Appendix R

Groundwater Replenishment Project Urban Runoff Capture at Lake El Estero

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GROUNDWATER REPLENISHMENT PROJECT
URBAN RUNOFF CAPTURE AT LAKE EL ESTERO

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Table i. Acronyms Used in this Report

Acronym	Description
AFY, ac-ft/yr	Acre-feet/year
cfs	Cubic foot per second
gpd	Gallons per day
mgd	Million gallons per day
mg/L	Milligrams per liter
µg/L	Micrograms per liter
MPN	Most Probable Number
ppb	Parts per billion
ppm	Parts per million
ASBS	Areas of Special Biological Significance
ASR	Aquifer Storage and Recovery
BMP	Best management practice
CAW, CalAm	California American Water Company
CCAMP	Central Coast Ambient Monitoring Program
CCR	California Code of Regulations
CCRWQCB	Central Coast Regional Water Quality Control Board
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CSIP	Castroville Seawater Intrusion Project
CWC	California Water Code
DWR	California Department of Water Resources
GWR	Groundwater Replenishment
MCWRA	Monterey County Water Resources Agency
MPWMD	Monterey Peninsula Water Management District
MRSWMP	Monterey Regional Stormwater Management Program
MRWPCA	Monterey Regional Water Pollution Control Agency
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	USDA Natural Resources Conservation Service
RTP	Regional Treatment Plant
SB	California Senate Bill
SIWTF	Salinas Industrial Wastewater Treatment Facility
SRDF	Salinas River Diversion Facility
SRDP	Salinas River Diversion Project
SVRP	Salinas Valley Reclamation Plant
SVWP	Salinas Valley Water Project
SVGB	Salinas Valley Groundwater Basin
SWRCB	California State Water Resources Control Board
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geologic Survey

Table ii. Units of Measure Used in this Report

Unit	Equals
1 acre-foot	= 43,560 cubic feet = 325,851 gallons
1 cubic foot	= 7.48 gallons
1 cfs	= 448.8 gallons per minute
1 MGD	= 1,000,000 gallons/day = 1,120 acre-feet / year
1 mg/L	= 1 ppm = $1 / 10^6$
1 µg/L	= 1 ppb =$1 / 10^9$

Summary of Lake El Estero Yield Study

The Monterey Peninsula Water Management District (MPWMD) and the Monterey Regional Water Pollution Control Agency (MRWPCA) are studying the proposed Groundwater Replenishment Project (Proposed Project), with the goal of producing highly treated recycled water supply for injection into the Seaside Groundwater Basin to replace existing supplies. The purpose of this study was to analyze the availability of stormwater runoff from portions of the City of Monterey for this project, and provide an engineering analysis of the infrastructure required and the effect of flow reductions to the Monterey Bay.

The City of Monterey maintains Lake El Estero as the central feature of the Lake El Estero Municipal Park. The Lake covers approximately 18-acres, and collects runoff from approximately 3.78 square-miles of urban, suburban and wooded area. Although the Lake is within one mile of the Monterey Bay, it does not directly connect to ocean. The Lake level is maintained for aesthetics and recreation use, and storm flows are pumped to the ocean through a gated pipeline. Two gravity pipelines provide an overflow outlet from the Lake to the beach.

Diverting stormwater flows into the sanitary sewer system as a source of supply for the Proposed Project was analyzed. Annual runoff into the Lake was estimated to average 268 acre-feet per year. Of that, an average of 87 acre-feet per year may be diverted to the Proposed Project using existing capacity in the City's wastewater collection system. Stormwater not captured for the Proposed Project would remain in the Lake or continue to be discharged to the ocean.

The drainage basin immediately to the west of the Lake drained into Lake El Estero until 1941, when a new storm sewer was installed in Figueroa Street which redirected those flows to Del Monte Beach. This basin is approximately 1.85 square-miles, and produces an estimated average runoff of 227 acre-feet per year. If this drainage basin were reconnected to the Lake, the average Proposed Project yield would increase to 136 acre-feet per year.

Limited water quality sampling indicates that the water in Lake El Estero is of a better quality than City stormwater discharging directly to the Bay. The Lake provides a basin for sediments and metals to settle out of the water column. As such, it is currently one of the more benign sources of fresh water inflow to the Bay. The Monterey Bay at Del Monte Beach is not classified as an estuary, so minimum targets for freshwater inflows have not been established. Reducing the annual discharge of stormwater is not anticipated to have a negative effect on the Bay water quality. If stormwater flows that currently discharge directly to the Bay are routed through the Lake, the average quality of stormwater discharges would be expected to improve. The only noted water quality risk of the Proposed Project is an increased chance of overflows in the sanitary sewer system due to adding stormwater to a portion of the collection system. Automated in-pipe flow monitoring will be required to shut off the stormwater diversion system if the pipeline capacity is needed to convey peak wet weather sanitary sewer flows.

Section 1 - Introduction

1.1 Project Description

The Monterey Peninsula Water Management District (MPWMD) and the Monterey Regional Water Pollution Control Agency (MRWPCA) are studying the proposed Monterey Peninsula Groundwater Recharge Project (Proposed Project), with the goal of producing highly treated recycled water supply for injection into the Seaside Groundwater Basin. Source water for the project may come from the City of Salinas Industrial Wastewater Treatment Facility, the Reclamation Ditch, the Blanco Drain, stormwater from MRWPCA member cities and/or secondary effluent from the MRWPCA Regional Treatment Plant. Water supplied to the Proposed Project would undergo primary and secondary treatment at the existing Regional Treatment Plant, followed by advanced treatment at a new facility to be located at the MRWPCA site, and then be conveyed to the Seaside Groundwater Basin for injection.

The MRWPCA provides wastewater treatment for municipalities along the Monterey Bay from Pacific Grove north to Moss Landing, and inland to the City of Salinas. Wastewater is collected in an interceptor pipeline system and conveyed to the Regional Treatment Plant (RTP), located north of the City of Marina. The RTP has an average dry weather design capacity of 29.6 million gallons per day (mgd) and a peak wet weather design capacity of 75.6 mgd. It currently receives and treats approximately 17 to 18 mgd of average dry weather flow and therefore has capacity to treat additional flows. The interceptor pipeline system also has currently unused or excess conveyance capacity. The Proposed Project will use the existing excess capacity in the wastewater interceptor system to convey source flows to the RTP using, rather than constructing a parallel conveyance system.

The purpose of this study was to analyze water availability from urban stormwater runoff into Lake El Estero and provide an engineering analysis of the potential yields and the infrastructure required to capture and convey those flows to the RTP. Transfers of source water flowing in known and definite channels, such as the City of Monterey's Lake El Estero, to the Proposed Project would be a consumptive use that may require an appropriative permit from the State Water Resources Control Board (SWRCB). If a permit is required, this hydrologic information and analysis may be used in the permit application to the SWRCB.

1.2 Water Source Description

Lake El Estero is an 18-acre lake located in the City of Monterey, less than one mile from the coast. It is fed by four tributary streams and a portion of the City's stormwater collection system. One tributary is a named stream (Majors Creek which runs through Dahvee Park), and the other three are unnamed streams. The Lake El Estero drainage basin is 2,418 acres, or approximately 3.78 square miles.

The Lake was originally a brackish lagoon, connected by a surface stream to the Monterey Bay. The connection to the bay was changed to pipe culverts in the 1870s when the Monterey and Salinas Valley Railroad was constructed. The Lake has been dredged several times during the last century to remove accumulated sediment. Until 1941, the drainage basin included 1,186-acres to the west, extending to Huckleberry Hill, which entered the Lake through a box culvert under Pearl Street. This portion of the City stormwater system was reconfigured with the addition of a box culvert under Figueroa Street, which now carries the flow from Pearl Street to discharge into the Monterey Bay at the Municipal Wharf. In 1968, the current stormwater pump station at the northeast corner of the lake and outfall pipeline were constructed to facilitate better management of water levels in the Lake.

In 1999, Fugro West[1] prepared a study of potential non-potable water supplies for the City of Monterey, and concluded that shallow groundwater percolates into Lake El Estero. Based upon their observations, groundwater inflows were estimated at 135 acre-feet/year. These inflows were found to replace evaporative losses and provide irrigation supply water to the City, which uses lake water for irrigation of the surrounding park (and cemetery). This groundwater inflow was not considered for diversion to the Proposed Project.

The Lake is surrounded by the City of Monterey's El Estero Park Complex, which includes sports facilities, play grounds, a fishing pier and a paddle boat wharf. The lake provides habitat for fish, amphibians, reptiles and native and migratory birds.

The Central Coast Regional Water Quality Control Board (CCRWQCB) has listed Majors Creek on the impaired water body listing pursuant to Section 303(d) of the Clean Water Act for copper, lead, zinc and Escherichia coli concentrations, and has listed the Monterey Harbor as impaired for metals and sediment toxicity. Lake El Estero is not a listed water body. A summary matrix of 303(d) listed streams is provided in Table B-1. Water quality is discussed in greater detail in Section 4 of this report.

[1] Engineering Analysis, Development of Non-Potable Irrigation Water Systems, pages 24-25

Section 2 - Yield Estimation

2.1 Methodology

Estimates of surface runoff into Lake El Estero from the City of Monterey were made based on daily rainfall gage data, National Resource Conservation Service[2] mapped hydrologic soil group information, and land use as shown on aerial photographs. Calculations were made for each day and aggregated by month and water year (October 1 through September 30) using the methods in SCS Manual TR-55, Urban Hydrology for Small Watersheds. Runoff curve numbers (CN) were determined based on soil group and cover. Curve numbers appropriate for scrub cover were used for areas of natural vegetation, and curve numbers appropriate for irrigated pasture were used for lawns and other irrigated ground cover. A curve number of 98 for antecedent moisture condition (AMC) II was used for all impervious areas. The runoff curve numbers used to calculate runoff varied between AMC I (with 1.4 inches or less during previous five days) and AMC III (with 2.1 inches or more during the previous five days) depending on the precipitation during the previous five days.

For each land use and soil group combination, runoff was determined for each day during the period of record. The following equations are used in the NRCS model:

$$R = \frac{(P - 0.2S)^2}{(P - 0.8S)}$$

Where P is the precipitation in inches, R is the runoff in inches, and S is the storage in inches:

$$S = \frac{1000}{CN} - 10$$

Rainfall Data for Monterey was obtained from NOAA gage USC00045795, Monterey, CA, for the period 10/1/1951 to 9/30/1998, and from gage USC00045802, Monterey WFO, for the period 10/1/1998 to 9/30/2013 (Table B-2). The average annual precipitation is 18.6 inches/year. The Lake El Estero drainage basin is 2,418 acres, or approximately 3.78 square miles (Figure A-1). Using the method described above, the total estimated runoff into Lake El Estero averages 268 acre-feet per year (Table B-3).

Runoff capture from Lake El Estero was estimated for two diversion options, as discussed below.

Option 1 is to divert water from the lake into the municipal sanitary sewer system (Figure A-2). SSMH D05-052 is located near the existing El Estero Stormwater Pump Station. This is a 21-inch vitrified clay pipe (VCP) sewer with a crown elevation lower than the water surface of the lake. Looking at the profile between this manhole and the MRWPCA Monterey Lift Station, the

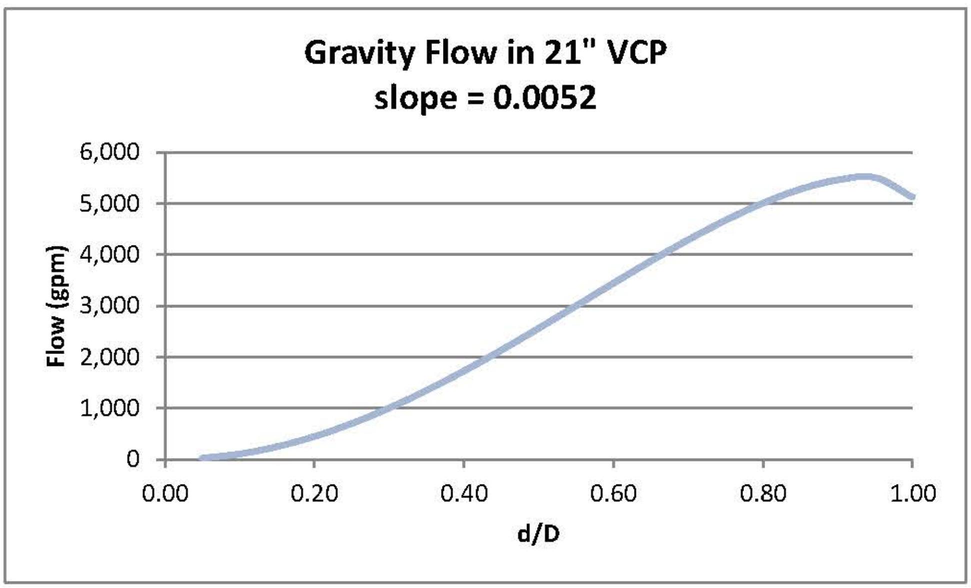
[2] Formerly the USDA Soil Conservation Service

limiting segment is a 21-inch VCP pipe at a slope of 0.0052 (Table 2-1). A flow monitor was installed in the pipeline during the months of November 2013 and January 2014 (see Appendix D). The observed peak dry weather flow (PDWF) in the pipeline was approximately 2,100 gpm. The peak wet weather flow (PWWF) was assumed to be 1.5 x PDWF = 3,100 gpm. Based on the pipeline slope and material, the capacity at d/D = 0.95 is estimated at 5,500 gpm (Figure 2.1), leaving an excess capacity of about 2,400 gpm for stormwater conveyance, or approximately 10.6 acre-feet/day. This diversion may be made with a gravity pipeline controlled by a motorized control valve.

Table 2-1: Existing Sanitary Sewer Manholes and Pipelines

Upstream SSMH	Invert	Downstream SSMH	Invert	D (in)	L (ft)	Slope
D06-004	-8.6	D06-005	-9.1	21	90	0.0056
D06-005	-9.1	D05-052	-10.89	21	223	0.0080
D05-052	-11.4	D05-061	-12.0	21	88	0.0068
D05-061	-12.0	MRW-006	-13.73	21	343	0.0052

Figure 2.1: Capacity Curve for Limiting Sewer Segment



Runoff capture from Lake El Estero was calculated based on two diversion limits. A lower limit of 5 acre-feet/day was assumed to be too small to initiate the runoff capture system (about three inches of rise in the 18-acre lake surface). The next 10.6 acre-feet were captured by the diversion system. Runoff in excess of 15.6 acre-feet/day was assumed to bypass the system and overflow to the bay. Using these limits, the estimated annual runoff capture was 87 AFY. This varied greatly based on the annual rainfall pattern, from a minimum of 0 AFY to a maximum of 224 AFY.

The City of Monterey and MRWPCA Staff conducted a two-day shunt test during the period February 24-26, 2014, to assess the effects of adding water from Lake El Estero to the municipal wastewater collection and treatment systems. A temporary pump was installed at the stormwater pump station and piped to SSMH D05-052. The pump operated at approximately 1,500 gpm for a period of 50 hours, transferring 4.5 million gallons. The inflow was reported to have caused minor surcharging at the receiving manhole due to the configuration of the temporary piping. Spills or surcharging were not reported for the limiting pipeline segment downstream.

Option 2 is to install a pump station and force main to divert flow directly to the MRWPCA Monterey Pump Station (MPS), which is approximately 0.75 miles from Lake El Estero. The MPS has a rated maximum day capacity of 20 MGD, but is currently using only 8 MGD on peak days, leaving an excess of 12 MGD, or 30 acre-feet/day (Figure A-3). Calculating the daily runoff capture using the same 5 AF/day minimum limit and increasing the maximum capture to 30 AF/day, the estimated annual capture volume is 140 AFY, with a range from 14 AFY (minimum) to 390 AFY (maximum). Although this yield is nearly twice that of the gravity diversion, the total yield is too small to justify the construction cost of a pump station and long force main.

The drainage basin adjacent to the west of the Lake El Estero drainage basin previously drained to the Lake, but was diverted directly to the bay with the construction of a box culvert in Figueroa Street. The connection to the lake may be restored to increase the volume of stormwater captured. This basin has an area of 1,186 acres (1.85 sq-mi). Soil types were identified using the NRCS Web Soil Survey, and land cover was estimated using the USGS 7.5 Minute Topographic Quadrangle for Monterey, CA (Table B-7). Runoff from the basin was estimated using the same method as for Lake El Estero (Table B-8). Although the basin is smaller, the average annual runoff is projected to be nearly equal to Lake El Estero (227 AFY in this basin, compared to 268 AFY in the Lake El Estero basin). The Figueroa basin has approximately the same amount of impervious cover (pavement and rooftops) as the El Estero basin, and the soil is predominantly Group D, which has a high runoff potential. The model results were checked against observed flow data for the Figueroa Box Culvert (see Appendix D). The single day results were within 5% of the metered flows. The multiple day results had a greater error, likely due to over-estimating the effects of antecedent rainfall.

The two areas were combined in a single model, and the runoff capture was recalculated (Tables B-9, 10 and 11). The average annual inflow to the Lake increased to 495 AFY, and the yield from the combined inflows was 136 AFY, an increase of 49 AFY over the Lake alone. To achieve this additional capture, the previous storm drain connection along Pearl Street must be reestablished. This connection should be configured with a by-pass weir, limiting the added inflow to the Lake to 4 ac-ft/day, or about 8 cfs, and allowing higher flows to overflow into the Figueroa Street box culvert. Routing all of the flows through the Lake would result in increased use of the existing stormwater pump station, which is an unnecessary cost.

2.2 In-Stream Flow Requirements

Lake El Estero is a land-locked water body which only discharges to the ocean during large storm events. There is no normal connection to the ocean nor a regular or consistent means of fish passage. The City's primary means of discharging water to the ocean is through their stormwater pump station at the northeast corner of the lake. This station moves water from the lake into a 48-inch pipeline that outfalls on Del Monte State Beach above the normal high water line. The pump station intake is screened to prevent fish from entering the station. The outfall structure is gated to prevent sand from accumulating inside the structure when not in use. If the pump station cannot divert the full volume of stormwater runoff entering the lake and the lake level rises sufficiently, water flows through two 33-inch gravity pipelines to a second point of discharge on Del Monte State Beach, west of the pump station outfall (see Figure A-2).

To the east of Lake El Estero is Del Monte Lake, which is a similarly land-locked water body. To the west, the City of Monterey stormwater collection system outfalls to the bay at several locations, the nearest being at the Municipal Wharf.

The City maintains the Lake El Estero water level for aesthetics and recreational use. The proposed project should not reduce the water levels below those currently maintained by the City. It should only reduce the volume of stormwater being discharged to the ocean.

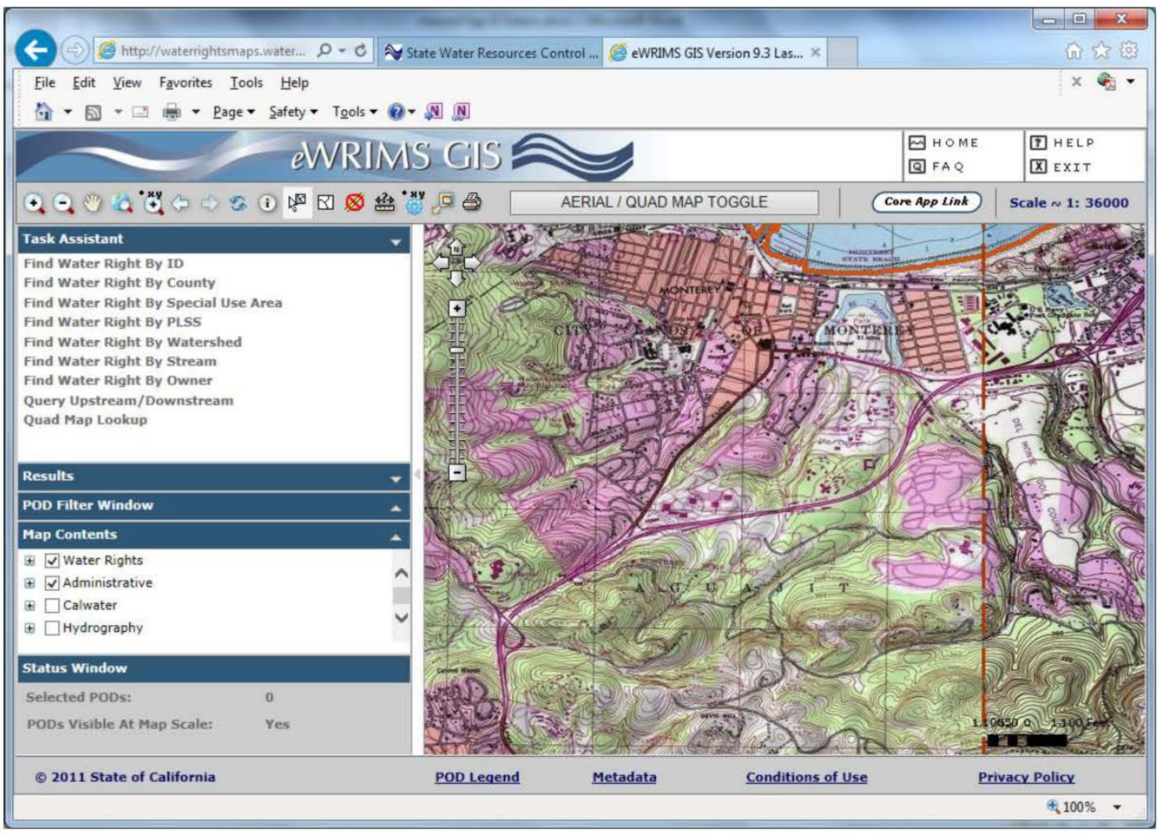
The Monterey Harbor and the Monterey Bay South Coastline are not classified as estuaries, so seasonal freshwater inflows are not required to maintain aquatic habitats. The Monterey Bay National Marine Sanctuary Final Management Plan was reviewed and no requirements for freshwater inflows to this portion of the Bay were listed. The reduction of urban stormwater inflows would be considered a marine water quality benefit because those flows currently carry pollutants into the Sanctuary.

2.3 Water Rights

It is not clear that a state water right would be required for the diversion of urban stormwater flows to the Proposed Project. The City of Monterey currently diverts water from the lake for irrigation within the surrounding park without a water right permit. That use may be considered a riparian claim, and therefore exempt from the formal permitting requirement. Existing water rights were researched to determine if any potential conflicts may exist.

The State Water Resources Control Board Electronic Water Rights Information Management System (eWRIMS) was queried to identify existing water rights in the Lake El Estero Watershed. The on-line GIS mapping tool was queried, and no Points of Diversion (PODs) within the Lake El Estero watershed were identified (Figure 2.2). A listing of all current water rights for Monterey County was obtained using a database query, and it also returned negative results for this area.

Figure 2.2: SWRCB eWRIMS Interface



The SWRCB Water Rights Order 98-08, Declaration of Fully Appropriated Stream Systems in California, identifies those stream segments which cannot support additional authorizations for diversion. The Carmel River is listed in that decision, but Lake El Estero and its tributary streams are not. There is no regulatory prohibition on requesting a water right from this source.

Section 3 - Facility Requirements

3.1 Description and Sizing

Two conceptual designs were developed for stormwater diversion facilities from the Lake: a gravity connection to the sanitary sewer system controlled by a motorized valve and a pumped diversion with a short force main. The following design criteria and assumptions were used:

- The inlet may be located on the lake bank or within the existing pump station
- The inlet must be screened to minimize fish and trash capture
- The diversion pipeline will connect to the existing sanitary sewer manhole near the stormwater pump station (D05-052)
- The minimum velocity in the pipeline shall be 2 feet/second to prevent the settling of suspended sediments in the pipeline
- The maximum velocity in the pipeline shall be less than 8 feet/second to limit the friction losses
- If required, submersible pumps will be used

Two sets of conceptual design diagrams are provided in Appendix C.

The normal water level of the Lake is above the crown of the receiving sanitary sewer main, so the first option considered was a gravity connection (Figures 1 and 2 in Appendix C). This proposed facility would be configured with a new gravity inlet located on the lake bank, equipped with a fish screen, a 12-inch gravity pipeline connecting to SSMH D05-052, a flow meter, a motorized control valve, and a check valve. The discharge pipe would be above the crown of the existing pipe connections in the manhole to provide an air-gap between the sanitary system and the lake. A control panel will be required to operate the motorized valve. It may be configured as autonomous, looking at a lake level sensor and the flow meter, or it may connect to the MRWPCA SCADA system and be controlled remotely. Because the system will be discharging to the municipal sanitary sewer, pressure transducers or float switches must be installed in the receiving system to shut off this system if the receiving sewer is flowing full.

The second option considered was a pumped connection (Figures 3 and 4 in Appendix C). Pumping the water will have a higher operating cost than a gravity connection, but offers positive flow control. This option is configured as adding a column-type pump in the existing pump station wet well, and a similar discharge pipeline with a check valve and flow meter as in the first option.

The screened inlet must be sized to allow full flow through the screen with a maximum velocity of 1 ft/s to allow fish to escape. Assume the screen has an open area of 50%, and that 50% of the screen is blinded by trash/vegetation. For a maximum flow of 5.3 cfs (= 2,400 gpm):

A_{screen} = 5.3 cfs / [(1 ft/s) x (50% screen openings) x (50% blinded)] = 21.2 sq-ft

Minimum dimensions: 4-ft wide x 5.3-ft long

For a new inlet, the Lake bank at the pipe penetration should be lined with rock or concrete to prevent erosion. If rock is used, a concrete cut-off collar should be cast around the pipeline to prevent water from migrating through the pipe bedding material. An alternative option would be to core-drill through the wall of the existing pump station wet well for the new inlet. The existing station uses diesel drives for the pumps, and the fuel tank and pipeline are located underground between the wet well and the receiving sanitary sewer, preventing the installation of a new pipeline at a uniform slope, so this inlet configuration was not used for the gravity option.

The pipeline would be a 12-inch PVC (AWWA C-900 pressure pipe). The size was selected based upon the calculated velocity and friction losses in the pipeline. It was assumed that the lake would provide a minimum of 5-feet of static head between the inlet and discharge. A 12-inch main flowing at 2400 gpm would have a velocity of 6.8 feet per second and estimated losses totaling 3.6 feet (Table C-1). A 10-inch main would have estimated losses totaling 7.6 feet, which exceeds the available system head. The pipeline should be installed with a minimum of 3-feet of cover in the pipe trench.

For the pumped option, an axial flow or column-type pump is recommended. A column may be added to the existing wet well, suspended from the pump deck and braced to the wall. The discharge piping may pass through the wall of the wet well (as shown in the diagram), or it may extend over the pump deck and then go underground. The lake provides a substantial forebay for the pump station, so a variable speed drive will not be required to match the incoming flow rate. Using a 12-inch discharge pipeline, the system horsepower requirement is only 5.3 hp. However, pumps of this type are typically sized for larger flows. The closest match found using the Flygt pump catalog was a 27 hp pump, model PL 7020 with a trimmed impellor to meet the low design point.

The proposed facilities are in a FEMA floodplain[3]. The proposed submersible pumps will not be affected by storm inundation, but the electrical power and control equipment must be elevated above the base flood elevation of 11-ft (approximately 2-ft above the existing pump station deck).

[3] FEMA Flood Insurance Rate Map, Panel 06053C0703G, April 2009 (see Appendix A)

3.2 Costs

Capital costs were estimated for the two transfer station configurations, gravity and pumped. Detailed estimates are provided in Tables C-3 and C-4 in Appendix C. Non-construction costs (design, permitting, legal, etc.) were estimated as 40% of the construction cost.

The condition of the existing box culvert in Pearl Street at Figueroa Street is unknown (was it bricked closed or physically removed), so no estimate was made of the cost to reconnect the adjacent drainage basin to Lake El Estero.

Right-of-way acquisition costs were not included in the capital cost estimates. The proposed site is on City of Monterey property, so standard encroachment fees should apply.

Table 3-1: Estimated Capital Costs

	El Estero Gravity	El Estero Pump Station
Estimated Construction Cost	$65,800	$157,900
Inspection and Testing (15%)	$10,000	$24,000
Construction Contingency (20%)	$13,000	$32,000
Estimated Total Construction Cost	$89,000	$214,000
Design, Permitting, Legal (40%)	$35,600	$85,600

Costs are in 1st Quarter 2014 dollars

The City of Monterey has standard capacity charges and monthly fees for connecting to the sanitary sewer collection system, which should apply to this connection. Similarly, the MRWPCA has standard capacity charges for connection to the regional wastewater system that are based on the flow rate, the biological oxygen demand (BOD) and the suspended solids concentration, and monthly charges for wastewater treatment. These fees are not included in this estimate, because the MRWPCA is a sponsor of the Proposed Project. The primary, secondary and advanced treatment costs for this source of supply will appear in the overall project cost analysis.

Annual operating and debt service costs for each configuration were estimated using the following planning factors:

- Debt service assumes a 30-year bond at 4% annual interest
- Annual operation and maintenance of pump stations is estimated at 2.5% of the capital cost
- Annual operation and maintenance of pipelines is estimated at 1% of the capital cost
- Electrical power cost is assumed at $0.16 per kWh
- Assume the station operates 13.5 days per year (average from runoff capture model)

The factors above provide an order-of-magnitude estimate of annual costs, which may be used in comparing project configurations. The estimated annual costs are provided below.

Table 3-2: Estimated Annual Costs, Gravity Option

Category	Basis	Annual $
Capital Repayment		
Assume 30-year bond at 4%	$146,000.00	$8,443.19
Annual Operation and Maintenance		
Assume 2.5% of Pump Station Capital Cost	$0.00	$0.00
Assume 1.0% of Pipeline Capital Cost	$146,000.00	$3,650.00
Electrical Power		
Number of operating days/year	13.5	
Pumps: None		
Estimated annual kWh	-	
Assumed cost per KWH	$0.16	$0.00
Total Estimated Annual Cost		**$12,100.00**

Table 3-3: Estimated Annual Costs, Pump Station Option

Category	Basis	Annual $
Capital Repayment		
Assume 30-year bond at 4%	$214,000.00	$12,375.64
Annual Operation and Maintenance		
Assume 2.5% of Pump Station Capital Cost	$200,500.00	$5,012.50
Assume 1.0% of Pipeline Capital Cost	$13,500.00	$337.50
Electrical Power		
Number of operating days/year	13.5	
Pumps: 27 HP (0.7457 kW/hp)	20.1	
Estimated annual kWh	6,523	
Assumed cost per KWH	$0.16	$1,043.74
Total Estimated Annual Cost		**$18,800.00**

Section 4 - Water Quality

4.1 Summary of Current Condition

The Central Coast Regional Water Quality Control Board (CCRWQCB) Water Quality Control Plan for the Central Coast Basin (Basin Plan) designated beneficial uses of the Lake El Estero as including municipal and domestic supply, groundwater recharge, water contact recreation, non-contact water recreation, wildlife habitat, cold water fish habitat, warm water fish habitat, spawning/reproduction/early development habitat and commercial or sport fishing. Many of these are the minimum uses listed for all inland water bodies within the region, unless specific water quality information caused the RWQCB to remove a specific use (e.g., not listing water contact recreation for a stream segment listed for fecal coliform contamination). The Monterey Harbor has designated beneficial uses of water contact recreation, non-contact water recreation, industrial service supply, navigation, marine habitat, shellfish harvesting, commercial or sport fishing and rare/threatened/endangered species habitat.

Lake El Estero is not listed as an impaired water body, but Majors Creek (at tributary stream to Lake El Estero) and the Monterey Harbor are listed. Majors Creek is listed as impaired water body pursuant to Section 303(d) of the Clean Water Act for copper, lead, zinc and Escherichia coliform. The Monterey Harbor is listed as an impaired water body for metals and sediment toxicity. Water quality has been sampled and monitored for the past 15 years under various programs, including the Central Coast Long-term Environmental Assessment Network (CCLEAN), the Monterey Bay Sanctuary Citizen Watershed Monitoring Network and the City of Monterey Urban Watch. The results of these programs have been consolidated in Table B-12, for Lake El Estero, Majors Creek, Monterey Harbor and Monterey Bay South Coastline. Sampling locations are shown on Figure A-5.

The Monterey Regional Storm Water Management Program identifies water quality objectives for stormwater discharging into the Monterey Bay. These and other applicable water quality standards are consolidated in Table B-13, Water Quality Objectives.

4.2 Effect of Diversion on Monterey Bay Water Quality

Stormwater runoff can carry pollutants such as oils, sediments and metals into the Monterey Bay, which is a National Marine Sanctuary. Lake El Estero serves as a settling basin for stormwater, which is a treatment process. Water passing through the lake carries lower levels of suspended solids than stormwater discharging directly to the Bay. Samples of the water discharged through the Lake El Estero stormwater pump station have not been collected and tested, but looking at the available water quality data in Table B-7, it may be inferred that these discharges will be of better quality than direct discharges from other portions of the municipal system. Therefore, the proposed diversion should have a little to no effect on the Bay.

Reconnecting the adjacent drainage basin to Lake El Estero through the Pearl Street box culvert should have a positive effect on near-shore water quality. Passing these flows through the lake will provide settling of suspended solids. During peak rain events, the addition of these flows to the lake will cause increased use of the stormwater pump station. The increased inflow rates will decrease the detention time in the lake, leading to a decline in water quality during stormwater pumping periods. However, the quality of the pumped discharge will be better than the current quality of flows directly discharged to the Bay.

Adding stormwater to the sanitary sewer system increases the risk of sanitary sewer overflows, which can convey bacterial pollutants into the Bay. The sanitary sewer pipeline between Lake El Estero and the MRWPCA interceptor will flow at maximum capacity during peak diversions, so certain safeguards should be included in the project. First, the sewer pipeline and manholes should be inspected for cracks and leaking joints. If found, they should be repaired to prevent the combined flows from leaking out into the surrounding soil. Second, pressure sensors should be installed in one or more manholes to identify backwater effects in the system. If the combined storm and sewer flow exceeds the gravity capacity of the sewer main, the stormwater system can shut off to prevent the sanitary flows from spilling. The stormwater can be held in the lake for later diversion or discharged through the stormwater pump station, depending upon the level of the lake at the time.

Appendix A: Figures

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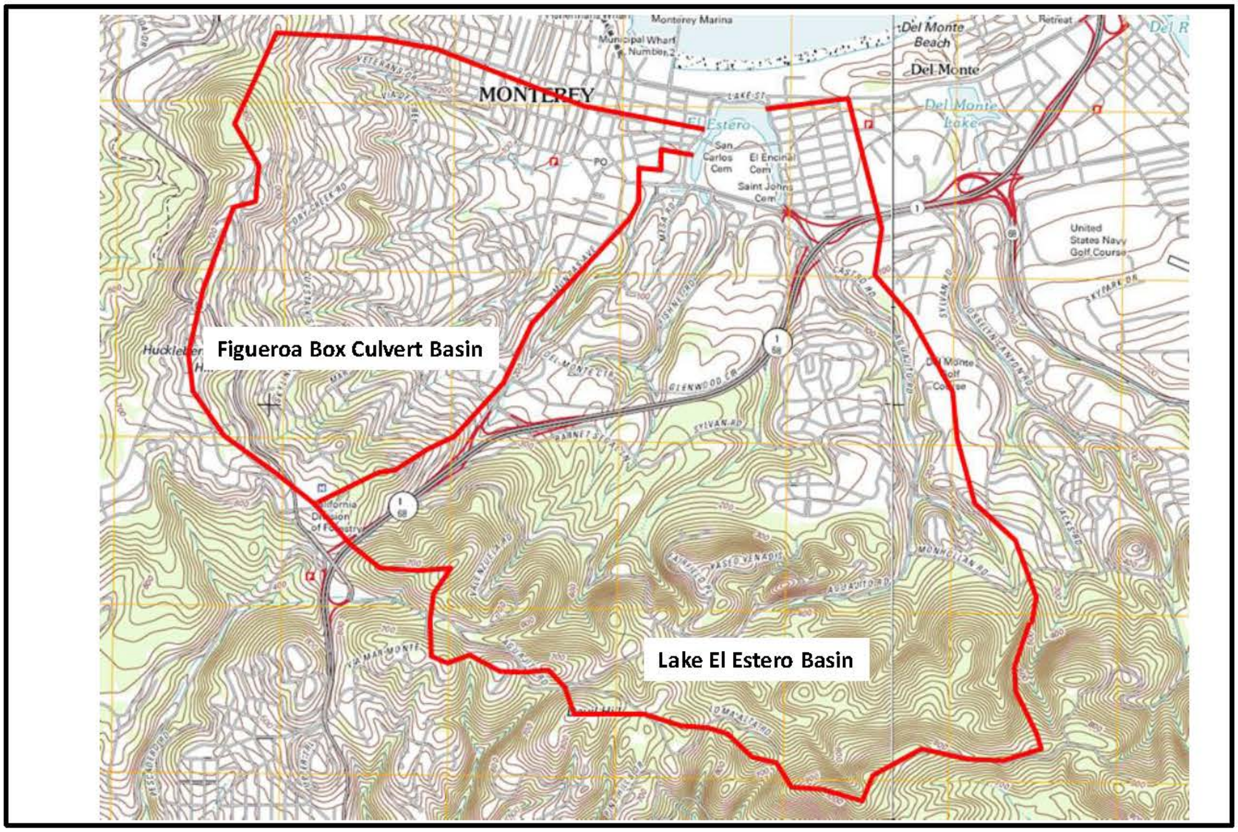
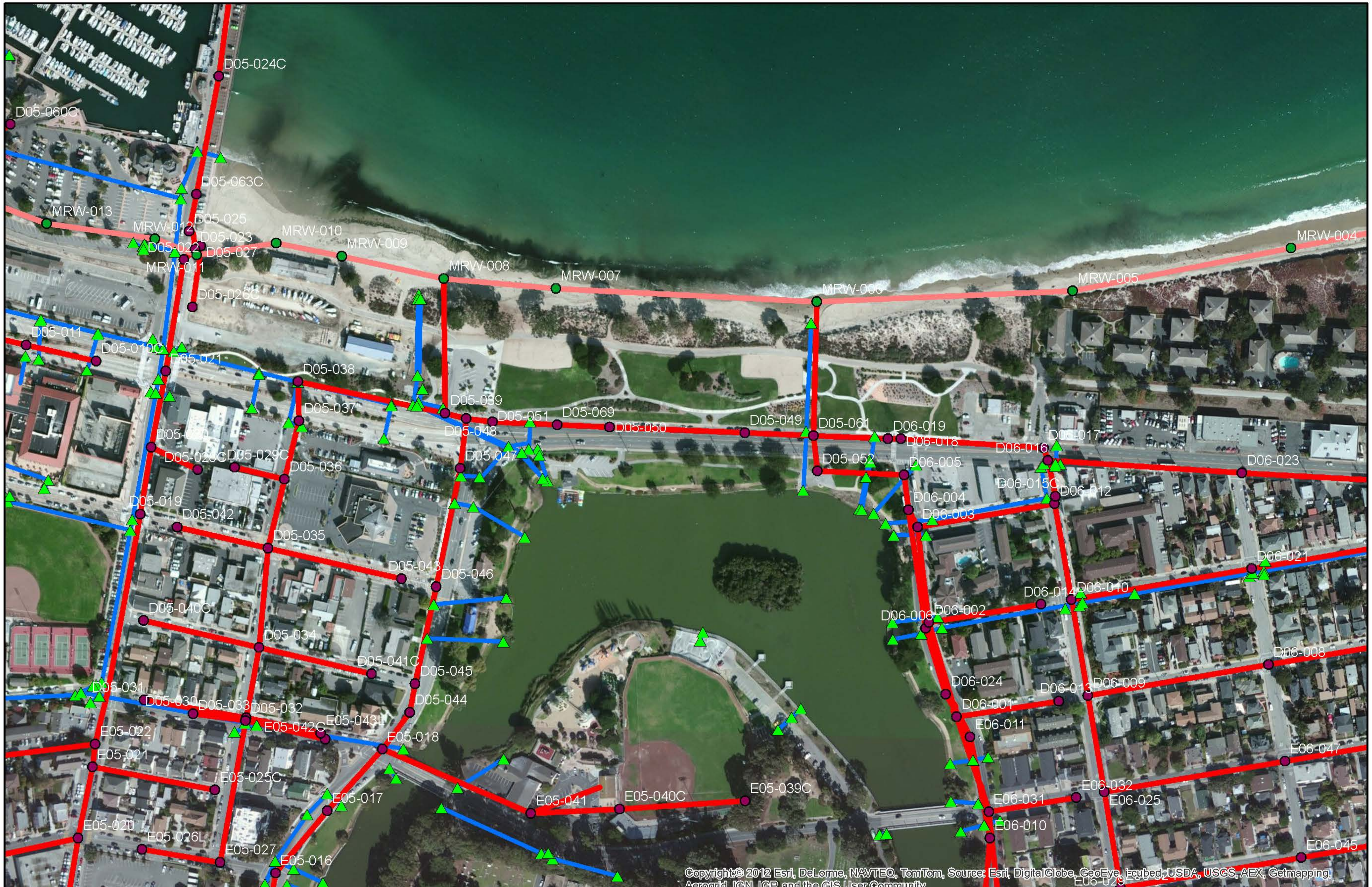


Figure A-1: Lake El Estero Drainage Basins

Source: overlay on USGS 7.5 Minute Quadrangles, Monterey, CA and Seaside, CA

Ground Water Replenishment

EIR Scoping Data



N
W E
S

Feet
0 50 100 200 300 400

1 inch = 254 feet

Monterey Peninsula Water Management District

Legend

- Private SMH
- SMH
- STORM POINTS
- Private SMN
- SMN
- STORM MAIN

Facility Name	Flow Rates (MGD) ADWF	PWWF
Monterey Interceptor (MI) Flows	6.7	19.8
Salinas Interceptor (SI) Flows	11.8	15.0
Castroville Interceptor (CI) Flows	0.7	2.0
Total RTP Influent Flows to Headworks	19.2	36.8
RTP Permitted Design Flows	29.6	75.6

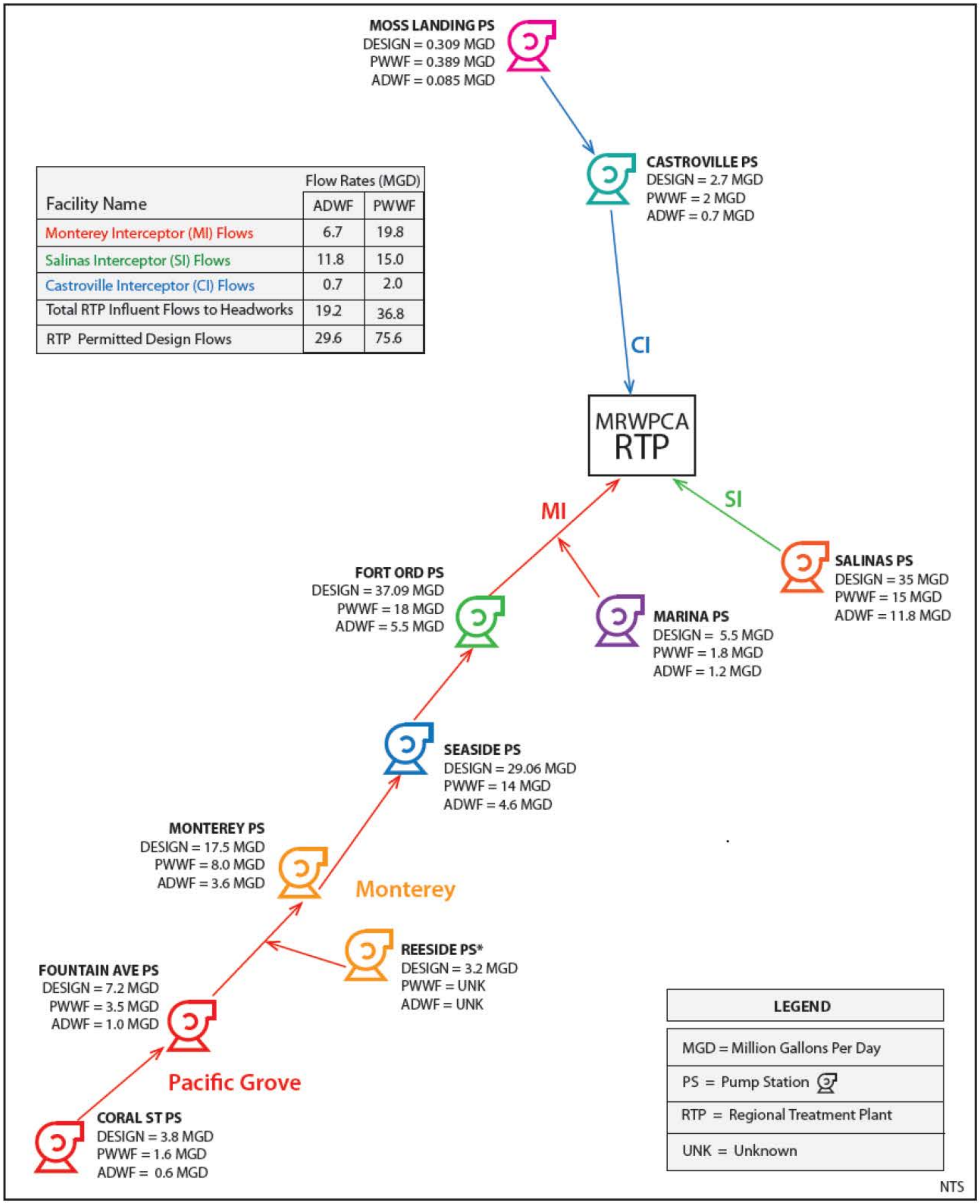


Figure A-3: MRWPCA Interceptor System Schematic

Source: Brezack and Associates Planners, September 2013

Figure A-4: FEMA FIRMette, Lake El Estero Pump Station

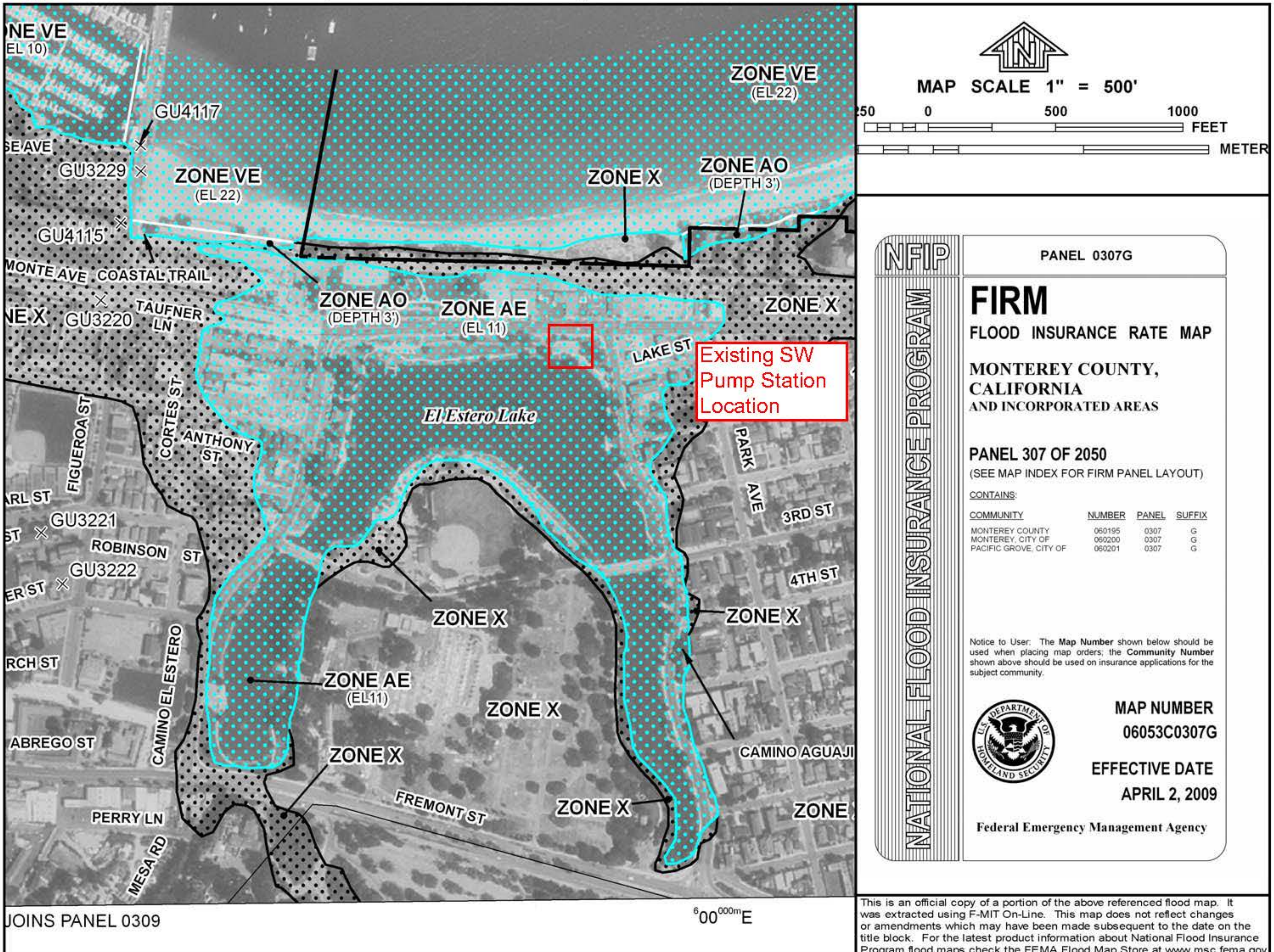


Figure A-4 (continued)

Definitions of FEMA Flood Zones

Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk and type of flooding. These zones are depicted on the published Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map (FHBM).

Special Flood Hazard Areas – High Risk

Special Flood Hazard Areas represent the area subject to inundation by 1-percent-annual chance flood. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply in these zones.

ZONE	DESCRIPTION
A	Areas subject to inundation by the 1-percent-annual-chance flood event. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown.
AE, A1-A30	Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. BFEs are shown within these zones. (Zone AE is used on new and revised maps in place of Zones A1–A30.)
AH	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are 1–3 feet. BFEs derived from detailed hydraulic analyses are shown in this zone.
AO	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are 1–3 feet. Average flood depths derived from detailed hydraulic analyses are shown within this zone.
AR	Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection.
A99	Areas subject to inundation by the 1-percent-annual-chance flood event, but which will ultimately be protected upon completion of an under-construction Federal flood protection system. These are areas of special flood hazard where enough progress has been made on the construction of a protection system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes. Zone A99 may be used only when the flood protection system has reached specified statutory progress toward completion. No BFEs or flood depths are shown.

Figure A-4 (continued)

Coastal High Hazard Areas – High Risk

Coastal High Hazard Areas (CHHA) represent the area subject to inundation by 1-percent-annual chance flood, extending from offshore to the inland limit of a primary front al dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. Structures located within the CHHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory purchase requirements apply in these zones.

ZONE	DESCRIPTION
V	Areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves. Because detailed coastal analyses have not been performed, no BFEs or flood depths are shown.
VE, V1-V30	Areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action. BFEs derived from detailed hydraulic coastal analyses are shown within these zones. (Zone VE is used on new and revised maps in place of Zones V1–V30.)

Moderate and Minimal Risk Areas

Areas of moderate or minimal hazard are studied based upon the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Local stormwater drainage systems are not normally considered in a community's flood insurance study. The failure of a local drainage system can create areas of high flood risk within these zones. Flood insurance is available in participating communities, but is not required by regulation in these zones. Nearly 25-percent of all flood claims filed are for structures located within these zones.

ZONE	DESCRIPTION
B, X (shaded)	Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.)
C, X (unshaded)	Minimal risk areas outside the 1-percent and .2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. (Zone X (unshaded) is used on new and revised maps in place of Zone C.)

Undetermined Risk Areas

ZONE	DESCRIPTION
D	Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

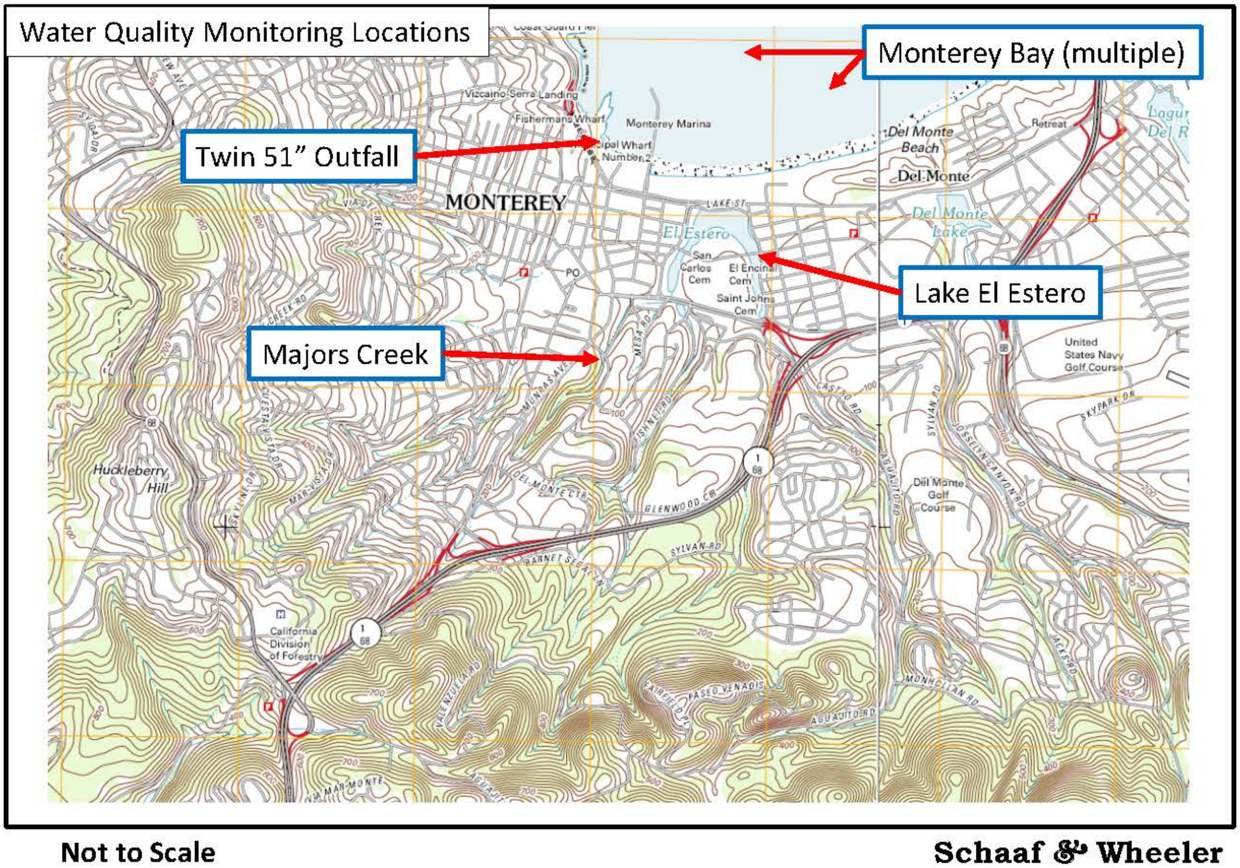


Figure A-5: MRSWMP/ MBNMS/ Monterey Urban Watch Water Sampling Sites

Source: various reports

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Appendix B: Tables

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Table B-1: 2010 California 303(d) Listing

Listed for:	Ammonia (Unionized)	Chlordane	Chloride	Chlorophyll-a	Chlorpyrifos	Copper	DDD (Dichlorodiphenyldichloroethane)	Diazinon	Dieldrin	Electrical Conductivity	Enterococcus	Escherichia coli (E. coli)	Fecal Coliform	Low Dissolved Oxygen	Metals	Nickel	Nitrate	Nutrients	Pathogens	PCBs (Polychlorinated biphenyls)	Pesticides	pH	Priority Organics	Sediment Toxicity	Sedimentation/Siltation	Sodium	Temperature, water	Total Coliform	Total Dissolved Solids	Toxaphene	Turbidity	Unknown Toxicity
Water Body																																
Alisal Creek (Monterey County)				X									X				X									X						
Alisal Slough (Monterey County)														X			X							X								X
Blanco Drain					X			X						X			X				X										X	
Espinosa Lake					X			X																								
Espinosa Slough	X							X									X				X	X	X	X							X	X
Gabilan Creek	X												X				X					X		X							X	X
Majors Creek (Monterey County)						**X**						**X**																				
Merrit Ditch	X													X			X							X							X	X
Monterey Harbor															**X**									**X**								
Moss Landing Harbor					X			X						X		X			X		X	X		X	X							
Natividad Creek	X											X		X			X					X		X			X				X	X
Old Salinas River				X	X			X				X	X	X			X					X		X							X	X
Old Salinas River Estuary																		X			X											
Salinas Reclamation Canal	X				X	X		X				X	X	X			X				X	X	X	X							X	X
Salinas River (lower, estuary to near Gonzales Rd crossing, watersheds 30910 and 30920)		X	X		X		X	X	X	X	X	X	X				X			X	X	X				X			X	X	X	X
Salinas River Lagoon (North)																		X			X											
Santa Rita Creek (Monterey County)	X											X	X	X			X									X					X	

Groundwater Recharge Project

Table B-2: Recorded Precipitation in Monterey, CA (inches)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
	1	2	3	4	5	6	7	8	9	10	11	12	
1952	0.9	2.8	6.9	10.0	3.0	4.4	1.1	0.2	0.2	0.1	0.1	0.1	29.7
1953	0.2	2.2	5.9	2.1	0.0	1.2	1.7	0.5	0.2	0.0	0.1	0.1	14.1
1954	0.4	2.2	0.6	4.3	2.3	4.9	0.9	0.4	0.4	0.0	0.2	0.1	16.4
1955	0.0	1.4	3.1	5.8	1.7	0.0	1.7	0.9	0.1	0.0	0.0	0.0	14.8
1956	0.1	2.0	9.8	5.8	2.3	0.2	1.7	0.6	0.0	0.1	0.0	0.4	22.8
1957	1.0	0.0	0.8	4.7	3.5	1.9	1.5	2.4	0.2	0.0	0.0	0.2	16.2
1958	1.6	0.9	3.7	3.7	5.7	7.2	4.7	0.6	0.4	0.0	0.0	0.5	28.9
1959	0.0	0.5	0.5	4.9	5.8	0.3	0.3	0.1	0.0	0.0	0.0	3.1	15.6
1960	0.0	0.0	0.6	4.3	4.5	0.8	0.9	0.3	0.0	0.0	0.0	0.1	11.6
1961	0.1	2.1	0.9	1.9	1.2	2.6	1.3	0.7	0.0	0.0	0.1	0.1	10.9
1962	0.0	1.7	1.2	2.6	5.2	2.6	0.3	0.2	0.2	0.0	0.3	0.2	14.4
1963	1.3	0.4	2.2	3.1	2.7	4.1	0.0	0.0	0.0	0.0	0.0	0.0	13.8
1964	1.5	3.8	0.5	3.5	0.4	2.2	0.2	0.9	0.2	0.1	0.4	0.0	13.7
1965	0.8	3.3	6.5	2.6	1.1	2.4	2.3	0.2	0.2	0.1	0.2	0.0	19.4
1966	0.2	6.5	5.6	2.3	1.9	0.4	0.3	0.1	0.1	0.3	0.1	0.3	18.1
1967	0.1	4.7	4.2	5.3	0.5	5.5	7.1	0.4	1.6	0.0	0.1	0.2	29.6
1968	0.4	1.6	2.3	3.1	1.4	3.1	0.8	0.3	0.0	0.1	0.2	0.1	13.3
1969	0.3	3.1	3.3	9.5	7.3	1.3	2.7	0.1	0.4	0.0	0.0	0.1	28.2
1970	0.5	0.7	3.1	5.9	2.0	3.0	0.4	0.1	0.3	0.0	0.1	0.0	16.0
1971	0.6	6.2	5.0	1.1	0.6	2.0	1.2	0.7	0.0	0.1	0.1	0.4	18.0
1972	0.1	2.0	4.8	1.2	1.1	0.0	0.9	0.1	0.2	0.1	0.0	0.1	10.5
1973	2.5	6.0	2.1	6.1	5.9	4.5	0.1	0.1	0.0	0.0	0.1	0.3	27.6
1974	2.2	3.9	4.7	3.7	0.9	4.5	3.4	0.0	0.4	0.3	0.0	0.0	24.0
1975	1.5	0.6	2.5	1.3	3.6	4.1	1.8	0.0	0.2	0.2	0.4	0.0	16.2
1976	1.7	0.5	0.4	0.2	3.0	1.5	1.7	0.1	0.2	0.0	1.0	0.4	10.7
1977	0.6	0.7	2.1	1.7	0.8	1.8	0.0	1.2	0.1	0.0	0.0	0.7	9.8
1978	0.1	0.5	5.9	6.8	4.8	5.2	5.4	0.0	0.1	0.0	0.0	0.3	29.2
1979	0.0	2.1	1.6	4.8	4.5	4.4	0.6	0.3	0.0	0.4	0.1	0.0	18.8
1980	1.8	2.9	3.2	4.8	4.8	2.4	1.8	0.6	0.0	0.7	0.1	0.1	23.1
1981	0.1	0.1	1.7	6.6	2.1	4.0	1.0	0.2	0.0	0.0	0.2	0.1	16.0
1982	2.1	5.7	1.7	4.7	2.4	8.0	3.1	0.1	0.5	0.1	0.1	1.5	29.9
1983	2.3	6.2	3.6	6.9	5.6	9.6	4.4	0.3	0.2	0.0	0.0	1.2	40.3
1984	0.5	5.3	3.7	0.1	2.4	1.2	0.8	0.2	0.2	0.0	0.0	0.0	14.5
1985	2.1	4.8	2.0	1.1	1.4	3.9	0.8	0.3	0.3	0.1	0.0	0.2	16.9
1986	1.6	4.4	1.5	2.1	4.5	5.1	0.4	0.4	0.1	0.0	0.1	0.9	21.2
1987	0.1	0.3	1.7	3.4	3.0	2.8	0.5	0.1	0.0	0.1	0.0	0.0	12.1
1988	1.1	1.8	3.2	2.2	0.7	0.1	1.9	0.6	0.3	0.0	0.0	0.0	12.1
1989	0.2	2.7	3.4	1.6	2.2	2.9	1.0	0.3	0.0	0.0	0.0	1.0	15.3
1990	1.7	1.4	0.2	3.5	2.9	1.6	0.9	1.8	0.0	0.0	0.1	0.1	14.1
1991	0.1	0.5	1.7	0.7	2.3	7.5	0.5	0.2	0.0	0.1	0.3	0.0	13.9
1992	1.3	0.1	3.5	2.2	6.3	4.0	0.0	0.0	0.2	0.0	0.1	0.1	17.8
1993	0.7	0.2	6.3	9.7	7.6	3.1	0.9	0.8	0.8	0.0	0.0	0.0	30.1
1994	0.2	1.8	2.2	3.0	4.0	0.5	1.4	0.8	0.0	0.0	0.1	0.1	14.0
1995	0.3	2.8	2.4	10.6	0.7	7.3	2.2	0.6	1.4	0.0	0.0	0.0	28.4
1996	0.0	0.2	2.3	5.0	8.1	2.9	0.9	1.3	0.0	0.1	0.0	0.0	21.0
1997	1.1	2.6	8.0	8.8	0.2	0.2	0.4	0.1	0.1	0.0	0.2	0.0	21.7
1998	0.6	7.5	3.6	10.4	14.3	4.2	3.4	2.7	0.3	0.3	0.0	0.2	47.4
1999	0.6	2.5	1.2	2.7	3.1	3.4	2.2	0.0	0.2	0.0	0.0	0.4	16.3
2000	0.1	1.0	0.2	5.3	5.8	2.4	0.7	0.4	0.0	0.0	0.0	0.2	16.2
2001	3.9	0.0	0.2	3.6	3.7	1.7	1.8	0.0	0.1	0.0	0.0	0.1	15.0
2002	0.2	2.3	4.8	1.1	1.0	1.0	0.4	0.7	0.0	0.0	0.0	0.0	11.4
2003	0.0	1.9	6.2	1.0	1.9	1.0	2.1	0.8	0.0	0.0	0.1	0.0	15.0
2004	0.4	1.7	5.3	1.3	4.1	0.5	0.0	0.0	0.1	0.0	0.0	0.1	13.5
2005	3.3	1.0	4.9	4.4	4.2	4.2	1.6	0.8	0.3	0.0	0.0	0.0	24.7
2006	0.1	1.1	3.6	3.2	0.9	7.1	2.8	0.6	0.0	0.0	0.0	0.0	19.5
2007	0.1	1.3	2.3	1.1	3.1	0.5	1.0	0.2	0.1	0.0	0.0	0.4	10.2
2008	1.1	0.5	1.1	6.3	2.6	0.5	0.2	0.0	0.0	0.0	0.0	0.0	12.4
2009	0.2	1.3	2.7	2.2	5.0	2.3	0.3	0.2	0.0	0.0	0.1	0.1	14.5
2010	2.4	0.3	2.2	5.9	2.9	3.2	3.0	0.6	0.0	0.0	0.2	0.1	20.6
2011	0.9	2.2	4.0	2.0	4.5	4.8	0.2	0.9	0.8	0.0	0.1	0.0	20.4
2012	1.9	1.4	0.2	1.3	0.7	3.5	2.2	0.1	0.3	0.0	0.0	0.0	11.8
2013	0.6	3.5	3.9	0.9	0.8	1.1	0.3	0.0	0.1	0.0	0.1	0.0	11.2
Average	0.8	2.2	3.0	3.9	3.2	3.0	1.5	0.5	0.2	0.1	0.1	0.2	18.6
Minimum	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8
Maximum	3.9	7.5	9.8	10.6	14.3	9.6	7.1	2.7	1.6	0.7	1.0	3.1	47.4

Data from 1951-10-01 to 1998-09-30 is from gage USC00045795 Monterey, CA
Data from 1998-10-01 to 2013-09-30 is from gage USC00045802 Monterey WFO

Table B-3: El Estero Watershed Areas and Curve Numbers

Determination of available surface water for non-potable water supply

	Land Use	Soil Group	Curve Number (AMC II)	Area (acres)	Percent Impervious	Impervious Area (acres)	Pervious Area (acres)
1	LD	A	34	22	15%	3.3	18.7
2	UHD	A	34	31	90%	28.1	3.1
3	DV	B	43	275	0%	0.0	274.6
4	MD	B	48	186	30%	55.9	130.5
5	HD	B	48	68	50%	34.0	34.0
6	LD	B	48	10	15%	1.5	8.6
7	UHD	B	48	60	90%	53.7	6.0
8	DV	C	60	1466	0%	0.0	1465.6
9	HD	C	65	31	50%	15.6	15.6
10	LD	C	65	2	15%	0.3	1.6
11	UHD	C	65	27	90%	24.0	2.7
12	DV	D	66	18	0%	0.0	18.4
13	HD	D	70	31	50%	15.6	15.6
14	LD	D	70	3	15%	0.4	2.3
15	UHD	D	70	169	90%	152.1	16.9
16	Lake	n\a	100	19	100%	19.3	0.0
				2418		**404**	**2014**

Curve Number (AMC II)	Area (acres)	Curve Number (AMC I)	Curve Number (AMC III)
Pervious Area			
34	21.9	18	54
43	274.6	25	63
48	179.0	29	68
60	1465.6	40	78
65	19.8	45	82
66	18.4	46	82
70	34.8	51	85
	2014		
Impervious Area			
98	404	94	99

Scrub runoff curve numbers used for dense vegetation
Irrigated pasture runoff curve numbers used for pervious areas of all other land use

Curve numbers come from NRCS Pub TR-55
AMC values come from NRCS Pub NEH-4 (National Engineering Handbook, Part 630, Chapter 10)

Groundwater Recharge Project

Table B-4: Estimated Runoff into Lake El Estero (acre-feet)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
	1	2	3	4	5	6	7	8	9	10	11	12	
1952	8	47	134	248	21	56	10	-	-	-	-	-	525
1953	-	30	86	15	-	10	14	-	-	-	-	-	155
1954	1	32	4	62	29	69	7	3	0	-	-	-	208
1955	-	14	41	92	17	-	7	3	-	-	-	-	174
1956	-	26	215	92	31	-	19	3	-	-	-	1	387
1957	3	-	6	58	36	7	12	31	-	-	-	0	153
1958	14	4	55	66	80	106	142	5	0	-	-	1	473
1959	-	1	2	111	110	0	1	-	-	-	-	72	298
1960	-	-	1	54	67	1	4	0	-	-	-	-	126
1961	-	21	5	14	8	26	14	1	-	-	-	-	88
1962	-	10	9	40	71	36	0	-	0	-	1	-	168
1963	21	1	33	57	49	68	-	-	-	-	-	-	228
1964	18	38	2	55	2	15	-	1	-	-	1	-	131
1965	4	40	154	24	7	25	18	-	-	-	-	-	272
1966	0	116	110	37	13	1	0	-	-	1	-	1	278
1967	-	52	127	112	1	118	114	1	16	-	-	-	541
1968	2	11	17	31	7	34	11	-	-	-	0	-	112
1969	0	34	20	269	128	10	34	-	0	-	-	-	496
1970	3	7	39	118	19	88	0	-	0	-	-	-	274
1971	1	199	67	4	1	23	6	1	-	-	-	3	305
1972	-	21	63	9	5	-	1	-	0	-	-	-	98
1973	30	136	8	75	89	43	-	-	-	-	-	0	381
1974	30	33	82	61	2	65	91	-	1	0	-	-	366
1975	16	2	24	9	31	36	6	-	-	-	3	-	127
1976	20	0	0	-	30	18	19	-	0	-	4	1	93
1977	7	4	44	39	4	19	-	4	-	-	-	4	125
1978	-	2	104	171	115	65	72	-	-	-	-	0	530
1979	-	26	13	58	39	53	1	0	-	2	-	-	193
1980	20	31	43	58	81	19	10	1	-	9	-	-	272
1981	-	-	19	153	12	36	8	-	-	-	-	-	228
1982	30	97	10	64	29	123	63	-	2	-	-	15	432
1983	35	125	68	190	60	246	69	0	-	-	-	19	814
1984	1	81	31	-	18	5	1	1	-	-	-	-	137
1985	30	57	15	4	22	35	5	0	1	-	-	0	168
1986	27	84	10	12	82	117	0	1	-	-	-	7	340
1987	-	0	9	30	46	25	3	-	-	-	-	-	114
1988	11	18	21	19	2	0	13	0	-	-	-	-	83
1989	-	29	40	13	31	21	5	0	-	-	-	7	145
1990	25	20	0	50	36	6	12	17	-	-	-	-	166
1991	0	5	11	4	23	128	0	-	-	-	-	-	172
1992	16	-	59	35	167	62	-	-	-	-	-	-	339
1993	3	0	115	273	172	37	6	1	3	-	-	-	611
1994	-	17	42	54	63	0	6	5	-	-	-	-	186
1995	1	13	17	220	2	118	13	2	17	-	-	-	403
1996	-	0	16	67	253	39	5	16	-	-	-	-	396
1997	5	49	165	202	-	-	1	-	-	-	0	-	423
1998	2	146	56	260	653	44	52	19	-	-	-	-	1,232
1999	7	23	4	20	37	16	24	-	-	-	-	2	133
2000	-	5	-	122	74	43	2	1	-	-	-	0	247
2001	53	-	-	38	43	11	12	-	-	-	-	-	158
2002	0	22	57	13	5	5	0	4	-	-	-	-	107
2003	-	30	116	6	16	7	5	1	-	-	-	-	181
2004	2	9	84	29	35	2	-	-	-	-	-	-	162
2005	52	4	112	80	55	52	6	2	0	-	-	-	363
2006	-	3	33	47	1	71	35	7	-	-	-	-	197
2007	-	5	20	4	26	2	5	-	-	-	-	1	63
2008	8	1	3	112	17	3	0	-	-	-	-	-	144
2009	0	6	22	28	57	22	0	0	-	-	-	0	135
2010	59	0	14	117	16	44	32	1	-	-	-	-	283
2011	2	16	33	27	88	99	-	2	4	-	-	-	271
2012	21	5	0	10	1	41	21	-	1	-	-	-	100
2013	1	48	58	2	5	3	-	-	-	-	-	-	117
Average	9	30	45	70	52	40	16	2	1	0	0	2	268
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	63
Maximum	59	199	215	273	653	246	142	31	17	9	4	72	1,232

Groundwater Recharge Project

Table B-5: Estimated Transferable Runoff from Lake El Estero (acre-feet)

Year	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	**Total**	**Type Year**
1952	69	2	26	4	0	0	0	0	0	0	12	42	154	Wet
1953	6	0	5	7	0	0	0	0	0	0	11	0	29	Dry
1954	32	13	21	2	0	0	0	0	0	0	7	13	88	Normal
1955	33	9	0	0	0	0	0	0	0	0	11	38	90	Wet
1956	33	12	0	11	0	0	0	0	0	0	0	0	56	Dry
1957	30	12	0	5	11	0	0	0	0	5	0	25	87	Normal
1958	24	23	52	47	0	0	0	0	0	0	0	0	147	Normal
1959	40	52	0	0	0	0	0	0	21	0	0	0	113	Dry
1960	16	38	0	0	0	0	0	0	0	0	11	0	65	Normal
1961	2	0	11	8	0	0	0	0	0	0	3	2	26	Dry
1962	18	26	11	0	0	0	0	0	0	11	0	12	77	Dry
1963	21	24	23	0	0	0	0	0	0	10	12	0	90	Normal
1964	18	0	7	0	0	0	0	0	0	0	15	55	95	Normal
1965	11	0	11	5	0	0	0	0	0	0	45	35	107	Normal
1966	15	5	0	0	0	0	0	0	0	0	21	28	69	Dry
1967	41	0	35	39	0	11	0	0	0	0	3	6	134	Normal
1968	13	0	15	6	0	0	0	0	0	0	13	1	47	Normal
1969	88	43	0	11	0	0	0	0	0	0	2	19	163	Wet
1970	42	7	21	0	0	0	0	0	0	0	33	31	135	Wet
1971	0	0	12	0	0	0	0	0	0	0	9	30	51	Dry
1972	3	0	0	0	0	0	0	0	0	13	52	0	67	Normal
1973	33	31	17	0	0	0	0	0	0	11	12	24	128	Wet
1974	31	0	22	11	0	0	0	0	0	9	0	8	81	Normal
1975	0	11	8	0	0	0	0	0	0	10	0	0	31	Normal
1976	0	13	9	9	0	0	0	0	0	2	0	11	43	Dry
1977	23	0	11	0	0	0	0	0	0	0	0	18	51	Dry
1978	37	38	29	36	0	0	0	0	0	0	15	4	158	Wet
1979	27	8	21	0	0	0	0	0	0	8	14	15	94	Normal
1980	27	29	2	0	0	0	4	0	0	0	0	9	71	Dry
1981	49	1	11	2	0	0	0	0	0	11	44	3	122	Normal
1982	28	17	41	25	0	0	0	0	6	21	38	24	200	Wet
1983	64	20	60	25	0	0	0	0	11	0	33	11	224	Wet
1984	0	1	0	0	0	0	0	0	0	18	17	7	42	Dry
1985	0	11	5	0	0	0	0	0	0	11	39	1	66	Dry
1986	1	33	52	0	0	0	0	0	1	0	0	0	87	Normal
1987	9	11	8	0	0	0	0	0	0	4	7	5	44	Normal
1988	7	0	0	0	0	0	0	0	0	0	14	13	34	Dry
1989	1	11	5	0	0	0	0	0	2	11	11	0	39	Dry
1990	18	15	0	7	4	0	0	0	0	0	0	2	47	Dry
1991	0	4	52	0	0	0	0	0	0	11	0	11	78	Normal
1992	11	39	21	0	0	0	0	0	0	0	0	40	111	Normal
1993	91	42	17	0	0	0	0	0	0	0	8	14	172	Normal
1994	25	20	0	0	0	0	0	0	0	0	0	5	50	Normal
1995	68	0	40	2	0	11	0	0	0	0	0	5	126	Wet
1996	32	43	18	0	11	0	0	0	0	0	15	36	154	Wet
1997	59	0	0	0	0	0	0	0	0	0	39	20	118	Normal
1998	68	101	16	17	5	0	0	0	0	2	11	0	220	Wet
1999	5	11	5	10	0	0	0	0	0	0	0	0	31	Normal
2000	26	40	12	0	0	0	0	0	0	25	0	0	103	Normal
2001	13	16	4	4	0	0	0	0	0	0	11	25	72	Normal
2002	7	0	0	0	0	0	0	0	0	0	11	40	59	Dry
2003	0	9	2	0	0	0	0	0	0	0	0	23	34	Dry
2004	11	10	0	0	0	0	0	0	0	22	0	35	78	Normal
2005	16	22	14	0	0	0	0	0	0	0	0	15	67	Wet
2006	19	0	26	11	2	0	0	0	0	0	0	9	66	Normal
2007	0	6	0	0	0	0	0	0	0	2	0	0	8	Dry
2008	38	1	0	0	0	0	0	0	0	0	0	9	48	Normal
2009	15	27	8	0	0	0	0	0	0	11	0	0	61	Normal
2010	39	3	21	15	0	0	0	0	0	0	6	10	94	Wet
2011	12	44	43	0	0	0	0	0	0	10	0	0	110	Normal
2012	2	0	21	11	0	0	0	0	0	0	11	22	65	Normal
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	Dry
25th Percentile	6	0	0	0	0	0	0	0	0	0	0	0	50	
50th Percentile	18	11	11	0	0	0	0	0	0	0	6	9	77	
75th Percentile	33	24	21	7	0	0	0	0	0	9	13	23	112	
Average	24	15	14	5	1	0	0	0	1	4	10	13	87	
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	
Maximum	91	101	60	47	11	11	4	0	21	25	52	55	224	

This is based on only runoff in excess of 5 acre-feet in one day being transferable.
A maximum of 10.6 acre-feet from one day of runoff may be transferred to the MRWPCA system.

Water Year Type based on Salinas Airport Gage, Dry < 25th percentile, Wet > 75th percentile

Average by Type	
Wet	147
Normal	85
Dry	48

Groundwater Recharge Project

Table B-6: Estimated Transferable Runoff from Lake El Estero using new connection to Monterey Pump Station (acre-feet)

Water Year	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	Total
1952	3	31	82	157	2	32	4	0	0	0	0	0	311
1953	0	20	59	6	0	5	7	0	0	0	0	0	97
1954	0	26	0	43	13	41	2	0	0	0	0	0	125
1955	0	7	27	58	9	0	0	0	0	0	0	0	101
1956	0	19	90	58	18	0	13	0	0	0	0	0	200
1957	0	0	0	31	12	0	5	24	0	0	0	0	72
1958	5	0	35	46	43	65	96	0	0	0	0	0	289
1959	0	0	0	78	75	0	0	0	0	0	0	59	212
1960	0	0	0	22	39	0	0	0	0	0	0	0	61
1961	0	14	0	2	0	19	8	0	0	0	0	0	43
1962	0	3	2	23	36	28	0	0	0	0	0	0	92
1963	16	0	20	47	33	45	0	0	0	0	0	0	160
1964	10	12	0	36	0	7	0	0	0	0	0	0	64
1965	0	15	96	11	0	12	5	0	0	0	0	0	140
1966	0	78	55	21	5	0	0	0	0	0	0	0	159
1967	0	24	58	64	0	78	58	0	11	0	0	0	293
1968	0	3	6	13	0	15	6	0	0	0	0	0	42
1969	0	22	1	169	68	0	22	0	0	0	0	0	282
1970	0	2	22	72	7	54	0	0	0	0	0	0	157
1971	0	72	37	0	0	12	0	0	0	0	0	0	120
1972	0	9	31	3	0	0	0	0	0	0	0	0	43
1973	16	83	0	40	43	17	0	0	0	0	0	0	200
1974	20	12	47	39	0	39	31	0	0	0	0	0	188
1975	9	0	8	0	11	8	0	0	0	0	0	0	37
1976	10	0	0	0	16	9	9	0	0	0	0	0	44
1977	2	0	31	24	0	14	0	0	0	0	0	0	70
1978	0	0	37	60	57	34	45	0	0	0	0	0	233
1979	0	16	4	40	8	33	0	0	0	0	0	0	101
1980	8	15	29	40	37	2	0	0	0	4	0	0	136
1981	0	0	9	90	1	11	2	0	0	0	0	0	114
1982	21	63	3	36	18	60	44	0	0	0	0	6	252
1983	25	85	48	123	20	118	43	0	0	0	0	14	476
1984	0	48	11	0	1	0	0	0	0	0	0	0	60
1985	20	27	7	0	17	5	0	0	0	0	0	0	76
1986	21	59	1	1	46	84	0	0	0	0	0	1	213
1987	0	0	0	9	30	8	0	0	0	0	0	0	48
1988	4	7	5	7	0	0	0	0	0	0	0	0	23
1989	0	14	16	1	21	5	0	0	0	0	0	2	59
1990	19	15	0	24	21	0	7	4	0	0	0	0	90
1991	0	0	2	0	4	82	0	0	0	0	0	0	88
1992	11	0	30	22	59	45	0	0	0	0	0	0	167
1993	0	0	69	162	100	18	0	0	0	0	0	0	349
1994	0	8	32	29	35	0	0	0	0	0	0	0	105
1995	0	0	5	110	0	60	2	0	12	0	0	0	188
1996	0	0	5	42	101	21	0	11	0	0	0	0	180
1997	0	34	75	131	0	0	0	0	0	0	0	0	240
1998	0	74	39	138	209	16	27	5	0	0	0	0	508
1999	2	11	0	5	26	5	10	0	0	0	0	0	59
2000	0	0	0	65	44	27	0	0	0	0	0	0	135
2001	27	0	0	13	16	4	4	0	0	0	0	0	64
2002	0	11	35	7	0	0	0	0	0	0	0	0	54
2003	0	21	70	0	9	2	0	0	0	0	0	0	101
2004	0	0	51	22	10	0	0	0	0	0	0	0	83
2005	31	0	81	35	30	33	0	0	0	0	0	0	211
2006	0	0	15	31	0	26	25	2	0	0	0	0	99
2007	0	0	9	0	6	0	0	0	0	0	0	0	14
2008	2	0	0	61	1	0	0	0	0	0	0	0	64
2009	0	0	9	15	31	8	0	0	0	0	0	0	63
2010	30	0	0	79	3	27	15	0	0	0	0	0	155
2011	0	6	10	12	63	61	0	0	0	0	0	0	152
2012	10	0	0	2	0	21	11	0	0	0	0	0	42
2013	0	30	32	0	0	0	0	0	0	0	0	0	62
25th Percentile	0	0	1	6	0	0	0	0	0	0	0	0	63
50th Percentile	0	7	10	27	12	12	0	0	0	0	0	0	103
75th Percentile	9	20	36	58	35	33	7	0	0	0	0	0	188
Average	5	16	23	40	23	21	8	1	0	0	0	1	140
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	14
Maximum	31	85	96	169	209	118	96	24	12	4	0	59	508

This is based on only runoff in excess of 5 acre-feet in one day being transferable.
A maximum of 30 acre-feet from one day of runoff may be transferred to the MRWPCA system.

Table B-7: Figueroa Watershed Areas and Curve Numbers

Determination of available surface water for non-potable water supply

	Land Use	Soil Group	Curve Number (AMC II)	Area (acres)	Percent Impervious	Impervious Area (acres)	Pervious Area (acres)
1	LD	A	34	0	15%	0.0	0.0
2	UHD	A	34	0	90%	0.0	0.0
3	DV	B	43	98	0%	0.0	98.0
4	MD	B	48	0	30%	0.0	0.0
5	HD	B	48	0	50%	0.0	0.0
6	LD	B	48	98	15%	14.7	83.3
7	UHD	B	48	0	90%	0.0	0.0
8	DV	C	60	36	0%	0.0	36.0
9	HD	C	65	0	50%	0.0	0.0
10	LD	C	65	53	15%	8.0	45.1
11	UHD	C	65	0	90%	0.0	0.0
12	DV	D	66	230	0%	0.0	230.0
13	HD	D	70	198	50%	99.0	99.0
14	LD	D	70	273	15%	41.0	232.1
15	UHD	D	70	200	90%	180.0	20.0
16	Lake	n\a	100	0	100%	0.0	0.0
				1186		**343**	**843**

Curve Number (AMC II)	Area (acres)	Curve Number (AMC I)	Curve Number (AMC III)
Pervious Area			
34	0.0	18	54
43	98.0	25	63
48	83.3	29	68
60	36.0	40	78
65	45.1	45	82
66	230.0	46	82
70	351.1	51	85
	843		
Impervious Area			
98	343	94	99

Scrub runoff curve numbers used for dense vegetation
Irrigated pasture runoff curve numbers used for pervious areas of all other land use

Curve numbers come from NRCS Pub TR-55
AMC values come from NRCS Pub NEH-4 (National Engineering Handbook, Part 630, Chapter 10)

Groundwater Recharge Project
Table B-8: Estimated Runoff from Figueroa Drainage Basin (acre-feet)

Water Year	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	Total
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	
1952	7	40	115	213	18	48	8	-	-	-	-	-	449
1953	-	25	73	13	-	9	12	-	-	-	-	-	132
1954	1	27	3	53	24	58	6	3	0	-	-	-	176
1955	-	12	35	78	14	-	6	2	-	-	-	-	147
1956	-	22	192	78	27	-	16	2	-	-	-	1	338
1957	3	-	5	49	31	6	10	26	-	-	-	0	130
1958	12	3	46	56	68	90	122	4	0	-	-	1	403
1959	-	1	2	95	95	0	1	-	-	-	-	62	255
1960	-	-	1	46	57	0	3	0	-	-	-	-	108
1961	-	18	4	11	7	22	12	1	-	-	-	-	75
1962	-	8	8	34	61	31	0	-	0	-	1	-	143
1963	18	1	28	48	43	58	-	-	-	-	-	-	195
1964	15	32	2	47	2	13	-	0	-	-	1	-	112
1965	3	34	133	21	6	21	15	-	-	-	-	-	233
1966	0	100	97	31	11	1	0	-	-	0	-	1	241
1967	-	44	101	95	1	102	98	1	14	-	-	-	455
1968	2	9	14	26	6	28	9	-	-	-	0	-	95
1969	0	29	17	230	111	8	29	-	0	-	-	-	424
1970	2	6	33	101	16	73	0	-	0	-	-	-	232
1971	1	153	58	3	1	20	5	1	-	-	-	2	244
1972	-	18	54	7	4	-	1	-	0	-	-	-	84
1973	26	117	6	64	76	36	-	-	-	-	-	0	324
1974	26	28	69	53	2	55	78	-	1	0	-	-	313
1975	14	1	20	8	26	30	5	-	-	-	3	-	108
1976	17	0	0	-	26	15	16	-	0	-	3	1	79
1977	6	4	37	35	4	16	-	3	-	-	-	3	108
1978	-	2	92	134	98	55	61	-	-	-	-	0	442
1979	-	22	11	50	33	45	1	0	-	1	-	-	164
1980	17	26	37	50	71	16	8	1	-	8	-	-	233
1981	-	-	16	137	10	30	7	-	-	-	-	-	201
1982	25	84	9	54	25	105	54	-	2	-	-	12	371
1983	30	108	58	162	51	207	59	0	-	-	-	17	690
1984	1	68	26	-	15	4	1	0	-	-	-	-	116
1985	25	48	12	3	19	30	5	0	1	-	-	0	143
1986	23	73	8	10	72	102	0	1	-	-	-	6	295
1987	-	0	8	26	39	21	2	-	-	-	-	-	97
1988	9	15	18	16	2	0	11	0	-	-	-	-	71
1989	-	25	34	11	26	18	4	0	-	-	-	6	123
1990	21	17	0	42	30	5	10	15	-	-	-	-	141
1991	0	4	9	4	19	111	0	-	-	-	-	-	148
1992	14	-	50	29	133	52	-	-	-	-	-	-	279
1993	3	0	100	234	150	32	5	1	2	-	-	-	527
1994	-	14	35	45	53	0	5	4	-	-	-	-	158
1995	1	11	14	194	2	100	11	2	14	-	-	-	350
1996	-	0	13	57	201	33	4	14	-	-	-	-	322
1997	5	42	143	172	-	-	1	-	-	-	0	-	362
1998	2	126	48	217	488	37	46	16	-	-	-	-	979
1999	6	20	3	17	32	14	20	-	-	-	-	1	113
2000	-	4	-	102	63	36	2	1	-	-	-	0	208
2001	45	-	-	33	37	10	10	-	-	-	-	-	134
2002	0	19	49	11	4	5	0	4	-	-	-	-	90
2003	-	26	99	5	14	6	4	1	-	-	-	-	155
2004	1	8	71	27	30	2	-	-	-	-	-	-	139
2005	44	4	95	68	47	44	5	2	0	-	-	-	309
2006	-	3	28	40	1	61	30	6	-	-	-	-	168
2007	-	4	17	3	22	2	5	-	-	-	-	1	53
2008	7	1	3	96	14	2	0	-	-	-	-	-	123
2009	0	5	18	23	49	19	0	0	-	-	-	0	114
2010	50	0	12	102	14	37	27	1	-	-	-	-	244
2011	1	13	28	23	76	85	-	2	4	-	-	-	233
2012	18	4	0	8	1	35	18	-	1	-	-	-	85
2013	1	41	51	2	4	2	-	-	-	-	-	-	101
Average	8	25	38	60	43	34	14	2	1	0	0	2	227
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	53
Maximum	50	153	192	234	488	207	122	26	14	8	3	62	979

Table B-9: Combined El Estero and Figueroa Watershed Areas and Curve Numbers

Determination of available surface water for non-potable water supply

	Land Use	Soil Group	Curve Number (AMC II)	Area (acres)	Percent Impervious	Impervious Area (acres)	Pervious Area (acres)
1	LD	A	34	22	15%	3.3	18.7
2	UHD	A	34	31	90%	28.1	3.1
3	DV	B	43	373	0%	0.0	372.6
4	MD	B	48	186	30%	55.9	130.5
5	HD	B	48	68	50%	34.0	34.0
6	LD	B	48	108	15%	16.2	91.9
7	UHD	B	48	60	90%	53.7	6.0
8	DV	C	60	1502	0%	0.0	1501.6
9	HD	C	65	31	50%	15.6	15.6
10	LD	C	65	55	15%	8.2	46.6
11	UHD	C	65	27	90%	24.0	2.7
12	DV	D	66	248	0%	0.0	248.4
13	HD	D	70	229	50%	114.6	114.6
14	LD	D	70	276	15%	41.4	234.4
15	UHD	D	70	369	90%	332.1	36.9
16	Lake	n\a	100	19	100%	19.3	0.0
				3604		**746**	**2857**

Curve Number (AMC II)	Area (acres)	Curve Number (AMC I)	Curve Number (AMC III)
Pervious Area			
34	21.9	18	54
43	372.6	25	63
48	262.3	29	68
60	1501.6	40	78
65	64.9	45	82
66	248.4	46	82
70	385.9	51	85
	2857		
Impervious Area			
98	746	94	99

Scrub runoff curve numbers used for dense vegetation
Irrigated pasture runoff curve numbers used for pervious areas of all other land use

Curve numbers come from NRCS Pub TR-55
AMC values come from NRCS Pub NEH-4 (National Engineering Handbook, Part 630, Chapter 10)

Groundwater Recharge Project

Table B-10: Estimated Runoff into Lake El Estero adding Figueroa Basin (acre-feet)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
	1	2	3	4	5	6	7	8	9	10	11	12	
1952	16	88	249	462	38	104	18	-	-	-	-	-	974
1953	-	55	159	28	-	19	26	-	-	-	-	-	287
1954	3	59	7	115	53	127	14	6	1	-	-	-	384
1955	-	27	76	169	31	-	14	5	-	-	-	-	321
1956	-	48	407	169	58	-	36	5	-	-	-	2	725
1957	6	-	10	107	67	12	23	58	-	-	-	1	282
1958	25	7	101	122	148	196	265	10	1	-	-	2	876
1959	-	2	3	207	206	0	1	-	-	-	-	134	553
1960	-	-	3	99	124	1	7	1	-	-	-	-	234
1961	-	39	9	25	14	48	25	2	-	-	-	-	163
1962	-	18	18	74	132	67	0	-	1	-	1	-	312
1963	39	2	60	105	92	126	-	-	-	-	-	-	423
1964	32	70	4	102	3	27	-	1	-	-	3	-	243
1965	7	74	287	45	14	46	33	-	-	-	-	-	505
1966	0	216	207	68	24	2	0	-	-	1	-	1	519
1967	-	95	228	207	3	220	212	2	29	-	-	-	997
1968	3	20	31	57	13	62	20	-	-	-	0	-	207
1969	0	63	37	499	239	18	63	-	0	-	-	-	919
1970	5	12	72	219	35	162	0	-	0	-	-	-	506
1971	1	353	125	8	2	43	10	2	-	-	-	5	549
1972	-	38	117	16	9	-	1	-	0	-	-	-	182
1973	56	252	14	138	165	79	-	-	-	-	-	0	705
1974	56	61	151	114	4	120	170	-	3	0	-	-	679
1975	30	3	43	17	57	66	12	-	-	-	6	-	234
1976	38	1	0	-	56	34	35	-	0	-	7	2	172
1977	12	8	82	74	8	36	-	7	-	-	-	7	233
1978	-	4	196	304	213	121	133	-	-	-	-	1	972
1979	-	49	23	108	73	98	3	1	-	3	-	-	358
1980	37	56	80	108	152	36	18	2	-	17	-	-	505
1981	-	-	36	290	23	66	15	-	-	-	-	-	430
1982	55	180	19	118	54	228	117	-	4	-	-	27	803
1983	65	233	126	352	111	453	128	1	-	-	-	36	1,504
1984	2	149	57	-	32	9	2	1	-	-	-	-	252
1985	55	105	27	7	41	64	10	0	2	-	-	0	311
1986	49	157	18	23	154	218	0	3	-	-	-	13	635
1987	-	0	17	56	86	46	5	-	-	-	-	-	211
1988	20	33	38	34	4	0	25	1	-	-	-	-	154
1989	-	54	73	24	57	38	9	0	-	-	-	13	268
1990	46	38	0	92	66	11	22	32	-	-	-	-	307
1991	0	9	20	8	42	239	1	-	-	-	-	-	320
1992	30	-	109	64	300	114	-	-	-	-	-	-	618
1993	6	0	215	508	322	69	11	2	5	-	-	-	1,138
1994	-	31	77	99	116	1	11	10	-	-	-	-	344
1995	2	25	31	415	4	218	23	3	32	-	-	-	753
1996	-	0	29	123	454	73	9	30	-	-	-	-	718
1997	10	91	307	374	-	-	2	-	-	-	1	-	785
1998	4	272	104	477	1,141	81	98	35	-	-	-	-	2,211
1999	13	43	7	37	69	30	44	-	-	-	-	3	246
2000	-	9	-	224	137	79	4	2	-	-	-	0	455
2001	97	-	-	71	80	21	23	-	-	-	-	-	292
2002	0	41	106	24	9	10	0	8	-	-	-	-	197
2003	-	56	215	12	29	13	9	2	-	-	-	-	336
2004	3	17	155	56	65	4	-	-	-	-	-	-	301
2005	95	8	207	148	101	97	11	3	1	-	-	-	671
2006	-	6	61	87	2	132	65	12	-	-	-	-	366
2007	-	9	37	7	48	4	10	-	-	-	-	2	116
2008	14	2	6	209	31	5	0	-	-	-	-	-	267
2009	0	11	40	51	106	40	0	0	-	-	-	0	249
2010	109	0	25	220	30	81	59	2	-	-	-	-	527
2011	3	29	61	51	164	184	-	4	8	-	-	-	504
2012	38	10	0	18	2	76	40	-	2	-	-	-	185
2013	3	89	108	4	9	5	-	-	-	-	-	-	218
Average	18	55	83	130	96	74	30	4	1	0	0	4	495
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	116
Maximum	109	353	407	508	1,141	453	265	58	32	17	7	134	2,211

Groundwater Recharge Project
Table B-11: Estimated Transferable Runoff from Lake El Estero adding Figueroa Basin (acre-feet)

Year	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	**Total**	**Type Year**
1952	90	16	32	11	0	0	0	0	0	0	18	51	217	Wet
1953	11	0	11	11	0	0	0	0	0	0	11	2	45	Dry
1954	32	22	27	9	1	0	0	0	0	0	11	19	121	Normal
1955	44	11	0	0	0	0	0	0	0	0	11	56	120	Wet
1956	44	17	0	11	0	0	0	0	0	0	0	5	77	Dry
1957	43	28	4	11	11	0	0	0	0	13	0	32	141	Normal
1958	31	57	64	59	5	0	0	0	0	0	0	0	216	Normal
1959	42	61	0	0	0	0	0	0	21	0	0	0	124	Dry
1960	36	53	0	0	0	0	0	0	0	0	11	0	100	Normal
1961	13	5	11	11	0	0	0	0	0	0	10	8	56	Dry
1962	23	43	11	0	0	0	0	0	0	11	0	17	105	Dry
1963	21	30	28	0	0	0	0	0	0	11	39	0	129	Normal
1964	25	0	11	0	0	0	0	0	0	1	29	74	139	Normal
1965	16	5	14	15	0	0	0	0	0	0	65	62	178	Normal
1966	27	11	0	0	0	0	0	0	0	0	36	32	106	Dry
1967	48	0	45	79	0	11	0	0	0	0	10	11	204	Normal
1968	29	3	29	11	0	0	0	0	0	0	19	12	103	Normal
1969	107	56	5	11	0	0	0	0	0	0	7	25	212	Wet
1970	63	18	21	0	0	0	0	0	0	0	44	37	183	Wet
1971	0	0	20	0	0	0	0	0	0	0	21	45	87	Dry
1972	9	4	0	0	0	0	0	0	0	21	70	1	105	Normal
1973	45	67	33	0	0	0	0	0	0	16	24	34	219	Wet
1974	34	0	31	16	0	0	0	0	0	11	0	13	105	Normal
1975	6	30	30	4	0	0	0	1	0	21	0	0	91	Normal
1976	0	22	13	21	0	0	0	0	0	7	2	16	81	Dry
1977	30	3	11	0	0	0	0	0	2	0	0	33	78	Dry
1978	54	51	53	45	0	0	0	0	0	0	21	11	234	Wet
1979	32	30	25	0	0	0	0	0	0	19	26	21	153	Normal
1980	32	62	15	3	0	0	11	0	0	0	0	21	144	Dry
1981	53	11	25	9	0	0	0	0	0	12	55	10	174	Normal
1982	41	21	77	32	0	0	0	0	13	21	49	31	285	Wet
1983	64	58	86	41	0	0	0	0	11	0	63	20	343	Wet
1984	0	13	0	0	0	0	0	0	0	21	33	11	78	Dry
1985	0	11	29	5	0	0	0	0	0	11	51	8	114	Dry
1986	8	49	64	0	0	0	0	0	6	0	0	5	133	Normal
1987	25	11	22	0	0	0	0	0	0	11	18	20	107	Normal
1988	19	0	0	10	0	0	0	0	0	0	25	24	77	Dry
1989	9	15	18	4	0	0	0	0	8	11	11	0	73	Dry
1990	39	23	1	11	17	0	0	0	0	0	4	8	102	Dry
1991	3	22	73	0	0	0	0	0	0	11	0	15	124	Normal
1992	15	55	24	0	0	0	0	0	0	1	0	51	145	Normal
1993	109	68	30	1	0	0	0	0	0	0	11	21	240	Normal
1994	44	34	0	2	4	0	0	0	0	0	6	11	100	Normal
1995	102	0	62	8	0	11	0	0	0	0	0	12	196	Wet
1996	43	64	31	2	11	0	0	0	0	1	21	58	232	Wet
1997	73	0	0	0	0	0	0	0	0	0	60	25	158	Normal
1998	90	120	35	38	13	0	0	0	0	8	21	0	325	Wet
1999	16	13	12	17	0	0	0	0	0	0	4	0	62	Normal
2000	34	53	20	0	0	0	0	0	0	43	0	0	149	Normal
2001	34	46	11	11	0	0	0	0	0	0	19	35	156	Normal
2002	11	2	5	0	2	0	0	0	0	0	14	64	98	Dry
2003	2	11	8	0	0	0	0	0	0	0	4	29	54	Dry
2004	11	26	0	0	0	0	0	0	0	41	2	42	121	Normal
2005	34	35	26	0	0	0	0	0	0	0	0	31	126	Wet
2006	31	0	54	13	7	0	0	0	0	0	3	21	129	Normal
2007	0	27	0	4	0	0	0	0	0	8	0	0	38	Dry
2008	65	6	0	0	0	0	0	0	0	0	4	14	89	Normal
2009	21	36	20	0	0	0	0	0	0	11	0	10	97	Normal
2010	58	11	25	29	0	0	0	0	0	0	11	28	161	Wet
2011	25	53	59	0	0	3	0	0	0	21	0	0	161	Normal
2012	8	0	35	14	0	0	0	0	0	0	11	33	100	Normal
2013	0	4	0	0	0	0	0	0	0	0	0	0	4	Dry
25th Percentile	11	5	4	0	0	0	0	0	0	0	0	6	97	
50th Percentile	31	19	20	3	0	0	0	0	0	0	11	17	123	
75th Percentile	44	46	31	11	0	0	0	0	0	11	21	32	161	
Average	33	26	23	9	1	0	0	0	1	6	16	21	136	
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	4	
Maximum	109	120	86	79	17	11	11	1	21	43	70	74	343	

This is based on only runoff in excess of 5 acre-feet in one day being transferable.

A maximum of 10.6 acre-feet from one day of runoff may be transferred to the MRWPCA system.

Water Year Type based on Salinas Airport Gage, Dry < 25th percentile, Wet > 75th percentile

Average by Type	
Wet	220
Normal	134
Dry	81

Table B-12: Lake El Estero and Monterey Bay Water Quality

Stream	Location	Analyte Name	No. Samples	Units	Mean	Min	Max
Lake El Estero	2 samples, 7/6/2009	Bicarbonate Alkalinity (HCO3)	2	mg/L	284.25	283.0000	285.50
Lake El Estero	2 samples, 7/6/2009	Boron	2	mg/L	0.24	0.23	0.25
Lake El Estero	2 samples, 7/6/2009	Calicium	2	mg/L	108.5	108.0	109.0
Lake El Estero	2 samples, 7/6/2009	Nitrate as N	2	mg/L	ND	ND	ND
Lake El Estero	2 samples, 7/6/2009	E. Coli	2	#/100 ml	48	10	86
Lake El Estero	2 samples, 7/6/2009	Coliform, Total	2	#/100 ml	6,499	6,131	6,867
Lake El Estero	2 samples, 7/6/2009	Enterococcus	2	#/100 ml	31	31	31
Lake El Estero	2 samples, 7/6/2009	Sulfate	2	mg/L	158.0	156.0	160.0
Lake El Estero	2 samples, 7/6/2009	Dissolved Solids, Total	2	mg/L	1,028.0	1,024.0	1,032.0
Lake El Estero	2 samples, 7/6/2009	Total Suspended Solids	2	mg/L	20.5	18.0	23.0
Lake El Estero	2 samples, 7/6/2009	Chloride	2	mg/L	320.5	317.0	324.0
Lake El Estero	2 samples, 7/6/2009	Potassium	2	mg/L	5.6	5.5	5.6
Lake El Estero	2 samples, 7/6/2009	Magnesium	2	mg/L	36.0	36.0	36.0
Twin 51" Outfalls	below El Estero	Nitrate	14	mg/L	0.62	0.16	1.30
Twin 51" Outfalls	below El Estero	Phosporus	15	mg/L	0.40	0.00	0.97
Twin 51" Outfalls	below El Estero	Urea	16	ug/L	317.86	16.00	920.00
Twin 51" Outfalls	below El Estero	E. Coli	17	MPN/100 mL	61,240	50	229,170
Twin 51" Outfalls	below El Estero	Enteroccoccus	18	MPN/100 mL	54,199	125	227,516
Twin 51" Outfalls	below El Estero	Zinc	19	ug/L	142.0	20.0	385.0
Twin 51" Outfalls	below El Estero	Copper	20	ug/L	36.54	5.00	99.00
Twin 51" Outfalls	below El Estero	Lead	21	ug/L	9.85	0.00	44.00
Twin 51" Outfalls	below El Estero	Total Suspended Solids	22	mg/L	40.07	0.00	183.00
Majors Creek	above El Estero	Calcium	5	mg/L	20.22	15.40	26.00
Majors Creek	above El Estero	Coliform, Total	18	MPN/100 ml	104,651	2,400	240,000
Majors Creek	above El Estero	Copper	15	ug/L	65.2	0.0	150.0
Majors Creek	above El Estero	Escherichia coli	18	MPN/100 ml	1,993	17	24,000
Majors Creek	above El Estero	Lead	15	ug/L	19.50	0.00	87.00
Majors Creek	above El Estero	Magnesium	6	mg/L	10.10	5.20	29.00
Majors Creek	above El Estero	Nitrate as N	19	mg/L	0.87	0.00	2.25
Majors Creek	above El Estero	Oil and Grease	1	mg/L	0.00	0.00	0.00
Majors Creek	above El Estero	Orthophosphate as P	19	mg/L	0.37	0.00	1.68
Majors Creek	above El Estero	Oxygen, Dissolved	5	mg/L	8.20	8.00	9.00
Majors Creek	above El Estero	Total Dissolved Solids	15	mg/L	399.73	149.00	930.00
Majors Creek	above El Estero	Total Suspended Solids	15	mg/L	101.13	12.40	531.00
Majors Creek	above El Estero	Zinc	15	ug/L	337.40	0.00	750.00
Monterey Bay	South Coastline	Ammonia as N	11	mg/L	0.023636	0.02	0.04000
Monterey Bay	South Coastline	Chlordanes	3	ng/L	0.01	0.01	0.01
Monterey Bay	South Coastline	ColiformFecal	13	MPN/100 ml	2	2	2
Monterey Bay	South Coastline	ColiformTotal	12	MPN/100 ml	60	2	659
Monterey Bay	South Coastline	Enterococcus	12	MPN/100 ml	2	2	2
Monterey Bay	South Coastline	Nitrate as N	12	mg/L	0.04	0.01	0.16
Monterey Bay	South Coastline	Orthophosphate as P	12	mg/L	0.02	0.01	0.04
Monterey Bay	South Coastline	Silica	12	mg/L	0.51	0.17	1.20
Monterey Bay	South Coastline	Total Suspended Solids	12	mg/L	13.35	6.70	34.40
Monterey Bay	South Coastline	Urea as N	12	ug/L	0.01	0.01	0.01

Highlighted cells exceed objective / standards. See table B13
Min value of 0.00 = Not Detected.

Table B-13: Water Quality Objectives

Analyte Name	Units	Standard	Reference
Nitrate as N	mg/L	2.25	CCAMP Proposed
Orthophosphate as P	mg/L	0.12	CCAMP Proposed
E. coli	MPN/100 ml	400	EPA Ambient Water Quality Criteria
Enterococcus	MPN/100 ml	104	EPA Ambient Water Quality Criteria
Zinc	ug/L	200	Basin Plan Objective
Copper	ug/L	30	Basin Plan Objective
Lead	ug/L	30	Basin Plan Objective
Total Suspended Solids (TSS)	mg/L	500	Basin Plan Objective

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Appendix C: Conceptual Diversion Facility

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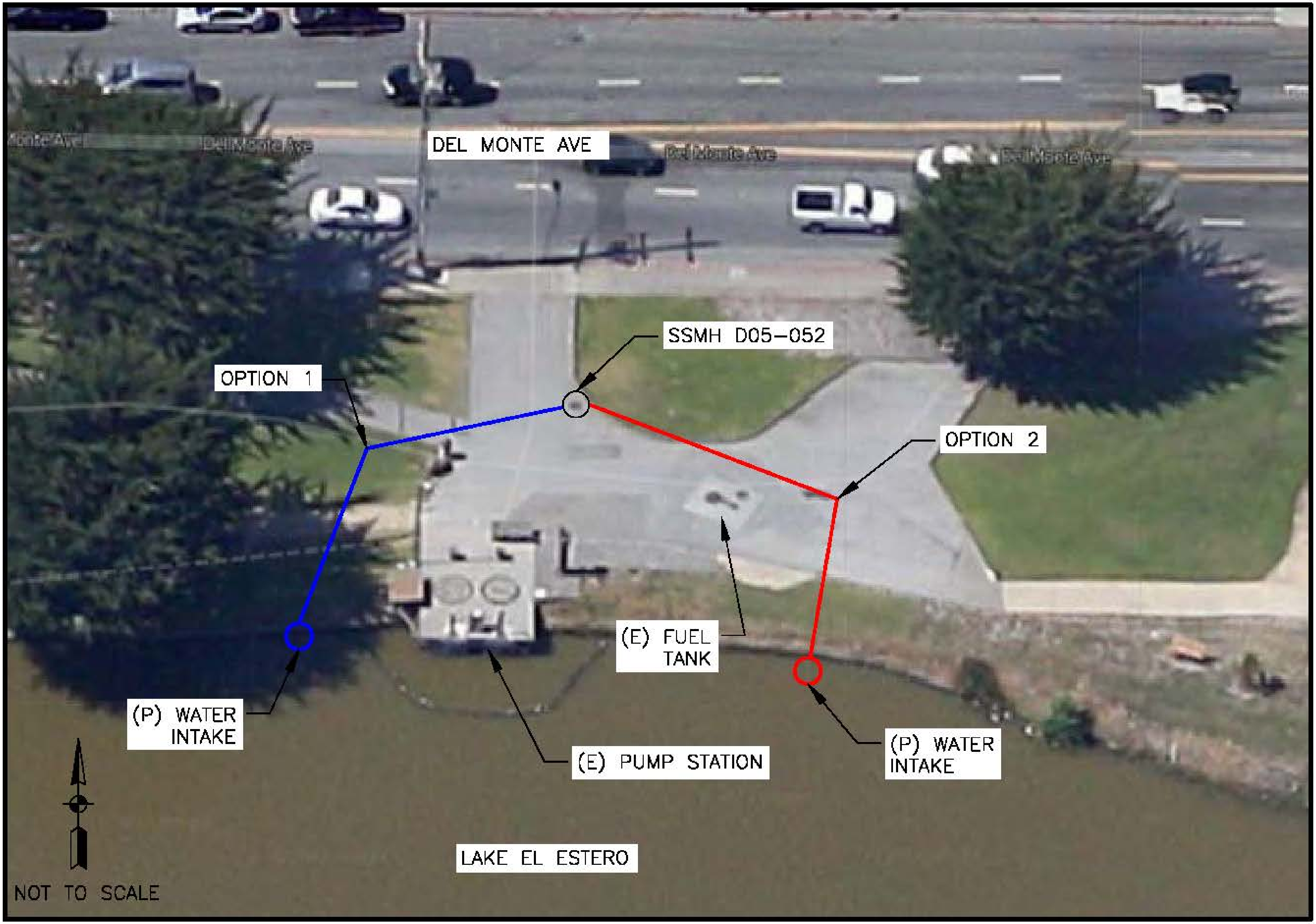
Figure 1 - Lake El Estero Water Intake Alignments



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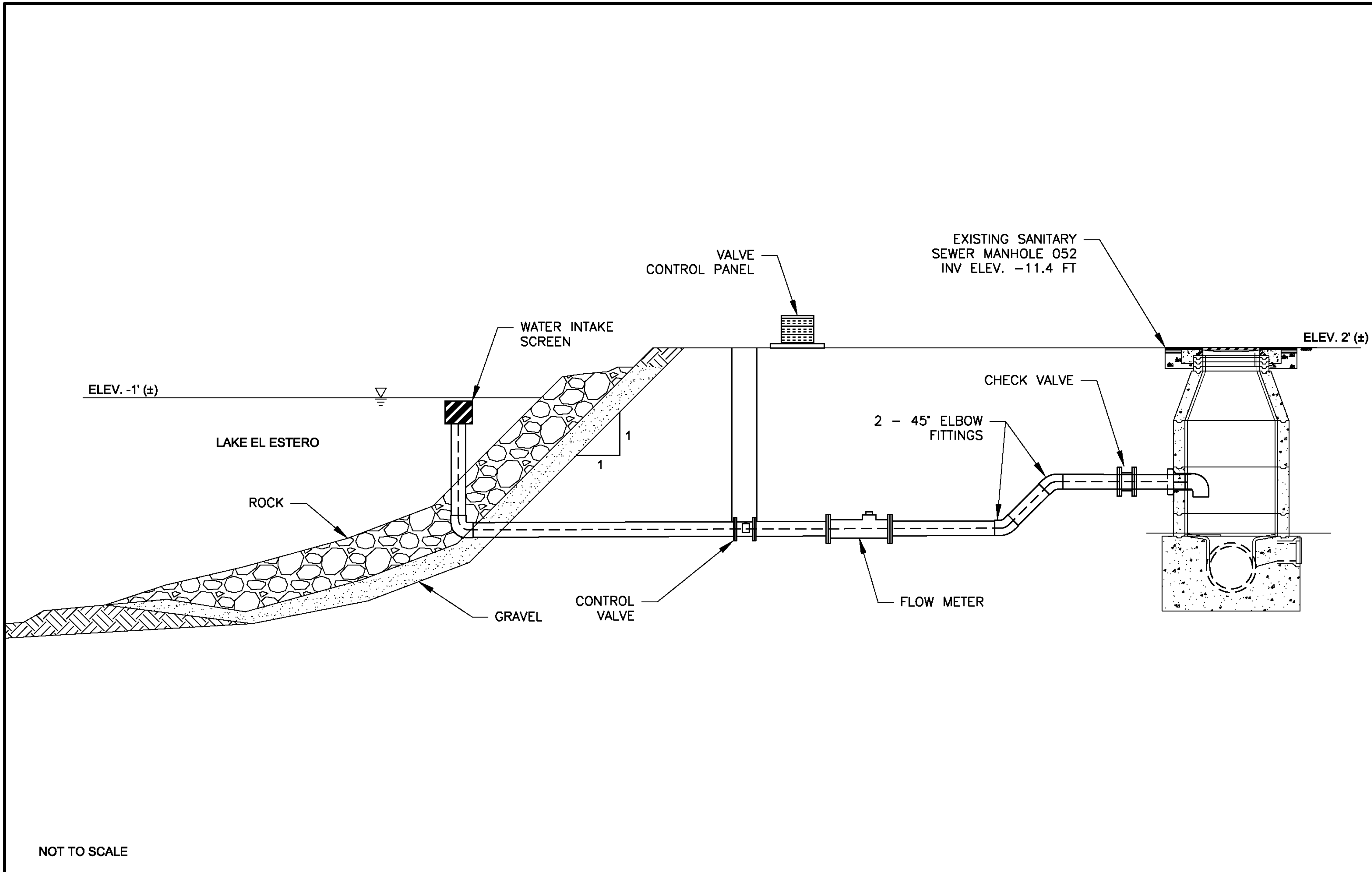


EXISTING SANITARY
SEWER MANHOLE 052
INV ELEV. -11.4 FT
VALVE
CONTROL PANEL
ELEV. 2' (±)
WATER INTAKE
SCREEN
CHECK VALVE
ELEV. -1' (±)
2 - 45° ELBOW
FITTINGS
1
LAKE EL ESTERO
1
ROCK
CONTROL
VALVE
FLOW METER
GRAVEL
NOT TO SCALE

Figure 3 - Lake El Estero Water Intake Pump Option

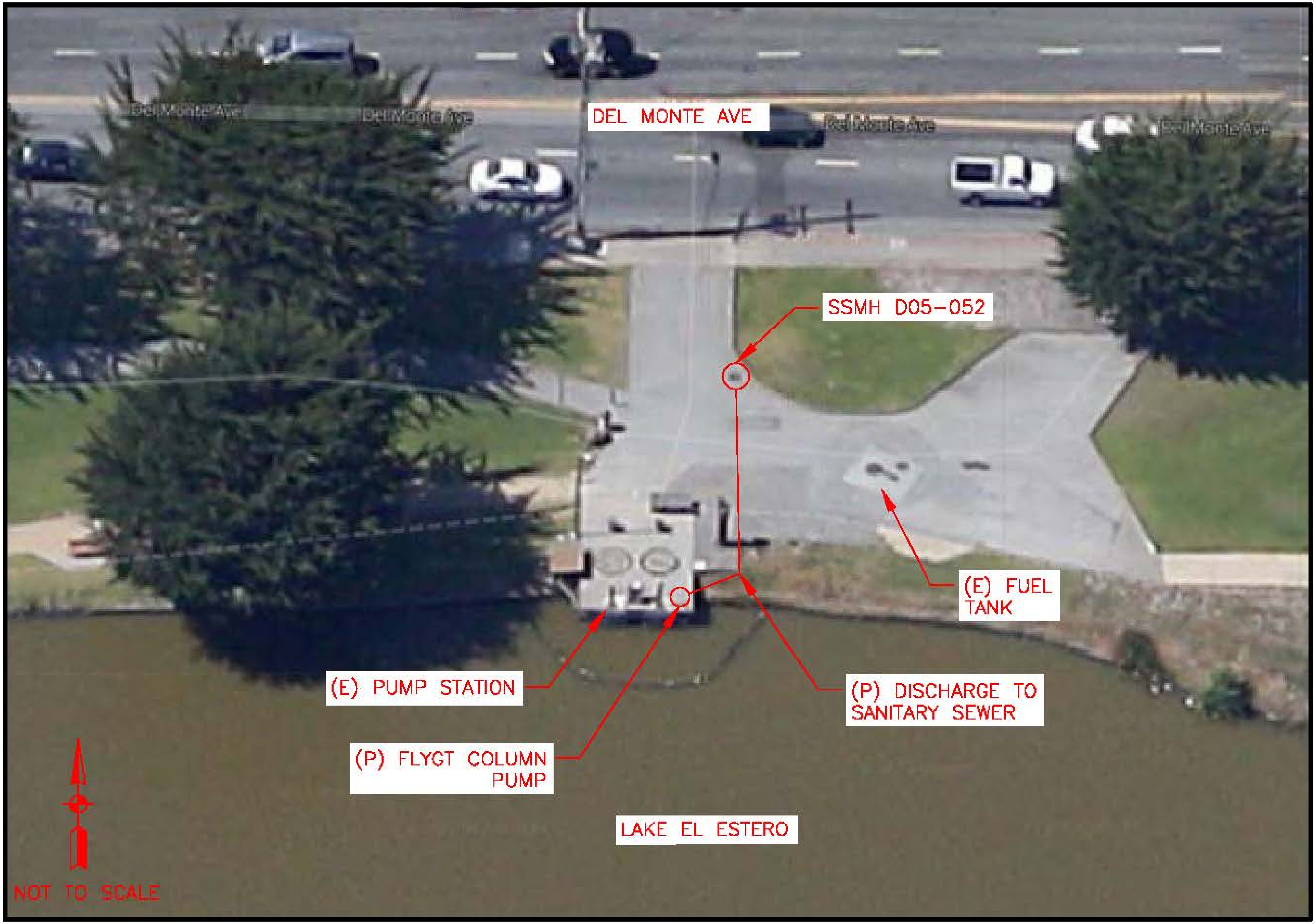
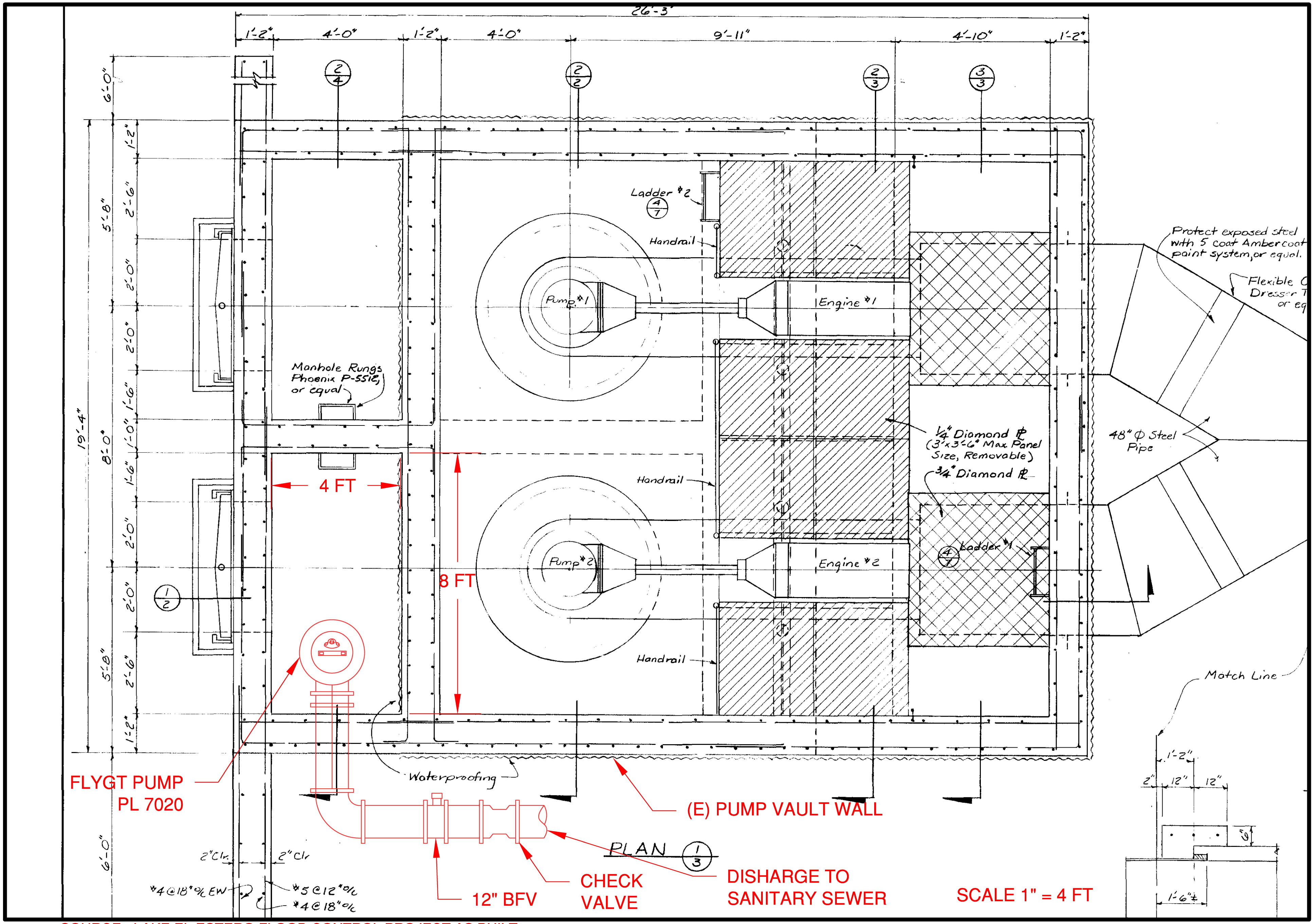


Figure 4 - Pump House Detail



SOURCE: LAKE EL ESTERO FLOOD CONTROL PROJECT AS BUILT 6/17/68

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Table C-1: Gravity Option Head Calculations

Estimate gravity flow potential from the lake to the SSMH.

Available head approx 5-ft for up-turned outlet.

Length	40	ft
Diameter	10	inch
Material	C900	PVC
Hazen-Williams	130	

Fitting	**K**
entrance	1.00
90-bend	0.30
gate valve	0.19
mag meter	0
swing check	2.00
90-bend	0.30
90-bend	0.30
sharp exit	0.19
Total minor losses	4.28

	Q gpm	Q cfs	V fps	Pipeline Loss ft	Minor Losses ft	Total Losses ft	gpd	AF/day
	1500	3.342	6.13	0.52	2.50	3.02	2,160,000	6.63
	1600	3.565	6.54	0.59	2.84	3.43	2,304,000	7.07
	1700	3.788	6.94	0.66	3.21	3.86	2,448,000	7.51
	1800	4.011	7.35	0.73	3.59	4.32	2,592,000	7.96
	1900	4.234	7.76	0.80	4.00	4.81	2,736,000	8.40
	2000	4.456	8.17	0.88	4.44	5.32	2,880,000	8.84
	2100	4.679	8.58	0.97	4.89	5.86	3,024,000	9.28
	2200	4.902	8.99	1.06	5.37	6.42	3,168,000	9.72
	2300	5.125	9.40	1.15	5.87	7.01	3,312,000	10.16
Target Flow -->	**2400**	**5.348**	**9.80**	**1.24**	**6.39**	**7.63**	**3,456,000**	**10.61**
	2500	5.570	10.21	1.34	6.93	8.27	3,600,000	11.05
	2600	5.793	10.62	1.44	7.50	8.94	3,744,000	11.49
	2700	6.016	11.03	1.54	8.09	9.63	3,888,000	11.93
	2800	6.239	11.44	1.65	8.70	10.34	4,032,000	12.37
	2900	6.462	11.85	1.76	9.33	11.09	4,176,000	12.82
	3000	6.684	12.26	1.87	9.98	11.86	4,320,000	13.26

Table C-2: Pump Option Head Calculations
Estimate pump size and pipeline diameter to move flow from the lake to the SSMH.
Maximum flow of 3,000 gpm.

Length	40	ft
Diameter	12	inch
Material	C900 PVC	
Hazen-Williams	130	

Fitting	**K**
entrance	1.00
90-bend	0.30
gate valve	0.19
mag meter	0
swing check	0.00
90-bend	0.30
90-bend	0.30
sharp exit	0.19
Total minor loss	2.28

	Q	Q	V	Pipeline Loss	Minor Losses	Static Lift	Total Losses			
	gpm	**cfs**	**fps**	**ft**	**ft**	**ft**	**ft**	**gpd**	**AF/day**	**HP**
	2000	4.456	5.67	0.36	1.14	4.00	5.50	2,880,000	8.84	4.0
	2100	4.679	5.96	0.40	1.26	4.00	5.66	3,024,000	9.28	4.3
	2200	4.902	6.24	0.43	1.38	4.00	5.81	3,168,000	9.72	4.6
	2300	5.125	6.53	0.47	1.51	4.00	5.98	3,312,000	10.16	5.0
Target Flow -->	**2400**	**5.348**	**6.81**	**0.51**	**1.64**	**4.00**	**6.15**	**3,456,000**	**10.61**	**5.3**
	2500	5.570	7.09	0.55	1.78	4.00	6.33	3,600,000	11.05	5.7
	2600	5.793	7.38	0.59	1.93	4.00	6.52	3,744,000	11.49	6.1
	2700	6.016	7.66	0.63	2.08	4.00	6.71	3,888,000	11.93	6.5
	2800	6.239	7.94	0.68	2.23	4.00	6.91	4,032,000	12.37	7.0
	2900	6.462	8.23	0.72	2.40	4.00	7.12	4,176,000	12.82	7.4
	3000	6.684	8.51	0.77	2.56	4.00	7.34	4,320,000	13.26	7.9

HP calculation assumes 70% pump-motor efficiency

Table C-3 - Estimated Cost Of Construction of the Lake El Estero Diversion Structure

Gravity Option - Conceptual Design Cost Estimate

21-Apr-14
By: Josh Tabije

Item of Work	Unit	Unit Cost	Quantity	Subtotal
Mobilization / Demobilization				
~ 5% of of project cost. This cost includes permits, fees, temporary structures, equipment rental and various misc. items				***$5,000***
Site Improvements				
Intake Screen	EA	$500.00	1	$500
8" PVC Pipe w/ Trenching and Backfill	LF	$200.00	80	$16,000
Control Valve	EA	$5,000.00	1	$5,000
Control Panel	EA	$1,230.00	1	$1,230
Flow Meter	EA	$210.00	1	$210
Check Valve	EA	$2,850.00	1	$2,850
De-watering & Site Preparation	LS	$10,000.00	1	$10,000
Tie-in to Existing SSMH	LS	$5,000.00	1	$5,000
Site Restoration	LS	$10,000.00	1	$10,000
Electrical Equipment				
Electrical Control Equipment	LS	$10,000.00	1	$10,000
ESTIMATED CONSTRUCTION COST				**$65,800**
INSPECTION AND TESTING (15%)				**$10,000**
CONSTRUCTION CONTINGENCY (20%)				**$13,000**
ESTIMATED TOTAL CONSTRUCTION COST				**$89,000**

This estimate of construction cost is a professional opinion, based upon the engineer's experience with the design and construction of similar projects. It is prepared only as a guide and is subject to change. Schaaf & Wheeler and its subconsultants make no warranty, whether expressed or implied, that the actual costs will not vary from these estimated costs, and assumes no liability for such variances. This estimate specifically excludes any costs associated with designing for handling and disposal of hazardous wastes and contaminated materials. Costs associated with land, right-of-way, or easement purchase are not included in this estimate.

Table C-4 - Estimated Cost Of Construction of the Lake El Estero Diversion Structure

Pump Option - Conceptual Design Cost Estimate

21-Apr-14

By: Josh Tabije

Item of Work	Unit	Unit Cost	Quantity	Subtotal
Mobilization / Demobilization				
~ 5% of of project cost. This cost includes permits, fees, temporary structures, equipment rental and various misc. items				***$5,000***
Pump				
Flygt Pump 7020 (27hp)	EA	$54,000.00	1	$54,000
Pump Column	LF	$500.00	10	$5,000
Site Improvements				
12" PVC Pipe w/ Trenching and Backfill	LF	$240.00	40	$9,600
Control Valve	EA	$5,000.00	1	$5,000
Control Panel	EA	$1,230.00	1	$1,230
Flow Meter	EA	$210.00	1	$210
Check Valve	EA	$2,850.00	1	$2,850
De-watering & Site Preparation	LS	$10,000.00	1	$10,000
Tie-in to Existing SSMH	LS	$5,000.00	1	$5,000
Site Restoration	LS	$10,000.00	1	$10,000
Electrical Equipment				
Electrical and Control Equipment	LS	$50,000.00	1	$50,000
ESTIMATED CONSTRUCTION COST				**$157,900**
INSPECTION AND TESTING (15%)				**$24,000**
CONSTRUCTION CONTINGENCY (20%)				**$32,000**
ESTIMATED TOTAL CONSTRUCTION COST				**$214,000**

This estimate of construction cost is a professional opinion, based upon the engineer's experience with the design and construction of similar projects. It is prepared only as a guide and is subject to change. Schaaf & Wheeler and its subconsultants make no warranty, whether expressed or implied, that the actual costs will not vary from these estimated costs, and assumes no liability for such variances. This estimate specifically excludes any costs associated with designing for handling and disposal of hazardous wastes and contaminated materials. Costs associated with land, right-of-way, or easement purchase are not included in this estimate.

Appendix D: Flow Monitoring

D1. Sanitary Sewer at Lake El Estero

Schaaf & Wheeler conducted sewer flow monitoring of the City of Monterey Sanitary Sewer at Lake El Estero. A depth monitor and data logger was installed on the sewer pipeline exiting manhole D05-052, located next to the Stormwater Pump Station, on November 12, 2013. The initial installation was not secure, and the monitor was reset on November 22, 2013. Data was downloaded from the monitor on several occasions. It was removed on February 24, 2014.

The data logger records the depth of water in the pipeline at set time intervals. The depth of water was converted to flow using Manning's equation:

$$V = \left(\frac{1.486}{n}\right) R^{2/3} S^{1/2}$$

Where:

V= velocity in feet/second
n = roughness coefficient
R = hydraulic radius
S = slope of the pipeline

The pipe roughness coefficient was assumed to be 0.013 for sewer pipe. The hydraulic radius is equal to the wetted perimeter of the pipe divided by the cross-sectional area of flow, which were calculated based on depth of flow and the pipeline diameter of 21-inches. The pipeline slope was calculated as 0.0068 based on the invert of SSMH D05-052 at -11.4 feet, the invert of SSMH D05-061 at -12.0-feet, and the pipeline length of 88-feet. The flow quantity was calculated by multiplying the flow velocity by the cross-sectional area of flow.

The data set and graph include several flow spikes where the instantaneous flow greatly exceeds the normal curve. These are likely caused by debris hanging up on the monitor or the mounting bracket and may be disregarded.

Based upon the monitoring, the average daily sewer flow at this location is 1,140 gallons per minute or 1.6 million gallons per day. The peak hourly flow was approximately 2,100 gpm. There were no significant rain events during the monitoring period, so these results should be considered Average and Peak Dry Weather Flows.

D2. Figueroa Box Culvert

Schaaf & Wheeler conducted storm sewer flow monitoring in Pearl Street above Figueroa Street in Monterey. A depth monitor and data logger was installed in the storm drain downstream of Pearl Street. The gage was active from November 26, 2013, to March 28, 2014. During that period there was limited rainfall. The two-day storm of February 28 – March 1, 2014 was used as a calibration check for the runoff prediction model.

The data logger collected water depth at a one-minute time step. Depth was converted to flow using Manning's equation and the following parameters: Pipe roughness of n = 0.013, slope = 0.0071 ft/ft, box width 9-ft, box height 4.5-ft at center and 4.25-ft at sides (valley gutter at invert). Cumulative flow was totaled and converted to acre-feet. Totals for the 2-day storm were compared to the modeled outputs:

Date	Precipitation (in)	Metered Flow (ac-ft)	Modeled Flow (ac-ft)
2/28/2014	1.38	23.1	23.7
3/1/2014	0.98	11.7	30.3

Modeled results for the first day were within 5% of the metered daily flow, which was better than expected. The modeled results for the second day were almost 300% of the metered flow. The majority of the flows on both days are from the hardscape. The difference between the two on 3/1/14 was due the model's adjustment of the curve numbers based on the cumulative precipitation in the preceding 5 days. The model applied below-average curve numbers for the condition on 2/28/14 and matched the observed flows. It applied above-average curve numbers for the condition on 3/1/14. This error does not affect the stormwater capture model, which by-passes peak flows above 15.6 ac-ft/day. Therefore, the runoff model was not adjusted.

Figures in this appendix:

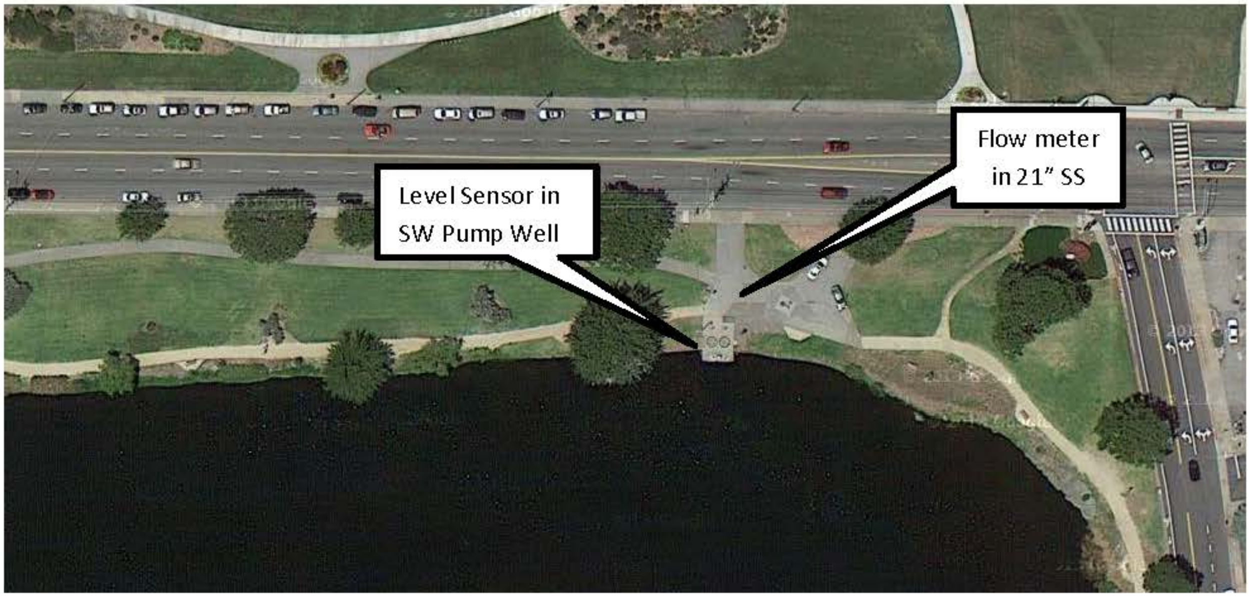
Monitoring Locations

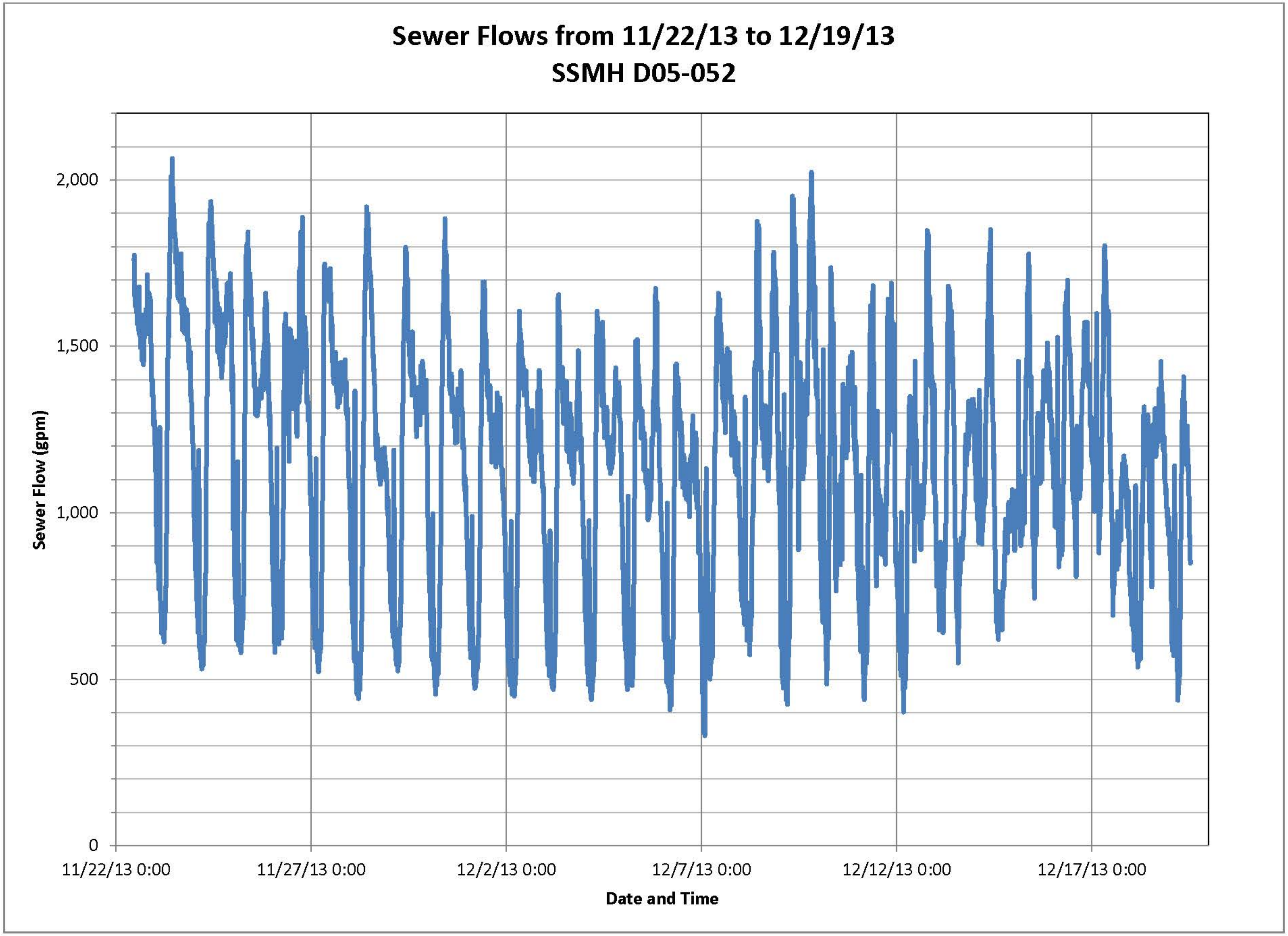
Graphed Sanitary Sewer Flows, 11/22/2013 – 12/19/2013

Precipitation during Monitoring Period

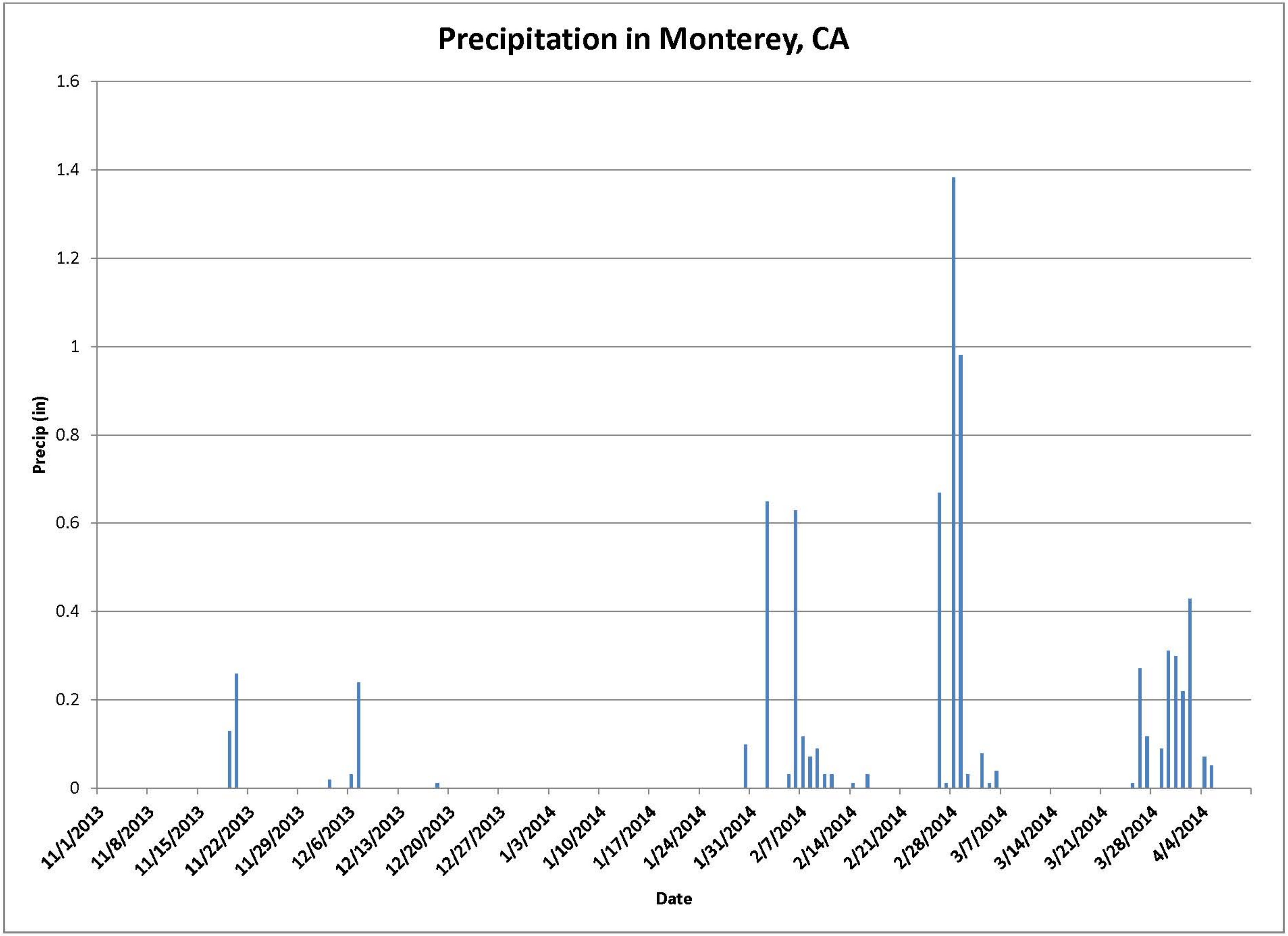
Figueroa Box Culvert Flows, 2/26/2014 – 3/1/2014

Figure D-1: Flow Monitoring Locations for Lake El Estero

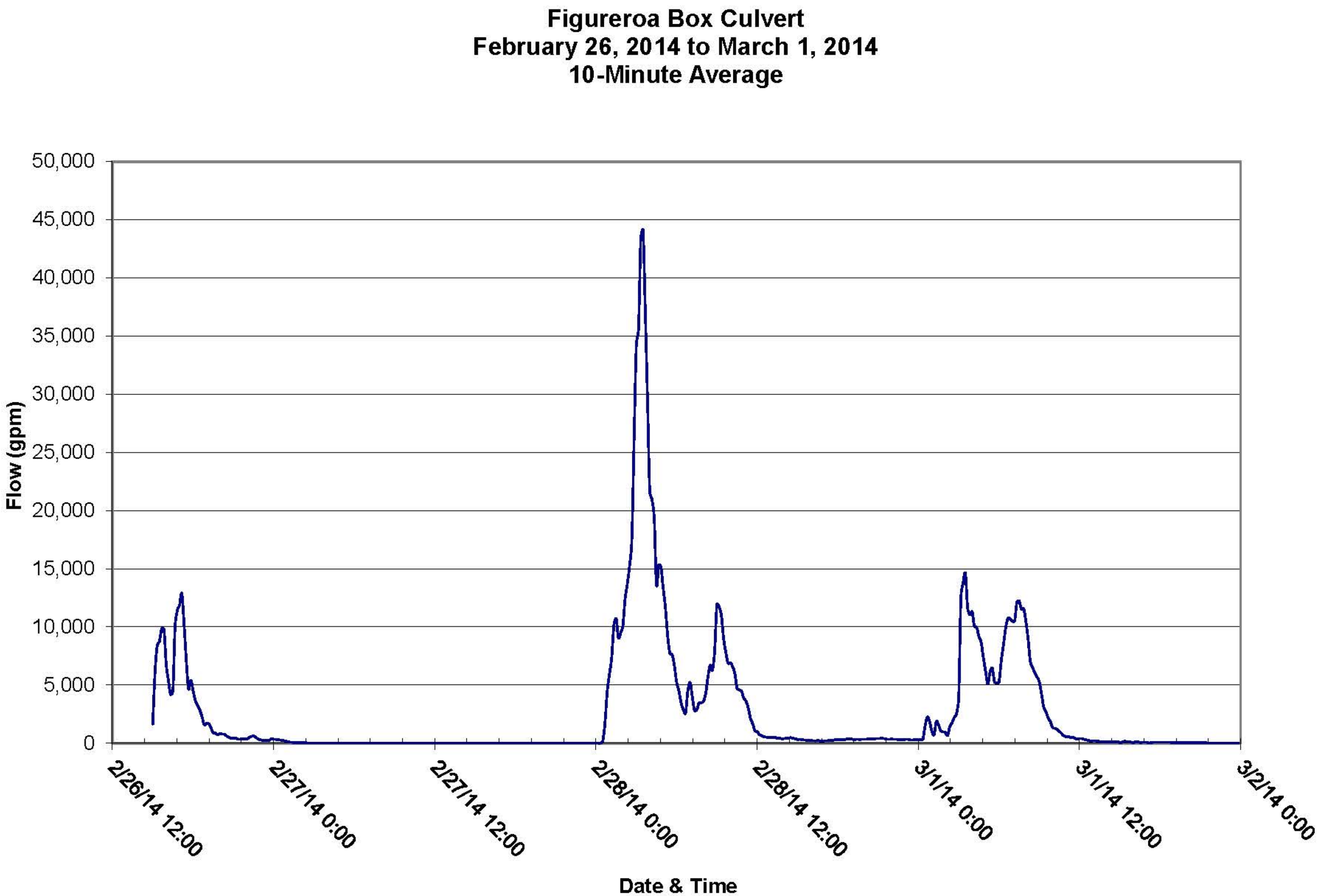




Sewer Flows from 11/22/13 to 12/19/13
SSMH D05-052
Sewer Flow (gpm)
2,000
1,500
1,000
500
0
11/22/13 0:00
11/27/13 0:00
12/2/13 0:00
12/7/13 0:00
12/12/13 0:00
12/17/13 0:00
Date and Time



Precipitation in Monterey, CA
Precip (in)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
11/1/2013
11/8/2013
11/15/2013
11/22/2013
11/29/2013
12/6/2013
12/13/2013
12/20/2013
12/27/2013
1/3/2014
1/10/2014
1/17/2014
1/24/2014
1/31/2014
2/7/2014
2/14/2014
2/21/2014
2/28/2014
3/7/2014
3/14/2014
3/21/2014
3/28/2014
4/4/2014
Date


Figurereoa Box Culvert
February 26, 2014 to March 1, 2014
10-Minute Average
Flow (gpm)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2/26/14 12:00
2/27/14 0:00
2/27/14 12:00
2/28/14 0:00
2/28/14 12:00
3/1/14 0:00
3/1/14 12:00
3/2/14 0:00
Date & Time

Appendix E: References

California Department of Water Resources:

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