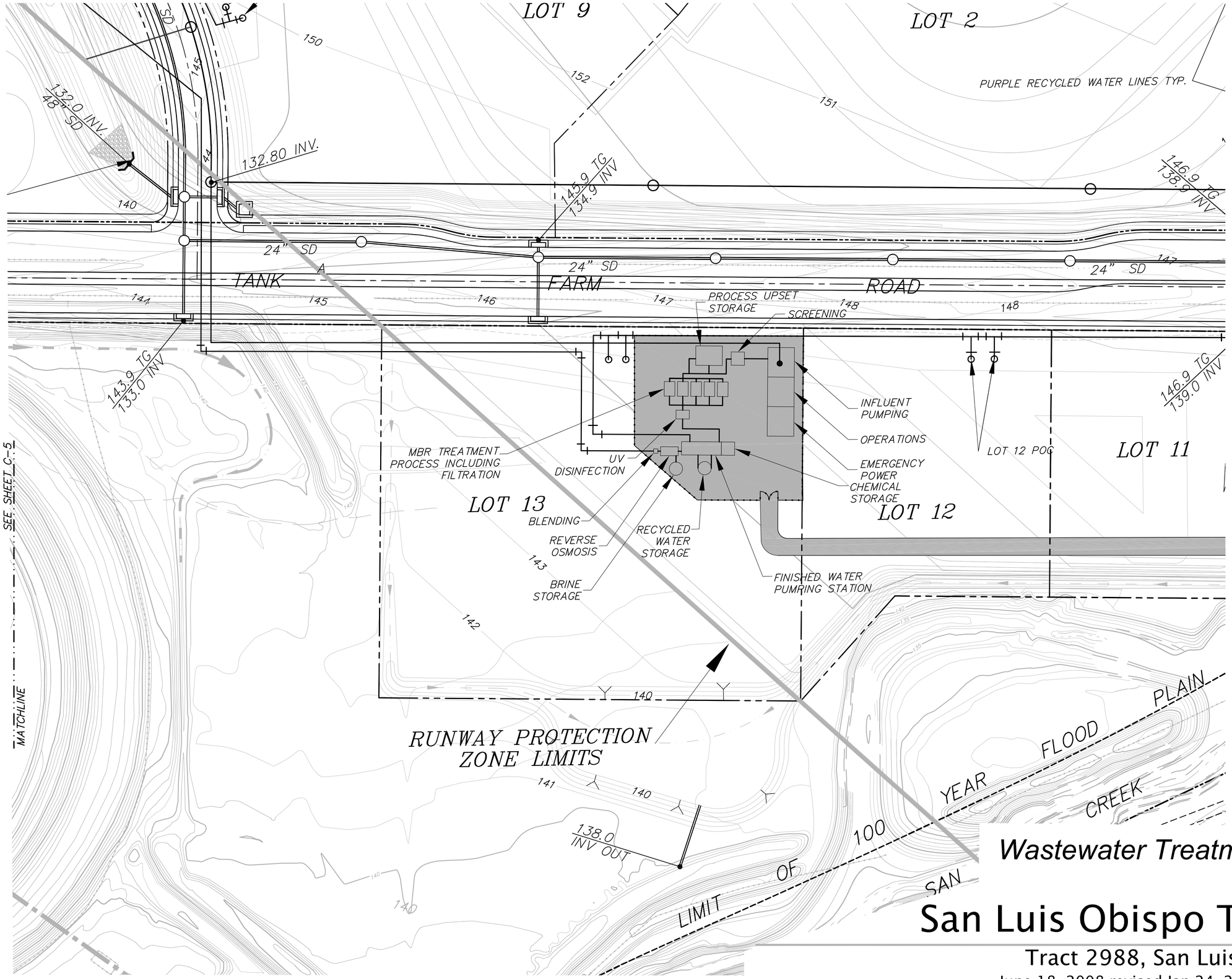
SHEET 1 OF 1

Appendix F

Membrane Biological Reactor (MBR) Package Plant – Plan View Diagram



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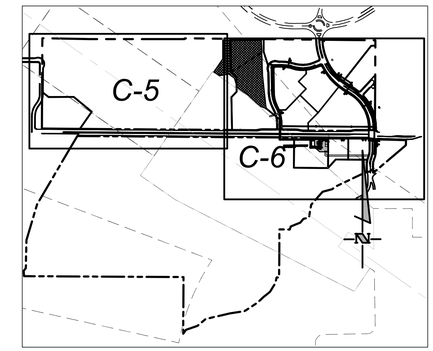


KEY MAP

Wastewater Treatment Facility-MBR

Job No.: 2008020

San Luis Obispo Tank Farm

Tract 2988, San Luis Obispo County

June 18, 2008 revised Jan 24, 2011 SHEET: 6 of 8

STP

Appendix G

Table 13. Tank Farm Development reverse osmosis calculations

Column	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*
Calculation						=C*D	=B*(1-E)	=A-C	=(H*B+F*G)/(H+F)	=(H+F)	=C-F	=((C*B)-(F*G))/K		=K*60*24*30.5/M
Phase	**Disposal Required (gpm)[1]**	**Wastewater TDS (mg/L)[2]**	**RO Feed (gpm)**	**Recovery[3]**	**Rejection[3]**	**Permeate Flow (gpm)**	**Permeate TDS (mg/L)**	**Blend Water Flow (gpm)**	**Blended TDS (mg/L)**	**Blended Flow (gpm)**	**Brine Flow (gpm)**	**Brine TDS (mg/L)**	**Disposal Truck Capacity (gal)[4]**	**Disposal Trips per Month**
1	3.0	860	1.1	0.75	0.99	0.8	8.6	1.9	600.8	2.7	0.3	3,414	4,000	3
2	7.5	860	2.8	0.75	0.99	2.1	8.6	4.7	600.7	6.8	0.7	3,414	4,000	8
3	10.6	860	3.9	0.75	0.99	2.9	8.6	6.7	600.5	9.6	1.0	3,414	4,000	11
4	11.3	860	4.2	0.75	0.99	3.1	8.6	7.1	600.9	10.2	1.0	3,414	4,000	11
5	16.3	860	6.0	0.75	0.99	4.5	8.6	10.3	600.9	14.8	1.5	3,414	4,000	17

[1] Obtained from Figure 6
[2] Obtained from Preliminary Environmental Impacts Study for Water Resources report (3)
[3] Expected values for brackish water reverse osmosis systems (18)

Appendix H

Table 14. Spray field water balance calculations – wet year

Column	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
Calculation					=C*D		=B*F/12	=E*F/12	=previous month storage+A+G-H
Month	WW Disposal Required (AF) [1]	Wet Year Precipitation (in)[2]	Wet Year Reference Evapotranspiration Eto (in)[2]	Turf Evapotranspiration Coefficient (16)	Spray field Evapotranspiration Et_c (in)	Spray Field Area (Acres)	Precipitation (AF)	Evapotranspiration (AF)	WW Stored (AF)
Jan-10	2.0	2.6	2.7	0.95	2.6	2.0	0.4	0.4	8.4
Feb-10	2.1	3.0	2.8	0.95	2.6	2.0	0.5	0.4	10.6
Mar-10	2.1	5.0	3.7	0.95	3.5	2.0	0.8	0.6	13.0
Apr-10	-1.2	0.2	5.4	0.95	5.1	2.0	0.0	0.8	11.0
May-10	-1.4	0.2	5.7	0.95	5.4	2.0	0.0	0.9	8.7
Jun-10	-1.8	0.1	6.2	0.95	5.9	2.0	0.0	1.0	5.9
Jul-10	-1.5	0.2	5.9	0.95	5.6	2.0	0.0	0.9	3.5
Aug-10	-1.2	0.2	5.3	0.95	5.1	2.0	0.0	0.8	1.5
Sep-10	-0.8	0.1	4.6	0.95	4.4	2.0	0.0	0.7	0.0
Oct-10	2.1	4.3	3.4	0.95	3.2	2.0	0.7	0.5	2.3
Nov-10	1.5	1.3	2.4	0.95	2.3	2.0	0.2	0.4	3.7
Dec-10	2.1	5.1	1.9	0.95	1.8	2.0	0.8	0.3	6.3
Jan-11	2.0	2.6	2.7	0.95	2.6	2.0	0.4	0.4	8.4
Feb-11	2.1	3.0	2.8	0.95	2.6	2.0	0.5	0.4	10.6
Mar-11	2.1	5.0	3.7	0.95	3.5	2.0	0.8	0.6	13.0
Apr-11	-1.2	0.2	5.4	0.95	5.1	2.0	0.0	0.8	11.0
May-11	-1.4	0.2	5.7	0.95	5.4	2.0	0.0	0.9	8.7
Jun-11	-1.8	0.1	6.2	0.95	5.9	2.0	0.0	1.0	5.9
Jul-11	-1.5	0.2	5.9	0.95	5.6	2.0	0.0	0.9	3.5
Aug-11	-1.2	0.2	5.3	0.95	5.1	2.0	0.0	0.8	1.5
Sep-11	-0.8	0.1	4.6	0.95	4.4	2.0	0.0	0.7	0.0
Oct-11	2.1	4.3	3.4	0.95	3.2	2.0	0.7	0.5	2.3
Nov-11	1.5	1.3	2.4	0.95	2.3	2.0	0.2	0.4	3.7
Dec-11	2.1	5.1	1.9	0.95	1.8	2.0	0.8	0.3	6.3

[1] Obtained from Table 7
[2] Precipitation and evapotranspiration values for the wet year (1987) (6)

Appendix I

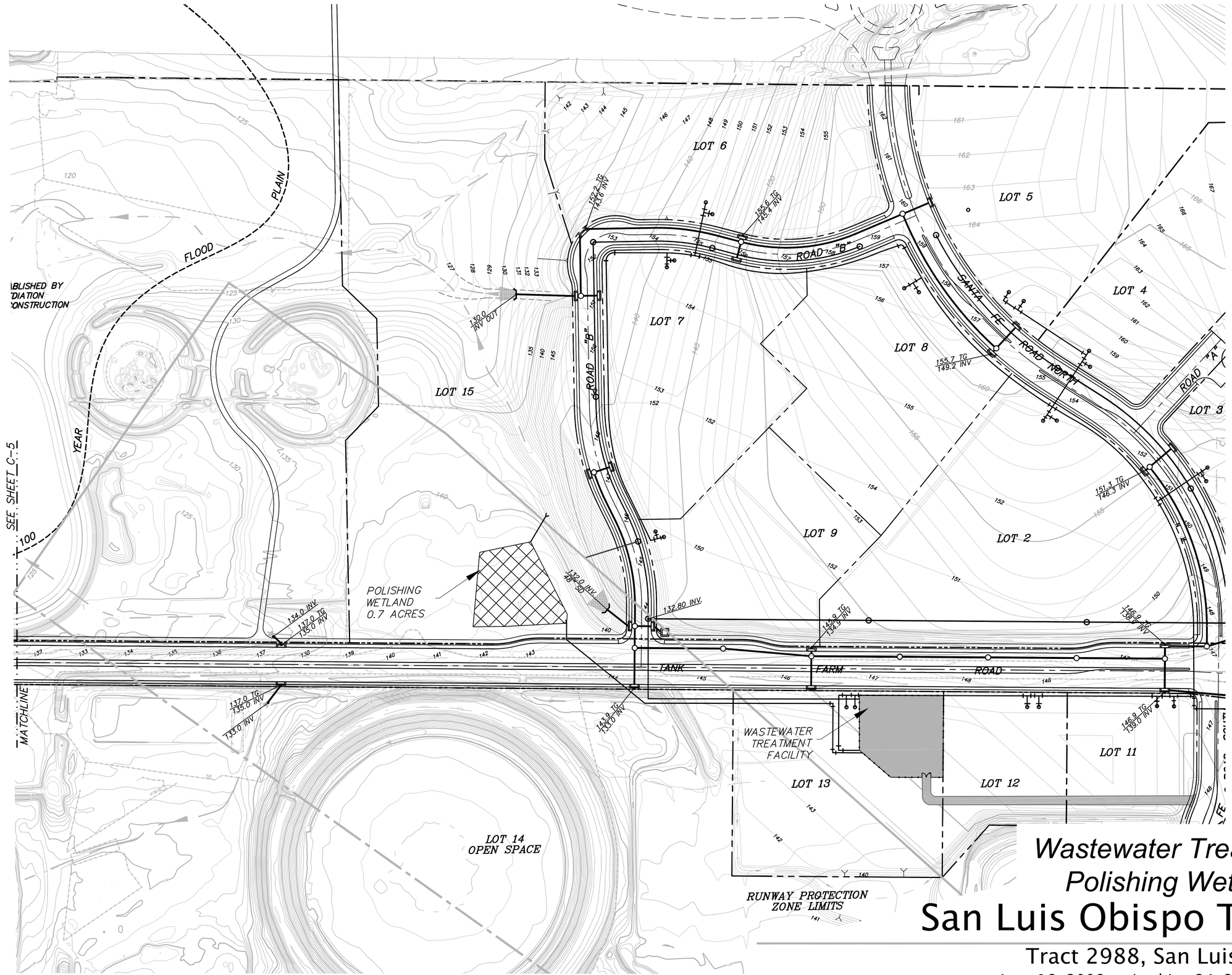
Table 15. Disposal wetlands water balance calculation – wet year

Column	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
Calculation					=C*D		=B*F/12	=E*F/12	=previous month storage+A+G-H
Month	**WW Disposal Required (AF)** [1]	**Wet Year Precipitation (in)** [2]	**Wet Year Reference Evapotranspiration Eto (in)** [2]	**Wetland Evapotranspiration Coefficient** (16)	**Wetland Evapotranspiration Et_c (in)**	**Spray Field Area (Acres)**	**Precipitation (AF)**	**Evapotranspiration (AF)**	**WW Stored (AF)**
Jan-10	2.0	2.6	2.7	1.20	3.3	3.8	0.8	1.0	8.0
Feb-10	2.1	3.0	2.8	1.20	3.3	3.8	1.0	1.1	10.1
Mar-10	2.1	5.0	3.7	1.20	4.5	3.8	1.6	1.4	12.4
Apr-10	0.0	0.2	5.4	1.20	6.4	3.8	0.1	2.1	10.4
May-10	0.0	0.2	5.7	1.20	6.9	3.8	0.1	2.2	8.2
Jun-10	0.0	0.1	6.2	1.20	7.5	3.8	0.0	2.4	5.9
Jul-10	0.0	0.2	5.9	1.20	7.1	3.8	0.1	2.3	3.7
Aug-10	0.0	0.2	5.3	1.20	6.4	3.8	0.1	2.0	1.7
Sep-10	0.0	0.1	4.6	1.20	5.5	3.8	0.0	1.8	0.0
Oct-10	2.1	4.3	3.4	1.20	4.1	3.8	1.4	1.3	2.2
Nov-10	1.5	1.3	2.4	1.20	2.9	3.8	0.4	0.9	3.1
Dec-10	2.1	5.1	1.9	1.20	2.3	3.8	1.6	0.7	6.2
Jan-11	2.0	2.6	2.7	1.20	3.3	3.8	0.8	1.0	8.0
Feb-11	2.1	3.0	2.8	1.20	3.3	3.8	1.0	1.1	10.1
Mar-11	2.1	5.0	3.7	1.20	4.5	3.8	1.6	1.4	12.4
Apr-11	0.0	0.2	5.4	1.20	6.4	3.8	0.1	2.1	10.4
May-11	0.0	0.2	5.7	1.20	6.9	3.8	0.1	2.2	8.3
Jun-11	0.0	0.1	6.2	1.20	7.5	3.8	0.0	2.4	5.9
Jul-11	0.0	0.2	5.9	1.20	7.1	3.8	0.1	2.3	3.7
Aug-11	0.0	0.2	5.3	1.20	6.4	3.8	0.1	2.0	1.7
Sep-11	0.0	0.1	4.6	1.20	5.5	3.8	0.0	1.8	0.0
Oct-11	2.1	4.3	3.4	1.20	4.1	3.8	1.4	1.3	2.2
Nov-11	1.5	1.3	2.4	1.20	2.9	3.8	0.4	0.9	3.2
Dec-11	2.1	5.1	1.9	1.20	2.3	3.8	1.6	0.7	6.2

[1] Obtained from Table 7. Negative values removed water in wetland cannot be used to meet recycled water demand.
[2] Precipitation and evapotranspiration values for the wet year (1987) (6)

Appendix J

Polishing Wetland for Surface Discharge – Plan View Diagram



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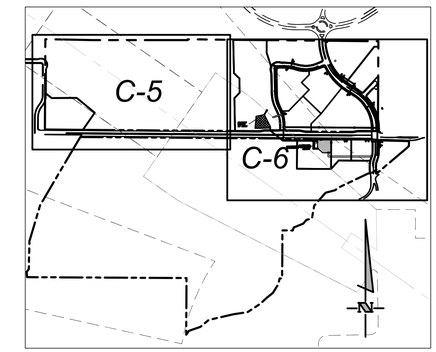

KEY MAP

N

100 0 50 100 200
(IN FEET)
1 INCH = 100 FT.

Wastewater Treatment Facility
Polishing Wetland Option
San Luis Obispo Tank Farm

Tract 2988, San Luis Obispo County

June 18, 2008 revised Jan 24, 2011 SHEET: 6 of 8

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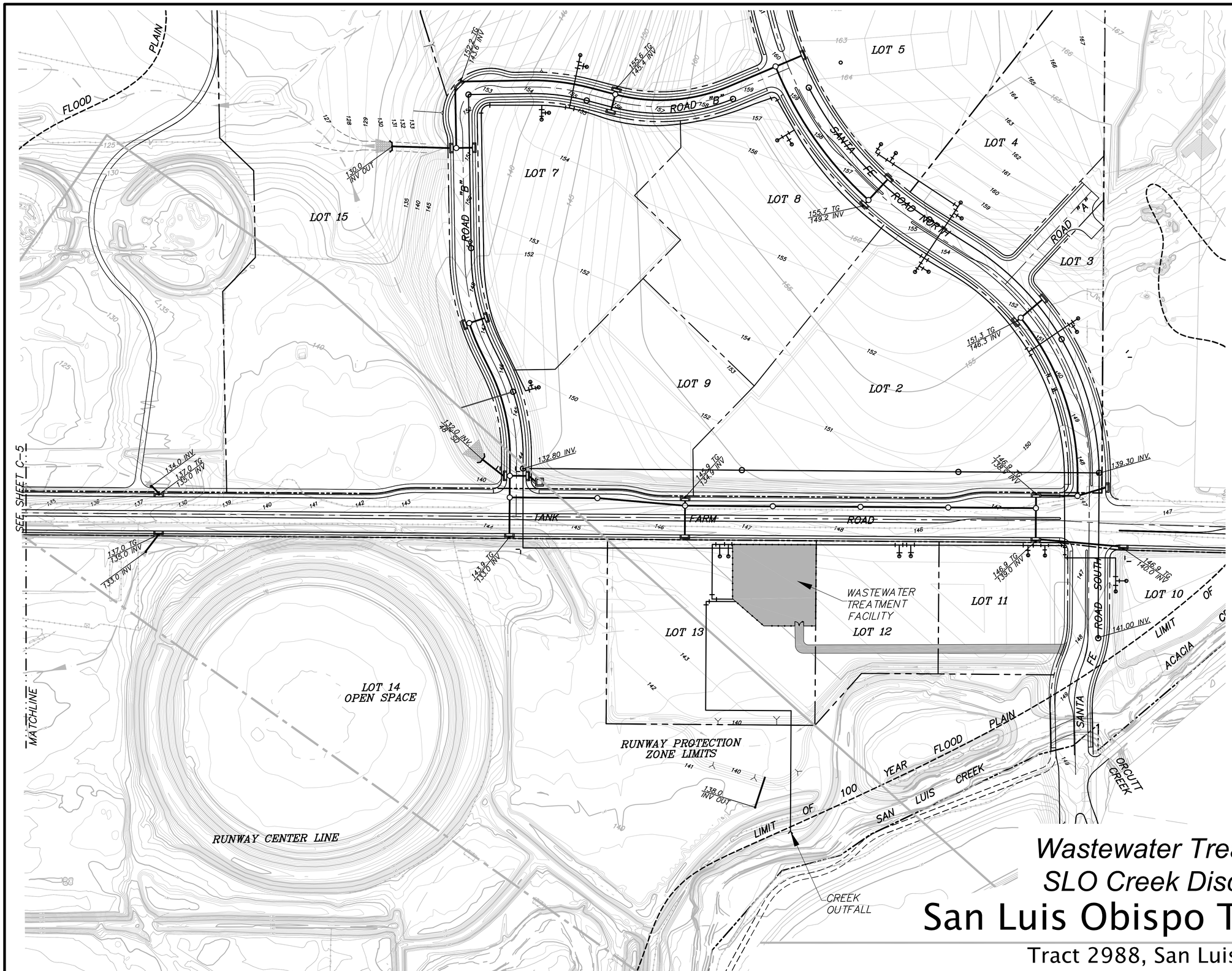
Job No.: 2008020

Appendix K

San Luis Obispo Creek Live Stream Discharge– Plan View Diagram



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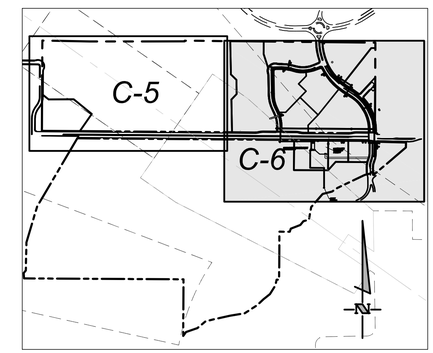

KEY MAP

N

100 0 50 100 200
(IN FEET)
1 INCH = 100 FT.

Wastewater Treatment Facility
SLO Creek Discharge Option
San Luis Obispo Tank Farm

Tract 2988, San Luis Obispo County

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