Vista Grande Drainage Basin Alternatives Analysis Report Project

Volume 3 | Lake Merced Alternative (Draft)

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PROJECT MEMORANDUM

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From:	Blake Rothfuss
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1 Introduction

This memorandum[1] summarizes the results of an evaluation of the Lake Merced Alternative, which is a supplemental alternative to those presented in the Vista Grande Drainage Basin Alternatives Evaluation Report (JA, 2007). The Lake Merced Alternative allows the City and County of San Francisco (CCSF) to operate Lake Merced within desired water levels using storm water from the Vista Grande Drainage Basin in the City of Daly City (City), and could significantly reduce the potential for localized flooding associated with a design storm event. Further, this alternative re-establishes, in part, the historic drainage conditions that existed before the watershed was developed, and the infrastructure necessary for the project could be used later to increase storm water diversions should stakeholders and State regulators desire and approve such increased diversions. Local nongovernmental groups have also expressed interest in managing Lake Merced lake level between a desired operating water surface elevation range[2] of 5.0 feet and 9.5 feet, with some fluctuation due to natural rainfall patterns.

Storm-related flooding has recurred throughout the Vista Grande Watershed Drainage Basin (Figure 1), specifically along the Canal across John Muir Drive north of Lake Merced Boulevard. In this area, the storm water drainage system collects flows from a 2.5-square-mile basin in the City and conveys them via several underground culverts to the Vista Grande Canal (Canal), located adjacent to John Muir Drive in San Francisco. From there, the water flows to the Vista Grande Tunnel (Tunnel) and Outfall Structure, through which it is discharged into the Pacific Ocean below Fort Funston, located in the Golden Gate National Recreation Area (GGNRA).

[1] Prepared by Jacobs Associates, Brown and Caldwell, ESA, and GeoSyntec.
[2] SFPUC Canal flow study, 14Aug07 to 02Aug08

Sporadically, rainstorms produce storm runoff that exceeds the hydraulic capacities of the tunnel, estimated at 170 cubic feet per second (cfs), and the canal, estimated at 500 cfs. When storm water inflows exceed the tunnel's capacity, the water backs up into the canal and occasionally causes upstream flooding and overtopping of John Muir Drive in San Francisco. Excess water may flow from the canal across John Muir Drive into Lake Merced or into other areas at lower elevations. The resulting flooding adversely impacts the community and public resources

The City commissioned the Vista Grande Drainage Basin Alternatives Analysis to develop feasible alternatives to:

- Manage storm water flows generated by the design storm event to improve public safety, minimize property damage, and minimize public inconvenience.
- Encourage the diversion and re-use of storm water to reduce uncontrolled overflows into Lake Merced, improve storm water quality, and provide beneficial uses to the community.

Overall, the alternatives under consideration address the need for additional flow capacity, the opportunity to reduce peak flows through storm water detention, and the concepts for beneficial storm water reuse. Previously, Jacobs Associates (JA) developed and evaluated 17 alternatives based on criteria related to anticipated public benefits, operability, environmental compliance and impacts, land use requirements and acquisition costs, constructability, and lifecycle costs. Each alternative will impact the surrounding natural environment and community differently. Subsequently, JA performed supplemental analyses to refine three alternatives that would continue routing storm water out of the basin directly into the Pacific Ocean.

Following discussions in July, 2009 with the public and key stakeholders, CCSF and the City agreed to explore the potential benefits of augmenting the existing infrastructure adjacent to and including Lake Merced to reduce the localized flooding potential within the watershed and better manage Lake Merced water levels. The analyses presented herein integrate the Lake Merced Alternative into the ongoing alternatives study and address:

- Safely routing storm water from the Vista Grande Watershed to Lake Merced and the Pacific Ocean;
- Improving storm water quality;
- Providing a non-groundwater source of water to assist the CCSF in managing Lake Merced lake levels;
- Achieving desired operating water surface elevations for Lake Merced in a safe and environmentally acceptable manner;
- Reducing uncontrolled canal overflows into Lake Merced; and
- Providing lake overflow capacity to minimize environmental and property damage associated with large storms and high lake levels.

This memorandum also discusses the Vista Grande Watershed storm water management alternative analysis as it relates to the Lake Merced Alternative.

Alternatives Overview

The Lake Merced Alternative will complement the alternatives previously discussed in the Draft Vista Grande Drainage Basin Alternatives Evaluation Report (AAR) (JA, 2007) and Supplemental Analysis (JA, 2009), which reflect a range of potential solutions for addressing local flooding in the Vista Grande drainage basin. The City and the consultant team evaluated and selected the alternatives based on their potential for reducing flooding, operational viability, public impacts, environmental benefits and constructability. The previously studied alternatives included three main elements—a drainage tunnel, a storage/detention structure and storm water reuse opportunities. The consultant team also prepared an Environmental Characterization and Permit Workbook to identify environmental issues and regulatory approvals/permits required to implement selected alternatives. The work has identified, developed and evaluated different tunnel inlet locations, tunnel outfall structure locations, storm water storage locations, and groundwater recharge alternatives. The drainage tunnel alternatives evaluated in the AAR are summarized below; Alternatives 5B, 6 and 7, included in the supplemental analysis, are shown in Figure 2.

- Alternatives 1A and 1B—running from the beginning of the Canal, beneath the Olympic Club, to either a new outfall structure near Fort Funston (1A) or the existing outfall structure (1B).
- Alternative 2—running from the north side of the Doelger Senior Center at Westlake Park, beneath the Olympic Club, to a new outfall structure near Thornton State Beach.
- Alternative 3—running beneath John Daly Boulevard from the south side of Cliffside Drive to a new outfall structure at Thornton State Beach.
- Alternative 4— running from Westlake Park, beneath Northgate Avenue, to a new outfall structure near Thornton State Beach.
- Alternatives 5A and 5B—running from a point approximately 800 feet from the beginning of the Canal, beneath the Olympic Club, to either a new outfall structure near Fort Funston (5A) or the existing outfall structure (5B).
- Alternative 6—running from a point approximately 2,100 feet from the beginning of the Canal, beneath the Olympic Club, to the existing outfall structure.
- Alternatives 7A and 7B—running from a point approximately 3,500 feet from the beginning of the Canal, beneath the Olympic Club, to the existing outfall structure. Alternative 7A considered a large-diameter tunnel with full flow capacity. Alternative 7B considered a small-diameter microtunnel sized to pass 330 cfs, which would complement the existing Tunnel capacity and provide a maximum capacity of 500 cfs to the outfall structure.
- Alternative 8, similar to Alternative 4, considered a possible microtunnel alignment running from Westlake Park, beneath a portion of Northgate Avenue and the Olympic Club, to a new outfall structure near Thornton State Beach.
- Alternative 9 considered a storm water detention structure located beneath Westlake Park to capture peak storm water flows, and following the peak runoff flow, would pump temporary stored water back into the box culvert connected to the Canal. A storm water detention alternative can complement a tunnel alignment alternative to reduce peak discharges through an outfall structure. This optional feature was incorporated into Alternatives 4, 5A, 5B, 6, 7A, 7B and 10.
- Alternative 10 considered the above alternatives in combination with a groundwater recharge feature.

The Lake Merced Alternative is a supplement to the current alternatives list. Implementing the Lake Merced Alternative would involve constructing facilities necessary to screen storm water; divert flows to the existing canal, Lake Merced, or both; improve storm water and authorized non-storm water quality through natural treatment processes (surface flow wetland); control the Lake's water surface; and reduce the potential for localized flooding in the watershed. This alternative considers diverting year round low flow storm water and non-storm water after those flows are processed through a constructed surface wetlands system, and a portion of the screened high volume storm water flows into Lake Merced to increase the lake's water volume and increase the lake level management flexibility. The balance of screened storm water flows would pass through the Canal, rehabilitated Tunnel, and reconstructed City outfall structure. Figure 3 shows various outlet/overflow configurations from Lake Merced's South Lake and North Lake shorelines. Appendix A includes conceptual designs for this alternative.

2 Vista Grande Watershed

2.1 Vista Grande Watershed

The Vista Grande Watershed lies in the northwestern portion of Daly City. Since its incorporation in 1911 (Chandler, 1973), the City has become increasingly urbanized, which has resulted in more paved areas and less open space and green areas. As of 2009, the City was comprised of approximately 66 percent residential and commercial areas, 12 percent open space, 20 percent public facility land uses, and 2 percent vacant land (City of Daly City, 2009). As an urban area with little available open space, the City generally lacks pervious surfaces. Colma Creek, Lake Merced, and local golf courses and cemeteries are the main pervious features that enable aquifer recharge in the area (City of Daly City, 1987).

The Vista Grande Watershed includes approximately 1,690 acres bounded by CCSF to the north, Colma Creek to the east and south, and the Pacific Ocean to the west. The watershed is mostly comprised of a densely developed urban area surrounded by hills on the east, west and south. Primary land uses are residential, commercial and recreational, with a high percentage of impervious surfaces (e.g. roads, roofs and parking lots). The major hydrologic features associated with the watershed area include the Vista Grande storm drain collection system, the Vista Grande Canal and Tunnel, and Lake Merced, which is the largest and dominant feature of Lake Merced Watershed that lies directly north of the Vista Grande Watershed.

2.2 Lake Merced

Lake Merced, located in the southwest corner of San Francisco, is the largest freshwater lake in the area and is considered an emergency source of water for the CCSF to be used solely for firefighting or sanitation purposes if no other sources of water are available due to natural disaster, or other emergency need. In the unlikely event that Lake Merced water actually enters San Francisco's potable water distribution system, the CCSF would issue a public health advisory "Boil Water Notice." The San Francisco Recreation and Park Department (SFRPD) manages the Lake's recreational areas under a 1950 agreement with the San Francisco Public Utilities Commission (SFPUC), and the SFPUC manages the water aspects of the Lake (SFPUC, 2010). Lake Merced historically served several functions for the City of San Francisco, and the lake levels responded dramatically until about 1940 in response to changing water use and operating regimes.

Lake Merced receives water primarily from the Vista Grande and Lake Merced Watersheds and is comprised of four smaller lakes—North, East, South and Impound lakes. The Lake is surrounded by golf courses (the private Olympic and San Francisco golf clubs and the public Harding Park Golf Club), residential areas, Lowell High School, San Francisco State University, Fort Funston and the Pacific Ocean.

Recreational Lake uses include bicycling, hiking, boating, fishing, golfing, skeet shooting, birding, wind surfing, and picnicking (SFPUC, 2004). Swimming, however, is prohibited. A paved, multi-purpose pathway circumscribes Lake Merced, and an informal jogging and walking trail runs along the northern edge of Harding Park Golf Course on the ridge overlooking East Lake. Formal and informal trails are found in various locations around the Lake, with several leading to areas of sand or open ground that are accessed for fishing, boating and other forms of recreation. SFRPD allows public boat launching into both North and South Lakes via docks, ramps and informal access sites. Rental boats and equipment have been offered at Lake Merced in the past, but are currently not available. No gasoline-powered boats (except emergency patrol boats) are allowed on the lakes. No boating is allowed on Impound Lake (EDAW and Talavera & Richardson, 2004).

Fishing at Lake Merced takes place year-round from designated shorelines, fishing piers, float tubes and boats in both North and South lakes. Fishing is permitted along all shorelines except for those areas designated "No Fishing." Fishing access along the shores of East and Impound lakes is limited, with a fishing pier located on the south end of South Lake (SFPUC, 2004; SFRPD brochure).

Except for the potential emergency use by CCSF described above, Lake Merced is not a current source of municipal and domestic water supply.

Lake Levels

Water levels in Lake Merced normally rise and fall between two to three feet seasonally due to rainfall, evaporation and groundwater seepage. Drought years can cause more significant lake level fluctuations. The upper water surface level typically occurs in late winter and early spring; lowest levels occur in the early fall. Lake levels can also be affected by the groundwater, with lake levels increasing and decreasing as groundwater levels increase and decrease (SFPUC, 1996).

The Lake levels are supported by a varying groundwater level, precipitation falling directly on the lake surface, local storm water runoff from the surrounding watersheds, and infrequent planned discharges of dechlorinated water into the Lake from SFPUC water operations. Outflows from Lake Merced include evaporation, transpiration from emergent vegetation, and groundwater seepage. Prior to 1940 and the construction of the San Francisco Zoological Gardens, a natural creek connected the North Lake with the Pacific Ocean near Sloat Boulevard and Lake Merced had previously operated at higher levels. Natural creek meandering, sand dune migration, lower lake levels, and urban development have contributed to the infilling of most of the historic creek. Urbanization around Lake Merced has reduced the watershed recharge capacity, which has decreased groundwater inflow into Lake Merced, and created lower water levels and a flatter groundwater gradient in the shallow aquifer. Lake Merced is, thus, likely to be considerably more sensitive to annual changes in precipitation and slow in recovering from drought conditions.

The current San Francisco Zoological Gardens development has integrated portions of the historic creek into its landscape. Inside the zoo and adjacent to Skyline Boulevard, imported water cascades from Eagle Lake (approximate Elevation 14) through a series of small pools to Pelican Lake. This water feature is approximately aligned with the historic creek connecting Lake Merced with the Pacific Ocean.

As the operating agency for Lake Merced, SFPUC is exploring alternatives for adding supplemental water to maintain Lake Merced water levels within the desired range and reduce the dependency on groundwater pumping. While assessing the feasibility of alternatives, SFPUC identified environmental and water quality issues associated with increased lake levels (SFPUC, 2004). SFPUC has committed to increasing the Lake Merced water levels, which have fallen over the years. In addition to changing the irrigation water source for the three adjacent golf courses from groundwater to recycled water provided by the City, SFPUC considered alternative water sources to increase lake levels. SFPUC analyzed four potential water sources—SFPUC water supply, Westside Basin groundwater, Daly City recycled water, and Vista Grande storm water. The analysis presented potential water quality and habitat impacts from these sources. If Vista Grande storm water is used to raise the lake levels, it would likely need to be used in conjunction with other water sources to meet and manage Lake level goals throughout the year, especially during the dry season when no storm water flows occur. As a result, Lake Merced's water level will be dependent on a blend of existing and supplemental water sources.

2.3 Existing Storm Water Drainage System

The City operates the Vista Grande Watershed storm water system. The Vista Grande portion of the City's storm water collection system drains the northwestern area of the City and an unincorporated portion of San Mateo County. The underground collection system conveys storm flows northwest to the Canal and then into the Tunnel, which discharges through the City outfall structure into the Pacific Ocean at the beach below Fort Funston, located in GGNRA lands.

The Canal and Tunnel are the downstream conveyance structures of the storm water collection system. The trapezoidal Canal, adjacent to the west side of John Muir Drive, has a capacity of about 500 cubic feet per second (cfs) and lies parallel to the southwest shores of Lake Merced. At the terminus of the Canal is the mouth of the Tunnel, which is 3,000 feet long and has a capacity of about 170 cfs. The Tunnel serves as the primary outlet for storm water from the Vista Grande watershed.

Wet Weather Flows

In wet weather, storm water drains into the Canal, through the Tunnel, and into the Daly City outfall structure to the Pacific Ocean. Since the watershed lacks significant pervious surface, rainfall quickly sheds from the watershed and generates high but short duration peak storm water flows. Historically, and as confirmed by hydraulic modeling, rainstorms produce storm runoff that exceeds the Canal's hydraulic capacity (500 cfs) less than once per year. Canal overtopping events cause property damage, bank erosion, traffic nuisances, public safety issues, and may have adverse impacts to Lake Merced water quality. As part of recent repairs to property damaged by Canal overtopping events, the City has constructed three hardened overflow chutes between John Muir Drive and Lake Merced. The watershed hydraulics associated with wet weather are discussed below.

Dry Weather Flows

In dry weather, the watershed collects residential irrigation runoff and other authorized non-storm water flows and delivers these to the Vista Grade Canal and Tunnel. The Tunnel also conveys treated wastewater from the City's wastewater treatment plant to the City outfall structure and submarine discharge pipeline below Fort Funston.

2.4 Watershed Hydraulics

The Vista Grande Watershed, an area of approximately 2.5 square miles (about 1640 acres), includes portions of the City and unincorporated San Mateo County. Three main culverts collect storm water flows from the watershed—a 24-inch-diameter culvert, a 60-inch-diameter culvert, and a 7-foot by 6-foot box culvert. These three culverts discharge storm water into the Canal. The Canal conveys the storm water about 3,500 feet to the existing Vista Grande Outfall Tunnel. The Tunnel discharges to the Pacific Ocean through an existing outfall beach structure below Fort Funston, located in the GGRNA.

For planning purposes, the City has selected a design storm event with a four-hour duration and a 25-year recurrence interval (RMC, 2006). A storm hydrograph shows water flow with respect to time and is comprised of two components—base flow and surface runoff. Base flow is rainfall that seeps into the soil and moves laterally to the storm drains and the Canal, reaching the Canal after many hours or days. Surface runoff is the rainfall that travels overland to the storm drain system, which carries it to the Canal. It also includes rainfall deposited directly into the Canal.

In 2008, RMC calibrated the basin storm drain hydraulic model and developed flow characteristics under various scenarios. The calibrated-constrained model designed for the 25-year storm event resulted in a peak storm water flow of about 980 cfs and a total volume of about 39 million gallons (MG). This model accounted for diversions out of the Canal system and storage within the system (pipes, manholes and catch basins to 0.5 feet below street grade), and included some future upstream improvements necessary to prevent collected storm water from surfacing. The calibrated-unconstrained model simulates the watershed storm water behavior after more extensive upstream improvements are completed, which resulted in a peak storm water flow of about 1,660 cfs, with a total four-hour volume of about 64 MG. Table 1 summarizes the modeling results.

Table 1. Summary of Modeling Runs for Vista Grande Drainage Area

Upstream condition	**Peak Storm water flow rate**	**Total storm water discharge volume [1]**		**Percent of rainfall reaching the canal as runoff [2]**	**Comments**
	cfs	***Million Gallons***	***Acre feet***		
Constrained Improved Model including *future extensive storm water collection system improvements*	980	39	120	47%	4-hour, 25-year storm Precipitation data source: NOAA Atlas (adjusted)
Unconstrained Model including *future very extensive storm water collection system improvements*	1,660	64	200	84%	

[1] Storm water discharge volume excluding temporary and localized storm water detention.
[2] Storm water flow that reaches the Canal.

Based on the modeling results, the City considered both the constrained and unconstrained maximum flow rates without storage, and selected a planning-level maximum hydraulic flow capacity of 1,660 cfs. To develop a watershed storm water flow capacity of 1,660 cfs which produced little or no localized flooding, extensive improvements would need to be constructed. Upper watershed improvements could include storm drain upsizing and cisterns, and lower watershed improvements would be strongly influenced by existing upstream and downstream elevation conditions among the watershed, Lake Merced and the Pacific Ocean. The project team verified RMC’s hydraulic modeling assumptions and evaluated how runoff diverted from the Canal would affect Lake Merced’s water surface level. The evaluation confirmed that storm water runoff could be routed to and managed within Lake Merced. In addition, using actual data from the NOAA Oceanside/Richmond-Sunset rain gage (1949 to 2003), the hydraulic analysis indicates that the RMC design storm generated a peak storm water flow rate which is conservatively high. Supplemental hydraulic analyses will be performed if this alternative is recommended for preliminary design.

It is unlikely that the City could obtain the required fiscal resources to construct all upper watershed improvements needed for a completely unrestricted runoff condition. It is likely, however, that the City will plan for improvements needed to arrive at a restricted condition. Accordingly, it is reasonable that a 980 cfs peak flow rate be considered for planning purposes.

3 Lake Merced Alternative

Using a natural storm water treatment process, e.g. surface flow wetlands, for low flow storm water and authorized non-storm water flows, and screening for diverted high flows, the Lake Merced Alternative could satisfy multiple project objectives. This alternative would provide the CCSF with supplemental storm water to operate Lake Merced within a desired water level range from the Vista Grande Drainage Basin in the City. The Lake's current water surface elevation is approximately 6.5 feet (1/9/10, CCSF Datum[3]), and there is Stakeholder interest in managing the lake's operating water surface elevation within the range of 5.0 feet and 9.5 feet (CCSF Datum), with some exception for natural rainfall patterns (e.g., drought may result in levels less than 5.0 feet). Diverting storm water flows into Lake Merced under the Lake Merced Alternative would increase Lake Merced's water levels and volume, which would increase the flexibility for managing water levels and water quality. Furthermore, the storm water diversions would significantly reduce flooding within the Vista Grande watershed.

Operating Model

The Lake Merced Alternative would help restore the historical drainage basin hydrology by returning a significant portion of surface water runoff that has been diverted by urbanization from Lake Merced. Returning these flows to the Lake must be done in a manner that protects existing Lake Merced beneficial uses and maintains or improves Lake Merced's existing water quality, in particular for dissolved oxygen and pH, as Lake Merced has been identified as "impaired" for these constituents on the State's 303(d) List. Accordingly, the recommended operating model includes provisions for several operating conditions dependant on flow and storm water quality. Overflow facilities and controls would be constructed to release excess water from Lake Merced to the Vista Grande Tunnel, when appropriate. Figure 4 presents the storm water adaptive management schematic which illustrates the operating flexibility of the Lake Merced Alternative. The three principal operating modes are briefly described below:

1. **Screened low-flows in the Canal flows can be routed through a wetlands system before being released to Lake Merced**. Screened dry weather flows (authorized non-storm water) and low storm water flows can be routed through a wetlands natural treatment system. These flows would help to maintain overall lake level and sustain wetlands throughout the year. Estimated wetlands retention time is five to seven days at a flow capacity of 4 cfs or less. Dry weather flows are estimated at less than 1 cfs and can be expected for up to 90% of the time[4], May through September of a normal year. Wet weather low flows can be expected for short duration storms and can be expected up to 97% of the time, October through April of a normal year. Alternatively, Canal flows can be routed to the Pacific Ocean via the canal and tunnel.
2. **Screened higher canal flows satisfying a storm water quantity or quality criterion can be routed into Lake Merced**. Winter storm water flows exceeding the capacity of the wetlands natural treatment system can be routed to either Lake Merced or the Pacific Ocean. These flows can be expected less than 3% of the time, October through April of a normal year, and are relatively short lived with the peak flow passing in less than an hour. Alternatively, canal flows can be routed to the Pacific Ocean via the canal and tunnel.

[3] Elevations referenced in this memorandum are with respect to the CCSF datum unless otherwise noted.

3. **Screened higher canal flows can be routed to the Pacific Ocean.** Screened storm water flows exceeding the capacity of the wetlands natural treatment system but not satisfying the storm water quantity or quality criterion can be routed to the Pacific Ocean via the canal and tunnel. These short duration flows can be expected less than 3% of the time, October through April.

Storm Water Quality Improvement Processes

The water quality of storm water diverted into Lake Merced can be improved through the following processes:

- Best Management Practices: The City already implements storm water quality best management practices (BMP) within the Vista Grande Watershed and is planning to implement additional BMPs consistent with the Municipal Regional Storm Water Permit.
- Screening Process: Use a debris screening system, which could consist of a gross solids removal device that would trap material > 5mm in diameter, a screen, a trash net, or a conventional trash rack. As shown in Figure 5, storm water would enter the debris screening system and pass through the louvers before entering the box culvert. A trash rack and trashrake (Figure 6) could be used on this project at the entrance to the existing tunnel or any of the overflow inlets to prevent debris from flowing to the ocean. As part of project maintenance, the City would need to remove debris using a vacuum truck several times each year through access hatches built into the screen tops.

Proposed Wetlands Natural Treatment System: Under the Lake Merced Alternative, low-flow storm water and authorized non-storm water in the Canal would be processed through a new, constructed wetlands natural treatment system located in the vicinity of Lake Merced and then discharged to Lake Merced year round. The wetlands would be designed to maximize bioremediation of the low flows and provide a visually appealing backdrop to the community. Conceptually, the water would flow through dual, linear, meandering wetlands that would be vegetated with marsh plants such as rushes. The wetland would be operated and maintained consistent with the RWQCB's Policy on the Use of Constructed Wetlands for Urban Runoff (No. 94-102). The project design would address and minimize issues such as standing water that could attract mosquitoes, or related odors or other nuisances.

Simulated Lake Merced Water Surface Response

SFPUC recently engaged Kennedy Jenks Engineers (KJ) to model Lake Merced and options for increasing and sustaining the lake level. As shown in Table 2, Lake Merced includes three subunits with limited connectivity between adjacent subunits. The KJ box model assumes that Lake Merced's South, North and East Lake are hydraulically connected. Accordingly, the diverted storm and non-storm water would raise the entire water surface elevation of Lake Merced.

Table 2. Lake Merced Characteristics		
Subunits	**Nominal Surface Area (acres)** [1]	**Comments**
North Lake & East Lake	66	Connects hydraulically with South Lake
South Lake	134	Connects hydraulically with both North Lake and Impound Lake
Impound Lake [2]	10	Connects to South Lake

[1] Per KJ total surface area of Lake Merced ranges from 100 acres to 319 acres depending on water level. The water surface elevation associated with the surface area was not available.

[2] Impound Lake can also receive limited inflow from one neighborhood in Daly City's Vista Grande Drainage but only during very large storm events when the canal is backed up. Rerouting this drainage path will be considered if additional engineering work is performed.

KJ developed a mass balance (box) model that considered the following parameters:

- Lake surface area as a function of lake level
- Surface evaporation as a function of lake surface area
- Subsurface infiltration into the groundwater
- Rainfall onto the lake surface
- Runoff from the lake's immediate, existing watershed

The model takes historical rainfall data (Mission Dolores rain gauge) for a 50-year period starting in 1957 and predicts lake surface elevation. The 50-year record includes two major droughts—1976/1977 and 1989 through 1991. The model also allows water inputs from a groundwater well and through Vista Grande drainage basin dry weather flow diversion after treatment in a constructed wetland. Figure 7a presents the modeling results with and without groundwater and SFPUC-proposed wetlands water inputs.

The SFPUC's objective is to be able to manage Lake Merced's water level between elevations 5.0 feet and 9.5 feet, with some exceptions due to natural rain patterns. The only physical outlet from Lake Merced is from South Lake via a 30-inch-diameter overflow at elevation 12.5 feet that connects to the existing Daly City Tunnel immediately downstream of the tunnel connection to the Canal. The estimated capacity for the overflow is approximately 400 cfs in its current configuration.

The consultant team prepared a modeling scenario that simulated the lake level response to diverted storm water without using pumped groundwater supplements or dry weather runoff processed through a wetland. This work involves two related pieces—physical facilities necessary to transfer water into the lake and provide overflow capability from the lake and, assuming diversion into Lake Merced is feasible, possible changes in lake level associated with storm water addition. Such diversions would effectively restore runoff to a historical pattern of increasing water level in the winter and spring, and decreasing water level in the summer and fall.

To assess possible benefits from storm water diversion, BC modified the KJ model (KJ, 2009) so that Vista Grande Basin flows would enter the lake. The modified model discontinues groundwater and dry weather runoff additions. On a monthly basis, the model converts rainfall based on the Mission Dolores rain gauge into runoff from the Vista Grande Basin. Analyses considered two Vista Grande Basin scenarios—constrained runoff (current situation with limited upstream improvements) and unconstrained (with extensive upstream improvements).

The Rational Method was subsequently used to generate storm hydrographs for all flows, with and without the constricted wetland approach, from events with measured rainfall greater than 1-inch. Over the historical record approximately 250 rainfall events occurred and rational-method hydrographs were developed for each. Event based storm water volume estimates were developed for events when the storm water flow exceeded 35, 50, 75, 100, 125, 150, and 170 cfs. Figures 7b and 7c show the simulated lake levels for the 35 cfs and 170 cfs diversion thresholds.

The results show that adding low-flows year-round from the Canal would improve lake levels significantly; however, lake levels would still drop quite low during low rainfall periods. Diverting high flow storm water into Lake Merced to augment year-round flows produces a more sustainable maximum water surface elevation and reduces the lake drawdown/refill durations.

Descriptions of Facilities

The Lake Merced Alternative would involve constructing facilities necessary to screen storm water; route flows to the existing canal and to Lake Merced; improve storm and non-storm water quality by routing low flows through a wetlands natural treatment process; control Lake Merced's water surface; and reduce the potential for localized flooding within the Vista Grande watershed.

Figure 3 presents a storm water adaptive management schematic diagram of the Lake Merced Alternative. This alternative would include constructing new facilities including: a collection box, a gross solid screening device, a 1,400-foot-long box culvert to replace a portion of the existing Canal, a semi-automated hydraulic diversion structure, a 700-foot-long box culvert that passes under John Muir Drive, a screened discharge structure in Impound Lake, a wetlands natural treatment system, and a screened low-level intake/overflow manifold at/in South lake. This alternative would also include rehabilitating: the existing Tunnel, the forced main discharge line, and the Daly City Outfall structure. Several alternative Lake Merced overflow structure locations were considered and are also shown.

The Vista Grande Tunnel, constructed in 1896, would be rehabilitated to extend its operating life and increase its hydraulic capacity to be at least equal to the Canal. The Daly City Outfall structure located on the beach below Fort Funston (Figure 8a) would be replaced with a low-profile outfall structure (Figure 8b) and renovated submarine outfall pipeline. In addition, a short segment of the existing force main from the Daly City Wastewater Treatment Plant would be replaced and integrated with the tunnel and the new outfall structure. Construction access to the outfall structure could be provided through the tunnel or by constructing an access road to the beach from Fort Funston.

4 Watershed Storm Water Management

The City currently operates with, and plans additional, storm water management practices in the City and San Mateo County as required under the revised Municipal Regional storm water Permit (Storm Water Permit). Storm water control and management would also occur as part of the Lake Merced Alternative, such as screening storm water before diverting it into Lake Merced or discharging it to the ocean, and developing a wetlands natural treatment processing system near Lake Merced to improve low-flow storm and authorized non-storm water quality.

Storm water management in Daly City and in the Vista Grande Watershed is regulated by the Storm Water Permit. This permit applies to the cities and unincorporated areas in several Bay Area counties, including San Mateo, Santa Clara, Contra Costa, Solano and Alameda counties. The Storm Water Permit lists provisions that each municipality must implement to reduce pollution sources. It also includes discharge prohibitions and limitations to protect the receiving waters' beneficial uses.

The City is committed to implementing storm water controls throughout the Vista Grande Watershed. For example, the City has developed measures for post-construction storm water management in new and redevelopment projects. The opportunities for such projects depend significantly on changes in the current land or property use (e.g., residential, commercial, construction site, landscaping, etc.); the City expects these to occur slowly. Table 3 summarizes the City's current efforts to manage storm water quality.

Table 3. Status of Post-Construction Storm water Management Measures

Measure	**Status**
Develop, implement, and enforce a program to address storm water runoff from new and redevelopment Projects to ensure that controls are in place to prevent or minimize water quality impacts.	Planning standards are in place.
Develop and implement storm water management strategies, including a combination of structural and/or non-structural best management practices (BMPs) appropriate for the community.	Multiple BMPs in-place in the community including: ▪ Educating the public about storm water quality management; ▪ Involving the public in solution finding; ▪ Detecting and mitigating sources of pollution; ▪ Sponsoring recycling programs; ▪ Enforcing SWPP measures in all City projects; ▪ Frequently sweeping city and county streets; ▪ Installing permanent storm water treatment controls and construction erosion control measures; and, ▪ Inspecting construction and other work sites.

Table 3 (Continued). Status of Post-Construction Storm water Management Measures	
Measure	**Status**
Use an ordinance or other regulatory mechanism to control post-construction runoff from new and redevelopment projects to the extent allowable by law.	City and county ordinances are in-place governing: ▪ Responsible applications and disposal of chemicals, pesticides and herbicides; ▪ Sponsoring recycling programs; ▪ Frequently sweeping city and county streets.
Ensure the adequate long-term operation and maintenance of BMPs.	The City Manager is responsible for ensuring BMPs' long-term operation and maintenance

The City is implementing a Storm Water Management Plan that considers the following BMPs consistent with the recently adopted Storm Water Permit:

- New Development and Redevelopment:
  - Have adequate development review and permitting procedures to impose conditions of approval or other enforceable mechanisms to implement the requirements. For projects discharging directly to "impaired water bodies" listed under Clean Water Act Section 303(d) such as Lake Merced, conditions of approval must require that post-development runoff not exceed pre-development levels for such pollutants that are listed;
    - Implement and encourage Low Impact Development (LID)
    - Numeric Sizing Criteria for Operation and Maintenance of Storm water Treatment Systems
    - Alternative or In-Lieu Compliance with Provision C.3.c.
    - Hydromodification Management
    - Required Site Design Measures for Small Projects and Detached Single-Family Home Projects
  - Evaluate potential water quality effects and identify appropriate mitigation measures when conducting environmental reviews, such as under the California Environmental Quality Act;
  - Provide training adequate to implement the requirements of Provision C.3 for staff, including interdepartmental training;
- Industrial and Commercial Site Controls;
- Illicit Discharge Detection and Elimination;
- Construction Site Control;
- Public Information and Outreach; and
- Water Quality Monitoring depending on the receiving water bodies including pesticides toxicity control, trash load reduction and controls on mercury, polychlorinated biphenyls (PCBs), copper, polybrominated diphenyl ethers (PBDE), and legacy pesticides and selenium.

The Storm Water Permit describes appropriate source control, site design and storm water treatment measures in new development and redevelopment projects. These address both soluble and insoluble storm water runoff pollutant discharges and prevent increases in runoff flows from new development and redevelopment projects. This goal is to be accomplished primarily by implementing low impact development (LID) techniques. Several projects underway in the City that include implementing LID techniques are:

- Monarch Village, a mixed-use commercial and residential development, that is required to design and operate a bioswale to capture and filter site runoff before entering the public storm water system and has executed an operations and maintenance agreement with the City.
- 7555 Mission Street, a Habitat for Humanity condominium project that will be adding permeable surfaces, native low-water landscaping, a percolation field and a 4,000-gallon underground rainwater harvesting storage tank.
- Westlake Shopping Center Safeway expansion, which will include installing a biotreatment planter to accept storm water runoff from the building and customer parking.

Lake Merced appears on the Clean Water Act Section 303(d) list for low dissolved oxygen and pH levels (RWQCB, 2007)[6]. The City will evaluate discharge and receiving water quality data, and evaluate source control and storm water treatment measures in the Vista Grande Watershed, where appropriate, when implementing the Lake Merced Alternative, if selected as the preferred alternative.

In its long-term planning efforts, the City is evaluating both internal and external project developments for opportunities to develop upstream BMP projects consistent with the criteria established by the *San Mateo County Sustainable Streets and Parking Lot Design Guidebook*, and *A Guidebook of Low Impact Development Examples* (December 2009) compiled by the San Mateo Countywide Water Pollution Prevention Program. Table 4 includes some illustrative example projects within the watershed.

Table 4. Possible Conceptual Vista Grande Watershed BMP Projects

Upstream LID/BMP project type	**Technical Opportunities**	**Constraints**	**Benefits**
Park Retrofit Project	Diverting from storm drain system; creating bioretention/ detention/ infiltration	Land use limitations, construction, diversion hydraulics	Subregional treatment, reduction of storm water flows, improvement of water quality, flow volume reduction
Highway/Street Corridor Retrofit	Treating direct street runoff prior to discharge to storm drain system.	Multiple jurisdictions	Potentially expandable throughout watershed
Shopping Center Retrofit	Treating direct facility, parking lot runoff.	Private property	Potential high pollutant load source
School Retrofit	Diverting from storm drain system and creation of bioretention/ detention/ infiltration	Educational uses, child health and safety, diversion hydraulics	Subregional treatment, Available public property

5 Regulatory Requirements

Regulatory requirements for the Lake Merced Alternative would follow a framework consistent with Municipal Separate Storm Sewer Systems (MS4) programs to include considering environmental issues such as the potential short-term and long-term environmental impacts from its implementation. Generally, the key environmental issues requiring evaluation include:

- Water quality;
- Public health and safety;
- Vegetation and wildlife habitat, including special-status species;
- Beach and coastal bluff erosion;
- Public access to the beach;
- Recreation activities and park resources;
- Aesthetics;
- Ocean resources; and,
- Short term construction-related traffic, road closures and noise.

Private, local, state and federal entities own the lands needed to construct, operate and maintain the storm water improvements. The City would need to consult with relevant resource agencies and follow prescribed environmental review processes to evaluate project environmental effects and obtain construction permits for proposed components or improvements. The City would conduct environmental review processes under the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). Given this memo's intent, the water-quality-related issues and regulatory considerations are described below in more detail.

5.1 Water Quality and Related Issues

The primary water quality issue is the quality of the storm water entering Lake Merced and its effect on the overall quality of Lake Merced water. The regulatory permits or approvals for water quality would be related to storm water management under the Lake Merced Alternative, driven by (a) the requirements under the federal Clean Water Act as administered by the State Water Resources Control Board and the Regional Water Quality Boards in California, and (b) Lake Merced's beneficial uses as a receiving water body that would determine the applicable regulatory standards.

The federal Clean Water Act of 1972 authorizes the U.S. Environmental Protection Agency (USEPA) to implement water quality regulations to restore and maintain the chemical, physical and biological integrity in the nation's waters. The National Pollutant Discharge Elimination System (NPDES) permit program under the Clean Water Act controls water pollution by regulating a variety of discharges into the waters of the United States. The USEPA has delegated authority for NPDES permitting in California to the California State Water Resources Control Board (SWRCB), which delegates this responsibility to the nine regional boards. The Regional Water Quality Control Board (RWQCB), San Francisco Bay Region, regulates water quality in the project area.

SFPUC last used Lake Merced as a drinking water supply source in the 1930s. SFPUC classifies Lake Merced as an emergency source of water supply for firefighting and sanitary uses if no other source were available during emergency situations, like following a catastrophic earthquake. Under a public health emergency declaration, the SFPUC would issue a "Boil Water Order" if it pumped water from the Lake into the potable water distribution system. For this reason, Lake Merced has been designated with a "potential" municipal and domestic supply beneficial use. Principal issues associated with this designation include 1) public health (disease transmission), 2) aesthetic acceptability (taste and odor), and 3) economic impacts associated with the storm water treatment. SFPUC is currently working on developing a groundwater management plan that could potentially provide groundwater to supplement or replace Lake Merced as an emergency potable water source.

Any storm or authorized non-storm water the City conveys into Lake Merced under the Lake Merced Alternative must not cause or contribute to an exceedence of applicable water quality standards and be consistent with the listed Lake Merced beneficial uses. As discussed below, water quality standards include both narrative and numerical water quality objectives.

- The San Francisco Bay Regional Water Quality Control Board (RWQCB) would regulate the diversions considered in the Lake Merced Alternative under the City's Storm Water Permit per Clean Water Act Section 402(p)(3). In October 2009, the RWQCB issued this permit to San Mateo County and the 20 incorporated cities and towns in the county (including the City) along with Alameda, Contra Costa, and Santa Clara counties and Fairfield-Suisun permitees. Permit compliance for the Lake Merced Alternative may include various conditions including a storm water monitoring plan. Daly City would also need to enter into an agreement with SFPUC on the project's long-term sustained operation.
- The RWQCB has prepared the *San Francisco Bay Basin Plan* (Basin Plan) that establishes water quality objectives and implementation programs to meet stated objectives and protect the beneficial uses of the Bay waters, including Lake Merced. The Plan lists Lake Merced's beneficial uses: potential municipal and domestic supply, cold freshwater habitat, fish spawning, warm freshwater habitat, wildlife habitat, and contact and noncontact water recreation. The Lake Merced Alternative will be evaluated by comparing data against the adopted water quality objectives to ensure appropriate protection of beneficial uses.
- As noted above, Lake Merced is listed as an impaired water body under Section 303(d) of the Clean Water Act for dissolved oxygen and pH levels. Analysis of the proposed diversion and storm water management would be required to consider these parameters for the Lake Merced Alternative.

Since the lake level will fluctuate within the desired normal operating range, analyses will need to consider impacts on the shoreline. Being an emergency drinking water supply may warrant further review in light of existing operations to assess whether alternate water quality requirements may be applicable.

SFPUC's technical memorandum lists, among others, coliform, nutrients (phosphorus, nitrogen), and metals and oils from road runoff as potential water quality constituents that may require control prior to discharge to Lake Merced. The Lake Merced Alternative may avoid some of these issues by diverting only high-flow, screened storm water which cannot be adequately processed through the constructed wetlands. Since storm water quality will vary seasonally, the City will need to assess the water quality effects on Lake Merced relative to seasonal storm water diversion as it develops a monitoring plan[5].

5.2 Preliminary Regulatory Compliance Assessment

The project design would be informed by the site survey (e.g., wetland delineation) and background research on protected species. The proposed new facilities, such as the discharge structure between Impound and South Lakes, would be located to avoid or minimize impacts to existing wetlands. The design and construction of the new facilities would need to comply with the: Clean Water Act Section 404 authorization from the Corps for working in Impound Lake and waters of the U.S.; Clean Water Act Section 401 Water Quality Certification from the San Francisco Bay RWQCB; and a Lakebed Alteration Agreement with California Department of Fish and Game (Fish and Game Code Section 1602 et seq.). In compliance with these permits, the City would be required to evaluate the project's effects on wetlands and other waters and on fish and wildlife habitat (both terrestrial and aquatic), and to mitigate any unavoidable impacts to wetlands, riparian vegetation and fisheries. Additional research and review of the Lake's protected species (including fisheries) will determine any particular flow and velocity requirements that may apply to weir operation.

The project would provide several benefits, such as restoring the historic flow regimes and the natural hydrology and enhancing the existing wetland habitat and flood control near Lake Merced. As encouraged under SB790, the storm water that otherwise flows into the ocean or causes flooding would be used as a resource for restoration of natural habitat and help restore and provide flexibility to manage Lake Merced water levels. Another benefit might be enhanced groundwater recharge. Next steps would involve additional studies on feasibility, evaluating water quality issues based on a refined project design, and coordinating and consulting with RWQCB, SFPUC, and other parties. Table 5 below summarizes the agencies with regulatory oversight, the governing regulation, and the likely permits and approvals that would be necessary.

[5] A field water quality assessment may include a suite of constituents: dissolved oxygen, pH, metals (copper, zinc, lead); bacteria (e.coli, entrerococcus, fecal, total coliform), nutrients (nitrate, total nitrogen, phosphorous), oil and grease, total organic carbon, and total suspended solids.

Table 5 Potential Regulatory Agencies Involved and Likely Requirements for the Lake Merced Alternative		
Agency	**Governing Regulation**	**Potential Requirements/ Permit**
During Construction		
City of Daly City Lead Agency, State of California		California Environmental Quality Act
TBD Lead Agency, United States		National Environmental Policy Act
Golden Gate National Recreation Agency		Special Use Permit Right-of-Way Permit
California Coastal Commission		Coastal Development Permit Local Coastal Plan compliance Public Works Plan Federal Consistency Determination
U.S. Army Corps of Engineers	Clean Water Act	Section 404 Authorization Nationwide 7 Nationwide 12
SWRCB	Clean Water Act	General Construction Permit/ Storm water Pollution Statewide General Waste Discharge Requirements Prevention Plan (SWPPP)
San Francisco Bay RWQCB	Clean Water Act	Municipal Discharge Permit (likely) or coverage under ”Storm water Permit”; Section 401 Water Quality Certification; Section 402 Policy on the Use of Constructed Wetlands for Urban Runoff (No. 94-102) Overflow discharge from the Lake Waste Discharge Requirements
California Department of Fish and Game	Fish and Game Code Section 1602	Lakebed Alteration Agreement
City / CCCF	Local ordinance/ storm water control ordinance	Compliance with SWPPP/ storm water control permit
During Operation		
San Francisco Bay RWQCB	Basin Plan	Water Quality Objectives listed in this memo
Monitoring Plan and requirements that may be tied with the Municipal Regional Storm water Permit listed above		

5.3 Other Environmental Considerations

5.3.1 Short-term Environmental Issues

Erosion and Sedimentation

Maximum water approach and discharge velocities would be established to minimize erosion, sediment transport, and potential turbidity. Design criteria would include maximum velocities.

Prior to and during project construction, the City would implement erosion and sediment control measures as part of the Storm Water Pollution Prevention Plan in compliance with the General Construction Permit, where appropriate. BMPs, such as installing silt fences and other measures to avoid or minimize water quality impacts specifically associated with construction of in-water components (e.g. the screening device, weir, and the culvert beneath John Muir Drive). The City would comply with any storm water and sediment control requirements under the Storm water Permit and/or the General Construction Permit administered by the SWRCB (including any requirements established by the CCSF).

Biological Species/Habitat

Constructing the wetlands natural treatment system, the South Lake low-level discharge structure, and the South Lake overflow structure may have temporary and/or permanent impacts on existing wetlands in or adjacent to the Canal and Impound Lake. The design would include aggressive requirements in the design criteria to minimize these impacts. The discharge structure would be located so as to minimize impacts to any existing wetlands.

Construction within Lake Merced will require Clean Water Act Section 404 authorization from the U.S. Army Corps of Engineers and Clean Water Act Section 401 Water Quality Certification from the San Francisco Bay RWQCB. A Lakebed Alteration Agreement with the California Department of Fish and Game (CDFG) (Fish and Game Code Section 1602 et seq.) may also be required.

5.3.2 Long-Term Environmental Issues

The storm water volume conveyed to Lake Merced would vary from water year to water year. Depending on the climatological and precipitation variations, the watershed might produce insufficient storm water runoff during some periods to manage the lake level within the desired operating range. It is assumed that the Lake levels would be managed by operating a lake outflow weir to limit the normal maximum water surface elevation between elevation 5.0 feet and 9.5 feet, where possible, with sufficient freeboard to accommodate extreme hydrological events.

Erosion

Water level fluctuations in Lake Merced would be expected to be very slow. Water surface draw-down would occur through natural processes, e.g. evaporation, groundwater infiltration, or through the lakes' overflow control weir when the lake levels exceed the desired maximum operating level. During and following a significant storm event, it is anticipated that processed storm water entering Lake Merced would slowly increase the water surface elevation up to 2 feet, depending on the size and duration of the storm. The likelihood that bank erosion and scour would result from lake level fluctuations is very low, but then future design would evaluate that risk.

Biological Species/Habitat

Maintaining the lake levels at a desired target level between 5 and 9.5 feet with sufficient freeboard is very important to minimizing or avoiding any adverse effects to existing wildlife habitat at or near Lake Merced. The maximum lake level elevation is 13.0 feet.

5.4 Emerging Regulatory Strategies

Unrelated to the Lake Merced Alternative, the City is applying a LID criteria to applicable new developments to improve storm water quality within the watershed. At the regulatory level, the recently adopted Storm Water Resource Planning Act (SB 790), effective January 1, 2010, allows municipalities to tap funds from the State's existing bond funds and use the money for projects that reduce or reuse storm water, recharge the groundwater supply, create green spaces and enhance wildlife habitats. SB 790 authorizes SWRCB to award grants for projects that implement a voluntary storm water resource plan (as defined by the Act) or implement or promote LID to improve water quality or reduce storm water runoff. SB 790 encourages the storm water management to augment local water supplies, maintain or enhance surface water quality, and provide other environmental benefits. The bill provides incentives for public agencies and nonprofit organizations to undertake low-impact development projects and develop storm water resource plans.

Storm water management through restoration along with the flood control benefit under the proposed Lake Merced Alternative would align with the intent and goals of the new SB 790. Therefore regulatory compliance and preparation of the Storm Water Resource Plan (under SB 790) would serve as a parallel effort to the storm water permitting task listed above.

6 Alternative Evaluation

6.1 Budget-Level Cost Estimates

Using the Association for the Advancement of Cost Engineering International classification system, budget-level cost estimates were prepared for the Lake Merced alternative employing unit costs developed from comparable projects, supplier quotes, and allowances. Three alternative overflow locations were considered in the study: the combined inlet and overflow structure; the existing South Lake Overflow, and the new South Lake Overflow. The estimate is included as Appendix B. The opinions of probable project cost consider the contractor's direct and indirect costs, project professional services, an escalation estimate, and design contingency. Table 6 presents the opinion of probable project costs for the base estimate.

Table 6. Opinion of Probable Project Costs (Budget Level Accuracy)

	Alternative Overflow Locations		
Estimate	**Combined Inlet/Overflow**	**Existing South Lake Overflow**	**New South Lake**
Contractor's direct & indirect costs	$40,100,000	$48,900,000	$49,900,000
Contractor's overhead & profit (50%)	18,300,000	22,300,000	22,700,000
Design & Permitting Allowance (10%)	5,800,000	7,100,000	7,300,000
Construction Management & QC Allowance (10%)	5,800,000	7,100,000	7,300,000
Environmental Mitigation Allowance (10%)	5,800,000	7,100,000	7,300,000
Subtotal	75,800,000	92,500,000	94,500,000
Escalation (3% per year)	12,100,000	14,700,000	15,000,000
Contingency (50%)	37,900,000	46,300,000	47,200,000
Total	$ 125,800,000	$153,500,000	$156,700,000

6.2 Project Objectives Evaluation

The evaluation methodology previously developed and used to prepare the Vista Grande Drainage Basin Alternatives Analysis Report (Draft) was applied to the Lake Merced alternative. The results of the scoring suggested a preliminary ranking of alternatives presented in Table 7. Appendix C presents the evaluation matrix, which provides a qualitative approach to evaluating the overflow options for Lake Merced using criteria of providing public benefits; satisfying a functional operations criteria; complying with environmental regulations and processes; minimizing land acquisition costs; maximizing constructability; and, minimizing lifecycle costs.

The evaluation results suggest that the Combined Discharge/Inlet Option satisfies the project objects slightly better than the South Lake Overflow Inlet (Existing) Option. The main difference in the options is the target minimum overflow control elevation.

Table 7. Preliminary Options Ranking based on the Project Evaluation Methodology		
Overall Rank	**Consolidated Score** ***(using golf scoring)***	**Description**
1	7	Combined Discharge/Inlet Option (minimum overflow control Elevation 10.2 feet)
2	7	South Lake Overflow Inlet (Existing) Option (minimum overflow control Elevation 8.4 feet)
3	13	South Lake Overflow Inlet (New) Option

7 Summary

Overall, the alternatives under consideration address the need for additional flow capacity, the opportunity to reduce peak flows through storm water detention, and the concepts for beneficial storm water reuse. The Lake Merced Alternative joins the 17 other alternatives which were developed and analyzed against a criteria related to anticipated public benefits, operability, environmental compliance and impacts, land use requirements and acquisition costs, constructability, and lifecycle costs. This Alternative explores the potential benefits of augmenting the existing infrastructure adjacent to and including Lake Merced to reduce the localized flooding potential within the watershed and better manage Lake Merced water levels. The analyses presented herein integrate the Lake Merced Alternative into the ongoing alternatives study and address:

- Safely routing storm water from the Vista Grande Watershed to Lake Merced and the Pacific Ocean;
- Improving storm water quality;
- Helping to restore the drainage basin's natural hydrology by returning the watershed's surface water currently discharged to the Pacific Ocean via the Canal and Tunnel.
- Providing a non-groundwater source of water to assist the CCSF in managing Lake Merced lake levels;
- Achieving desired operating water surface elevations for Lake Merced in a safe and environmentally acceptable manner;
- Reducing uncontrolled canal overflows into Lake Merced; and
- Providing lake overflow capacity to minimize environmental and property damage associated with large storms and high lake levels.

7.1 Watershed-Level Storm water Management

Under the Lake Merced alternative, the storm water quality in the Vista Grande Watershed would be actively managed on several levels to ensure that the Lake water quality is not diminished. Storm water management in the Vista Grande Watershed is subject to the recently adopted San Francisco Bay Storm Water Permit for the City and San Mateo County. The Storm Water Permit provides a list of provisions that each municipality must implement to reduce pollution sources. The Permit also includes discharge prohibitions and limitations to protect the beneficial uses of receiving waters. The 2006 *San Francisco Bay Basin Plan* identifies the beneficial uses for Lake Merced as municipal and domestic supply, cold freshwater habitat, warm freshwater habitat, fish spawning, wildlife habitat, and contact and noncontact water recreation; the Plan drives the water quality standards that apply to the Lake Merced.

The City has been implementing storm water management practices to reduce pollutant sources, including street sweeping, regular maintenance and cleaning of storm drains, implementation and enforcement of water quality control ordinances, and improvements to the sanitary sewer system. The City will continue and expand the storm water quality improvement programs by implementing the new Storm Water Permit's terms. These programs include implementing an industrial and commercial site control program that will include operational oversight of businesses, additional illicit discharge detection and elimination measures, and further control measures for specific constituents of concern.

7.2 Storm water Management under the Lake Merced Alternative

Storm water management, under the Lake Merced Alternative, would include provisions for screening all water flows reaching the Vista Grande Canal, processing low-flow storm and authorized non-storm water flows from the Canal using a constructed wetlands natural treatment process, diverting storm water meeting water quantity and quality criterion to Lake Merced, and routing remaining storm water directly to the Pacific Ocean.

7.3 Description of Proposed Facilities

The following facilities were considered when developing this alternative:

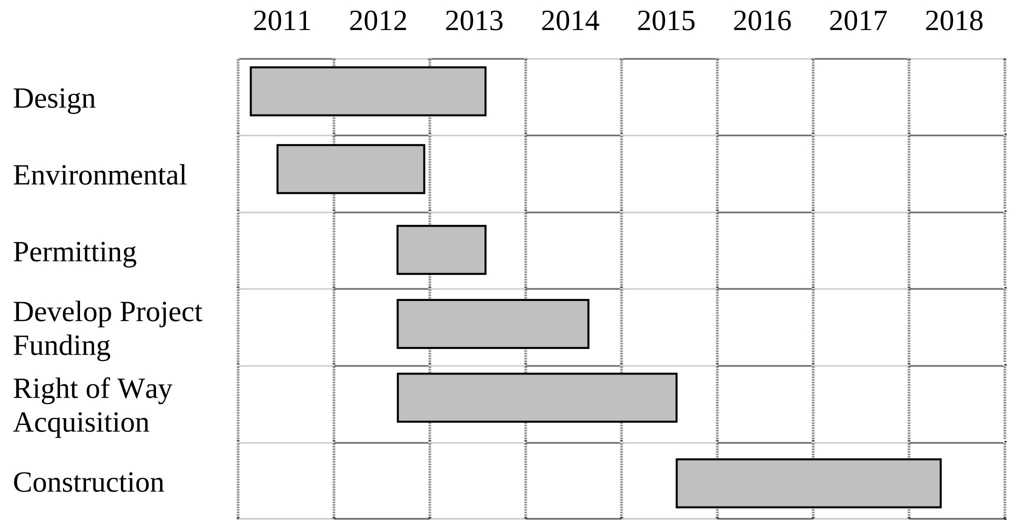
- A 25-foot-long collection box at the Canal inlet
- A 275-foot-long debris screening device at the Canal inlet
- A 1,200-foot-long box culvert from the debris screening device to the diversion structure
- A gated hydraulic diversion structure
- A 200-foot-long split (quadruple) box culvert under John Muir Drive connecting the diversion structure with the new discharge structure in Lake Merced's Impound Lake
- A discharge structure in Impound Lake connected to a discharge manifold into South Lake
- A wetlands near Lake Merced. Adequate space exists for a low-flow natural treatment process wetlands along John Muir Drive between the Vista Grande Canal and the southern shoulder of John Muir Drive.
- A screened overflow structure located at:
    - Impound Lake Combined Discharge/Inlet connected with the Canal
    - An existing overflow in South Lake connected with the Canal
    - (Optional) North Lake Inlet leading to a culvert running through the San Francisco Zoological Gardens to a new wet well and lift pump
- Rehabilitation of the existing Tunnel to extend its capacity, operating life and reliability
- Relocation of a portion of the existing DCWWTP 30- to 33-inch diameter effluent gravity line
- Relocation of a portion of the existing DCWWTP effluent forced main pipeline and drop shaft and integrating it with the Tunnel and Daly City Outfall,
- Rebuilding of the existing Daly City Outfall Structure as a low-profile structure, integrated WWTP effluent discharge and rehabilitated submarine pipeline.

7.4 Estimated Project Timeline

To advance the project, the recommended preferred alternative conceptual design should be developed to a 35 percent completion level concurrently with the CEQA/NEPA process. The design process would include a geotechnical study, as well as preliminary structural design of the new and modified facilities. The entire design process is estimated to take 18 to 30 months. Concurrently, the environment compliance process can begin, based on the prescribed CEQA and NEPA procedures. This process is estimated to take 12 to 24 months.

After the environmental process has been completed, permitting (12 months), project funding (18 to 24 months), and right-of-way acquisition (12 to 36 months) can begin. After these have been completed, it is estimated that construction will take from 24 to 30 months. Table 8 shows a conceptual project timeline.

Table 8. Conceptual Project Timeline



7.5 Next Steps

The City will sponsor a public meeting introducing the Lake Merced Alternative to the public as a supplemental alternative to the Alternatives Analysis Report.

Following the public consultation, the City will identify a Recommended Preferred Alternative which will be evaluated in further detail. Then, the City should consider the following activities to continue the project development:

- Daly City would continue outlining its Storm water Management Plan.
- Develop the 35 percent Preliminary Design documents including a condition assessment of the existing Tunnel, engineering drawings, a specification outline, and cost estimate of the Preferred Alternative. The objective of this task is to define the project features in sufficient detail to support the funding, permitting, and land management efforts.
- Initiate the environmental and regulatory permitting process. The objective of this task is to assist the City with the NEPA/CEQA processes which will evaluate the Recommended Preferred Alternative relative to other alternatives. This process will identify the permits and agreements necessary to construct and operate the drainage basin improvements. This task also includes securing the permits and agreements.
- Develop and pursue a public funding strategy. The task objective is to assist the City secure public funding for the drainage basin improvements.
- Initiate the land acquisitions (as required) and easement process. The objectives of this task are to: (a) identify the necessary easements and land acquisitions; and, (b) assist the City with the processes to access the required lands for the project.
- Continue the public outreach and communication efforts. The objectives of this task are to: (a) facilitate the City's decision making processes; (b) participate in the public outreach; (c) assist the City respond to comments from the public and other stakeholders.

8 References

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9 Figures

Figure 1: Vista Grande Watershed outlined in yellow
other demarcations refer to city and county boundaries

Figure 2: Screened Alternatives

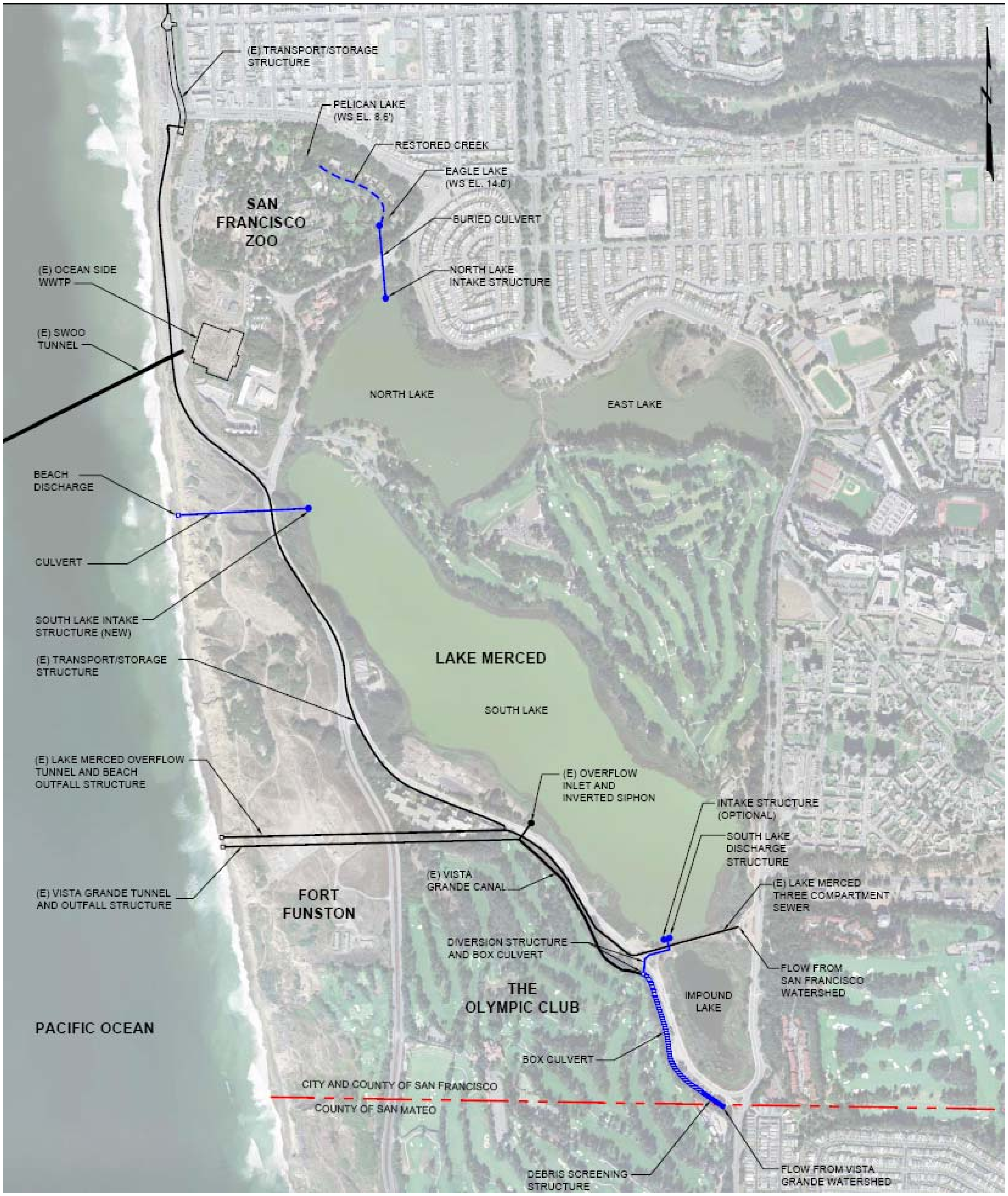


Figure 3: Lake Merced Alternative

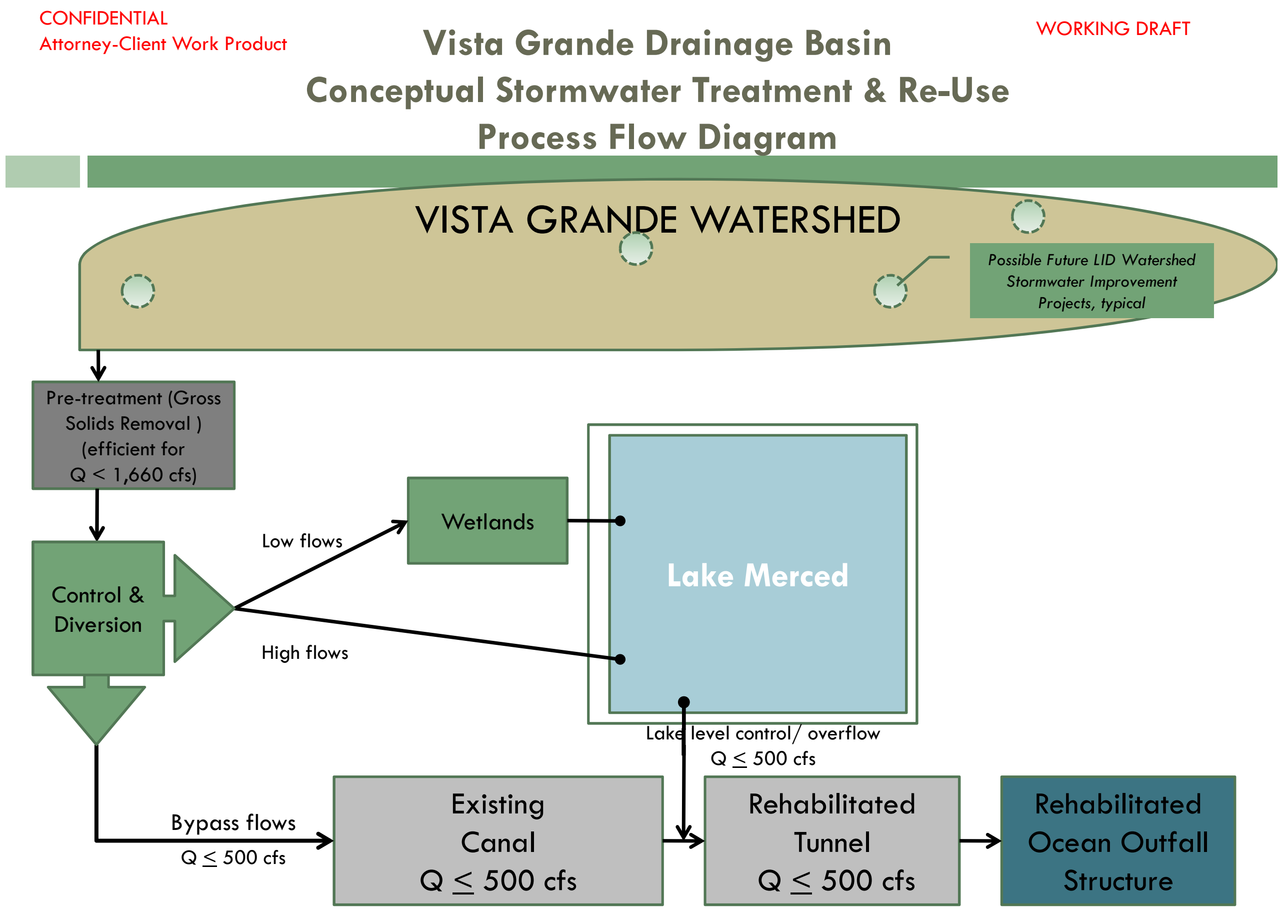


Figure 4: Storm Water Adaptive Flow Management Schematic

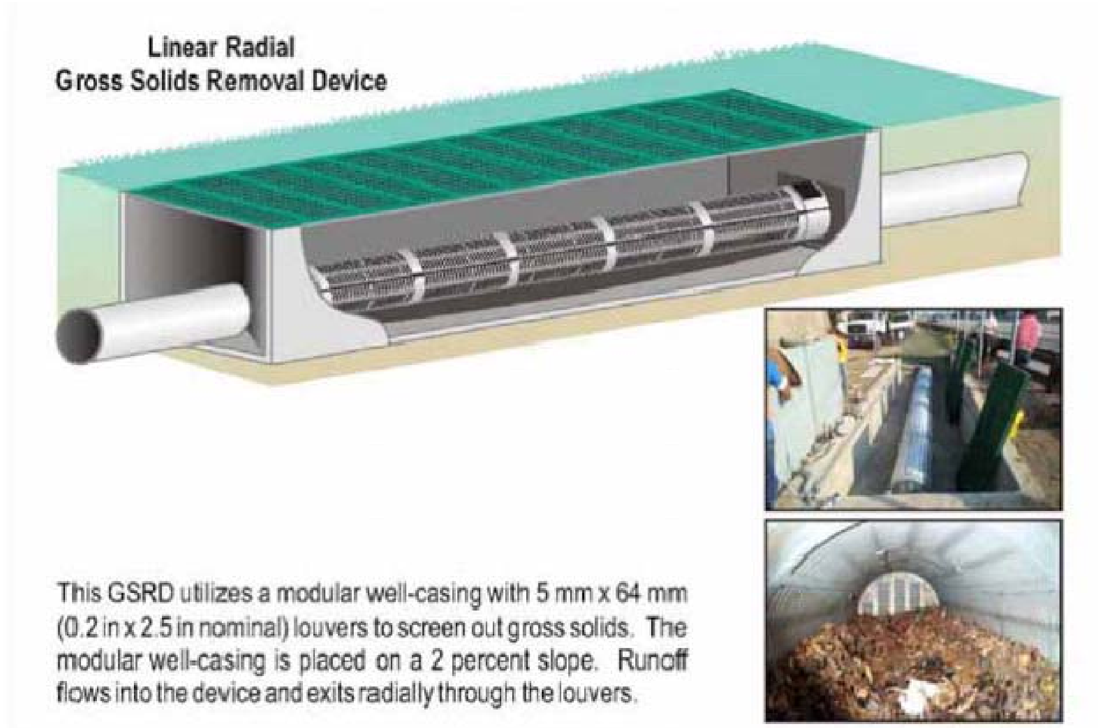


Figure 5. Gross Solids Removal Device (provided by manufacturer)

Figure 6. Typical Trashrack and Trashrake
(Courtesy of Atlas-Polar Hydrorake)

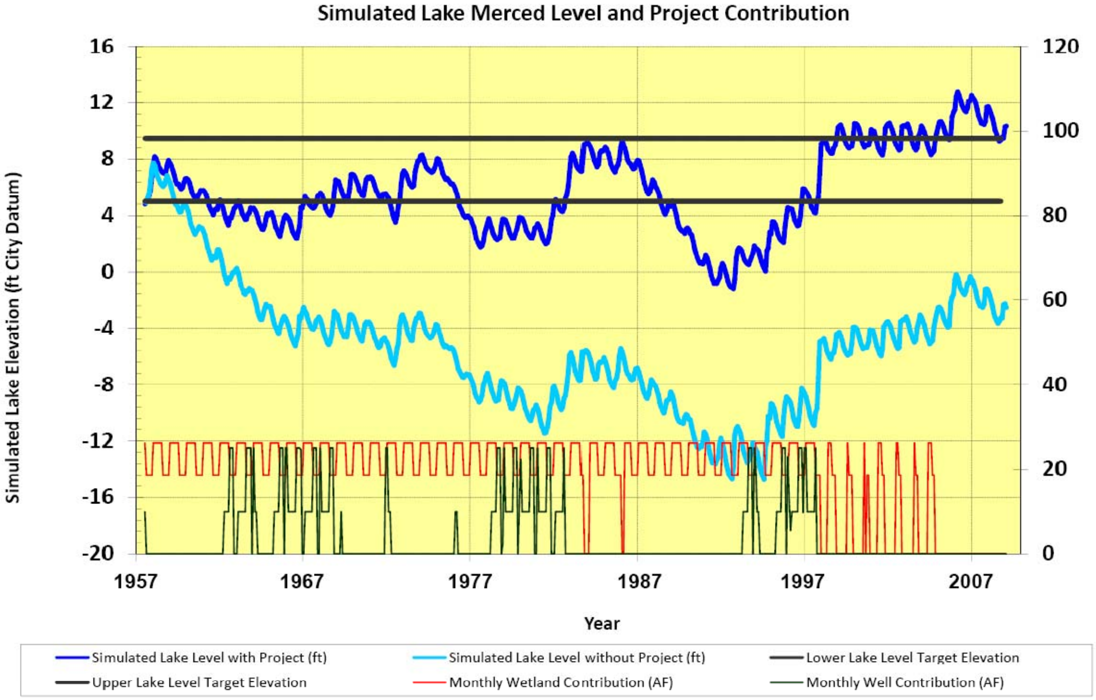
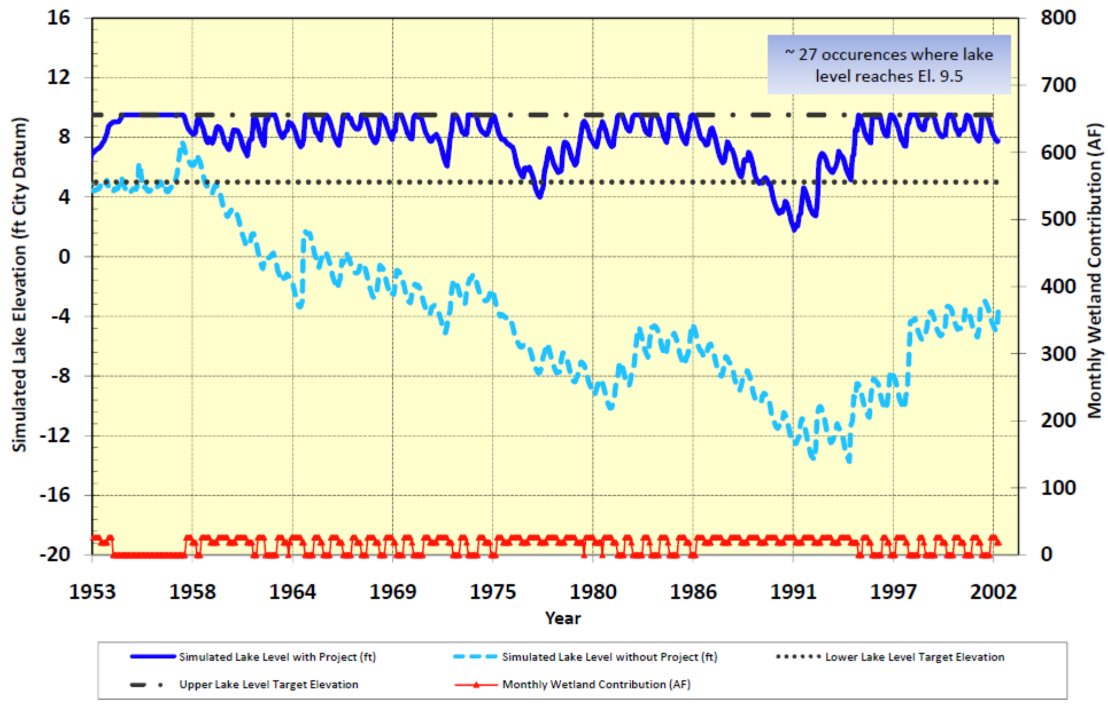


Figure 7a: Simulated Lake Merced Level without Vista Grande Drainage Area Storm water, Assumptions: Excludes runoff from the Vista Grande Watershed.



Model only considers flows for rain events > 1 inch per storm.
Model only considers flows for rain events > 1 inch per storm.

Figure 7b: Simulated Lake Level with Vista Grande Drainage Area Storm Water Contribution ≥ 35 cfs, Assumptions:

Excludes rainfall events generating less than 0.25-inches of precipitation and storm water flows generated from storms with < 1" of precipitation;

Excludes groundwater supplements; and, assumes 48% (runoff coefficient) of rainfall over the entire Vista Grande Basin that reaches the Vista Grande Canal as storm runoff.

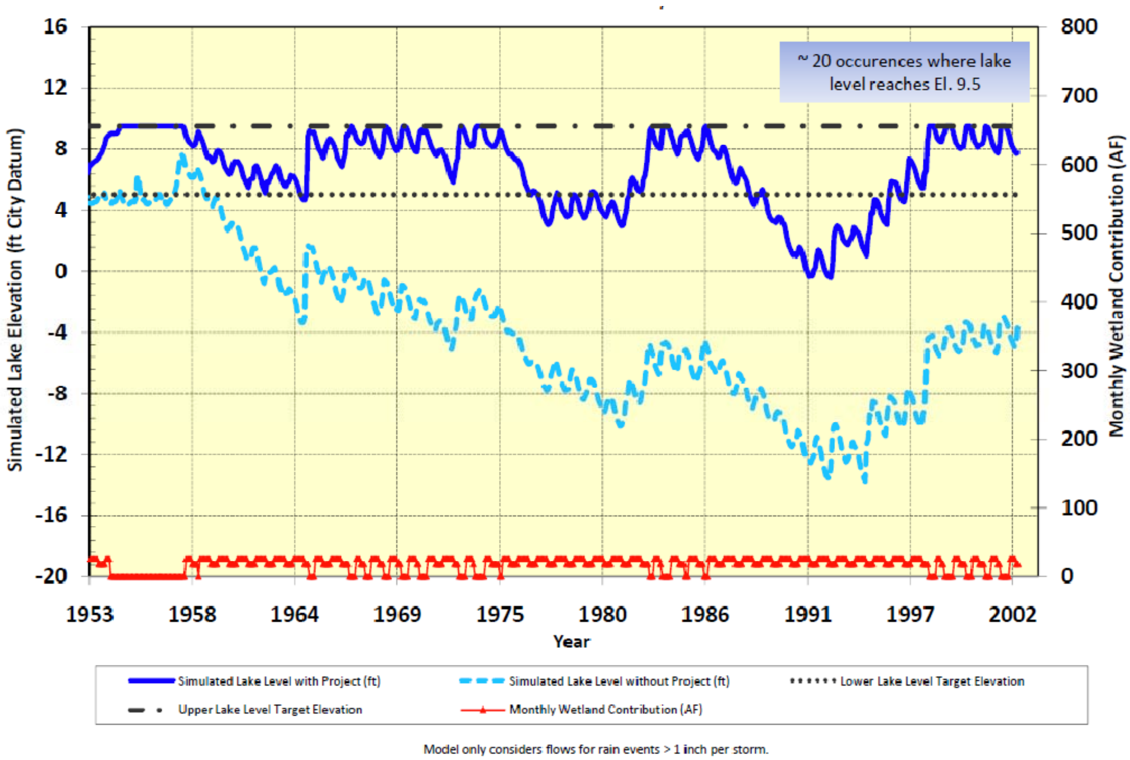


Figure 7c. Simulated Lake Level with Vista Grande Drainage Area Storm Water Contribution ≥ 170 cfs, Assumptions:

Excludes rainfall events generating less than 0.25-inches of precipitation and storm water flows generated from storms with < 1" of precipitation;

Excludes groundwater supplements; and, assumes 48% (runoff coefficient) of rainfall over the entire Vista Grande Basin that reaches the Vista Grande Canal as storm runoff.

Figure 8a. Daly City Outfall Structure, Existing Condition

Figure 8b. Daly City Outfall Structure, Rendering of Proposed Design

Appendix A—Conceptual Design Sketches

LEGEND:

SFPUC	SAN FRANCISCO PUBLIC UTILITY COMMISSION
DC	CITY OF DALY CITY
(E)	EXISTING
WS	CURRENT WATER SURFACE
WL	PROPOSED WATER LEVEL
SD	STORM DRAIN

DRAFT
FOR REVIEW COMMENTS ONLY

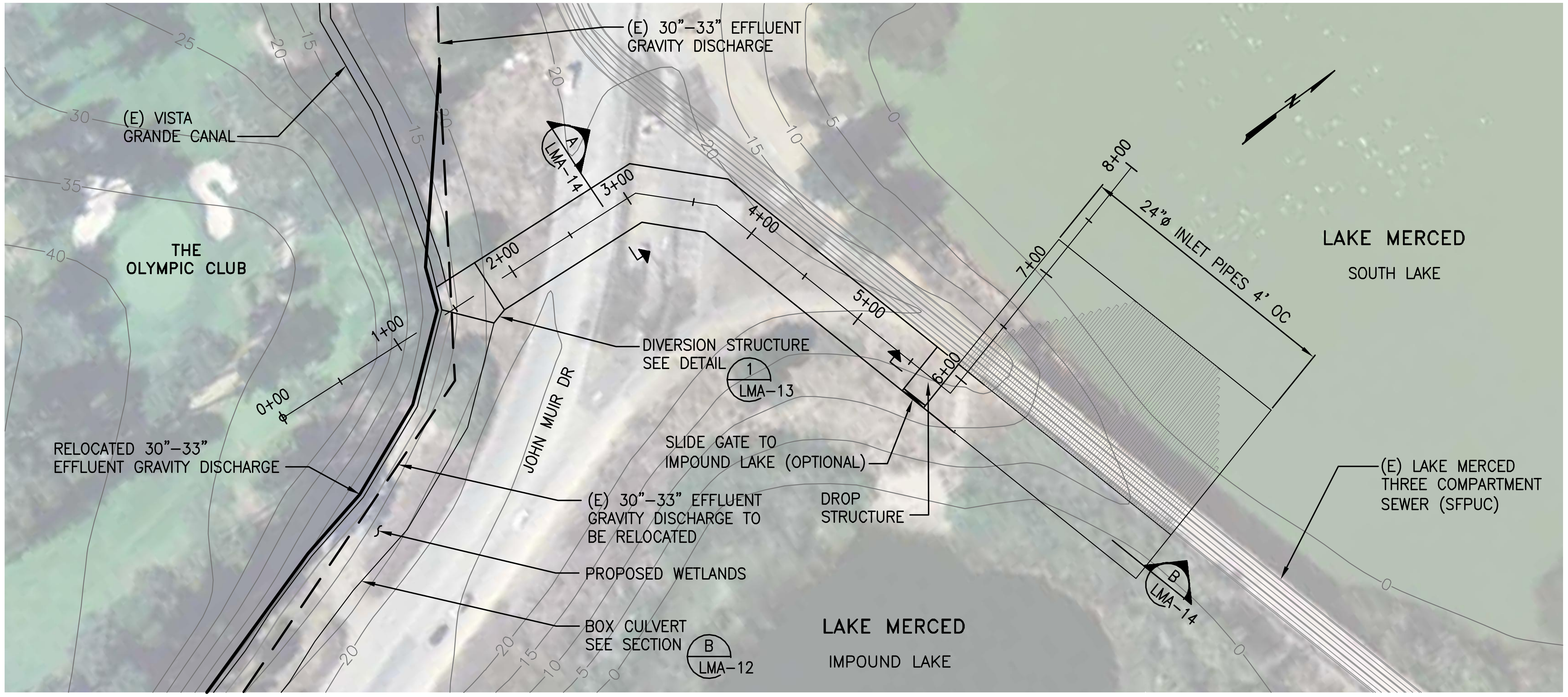
JACOBS ASSOCIATES
Engineers/Consultants

THE CITY OF DALY CITY
CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

VISTA GRANDE DRAINAGE BASIN ALTERNATIVES ANALYSIS

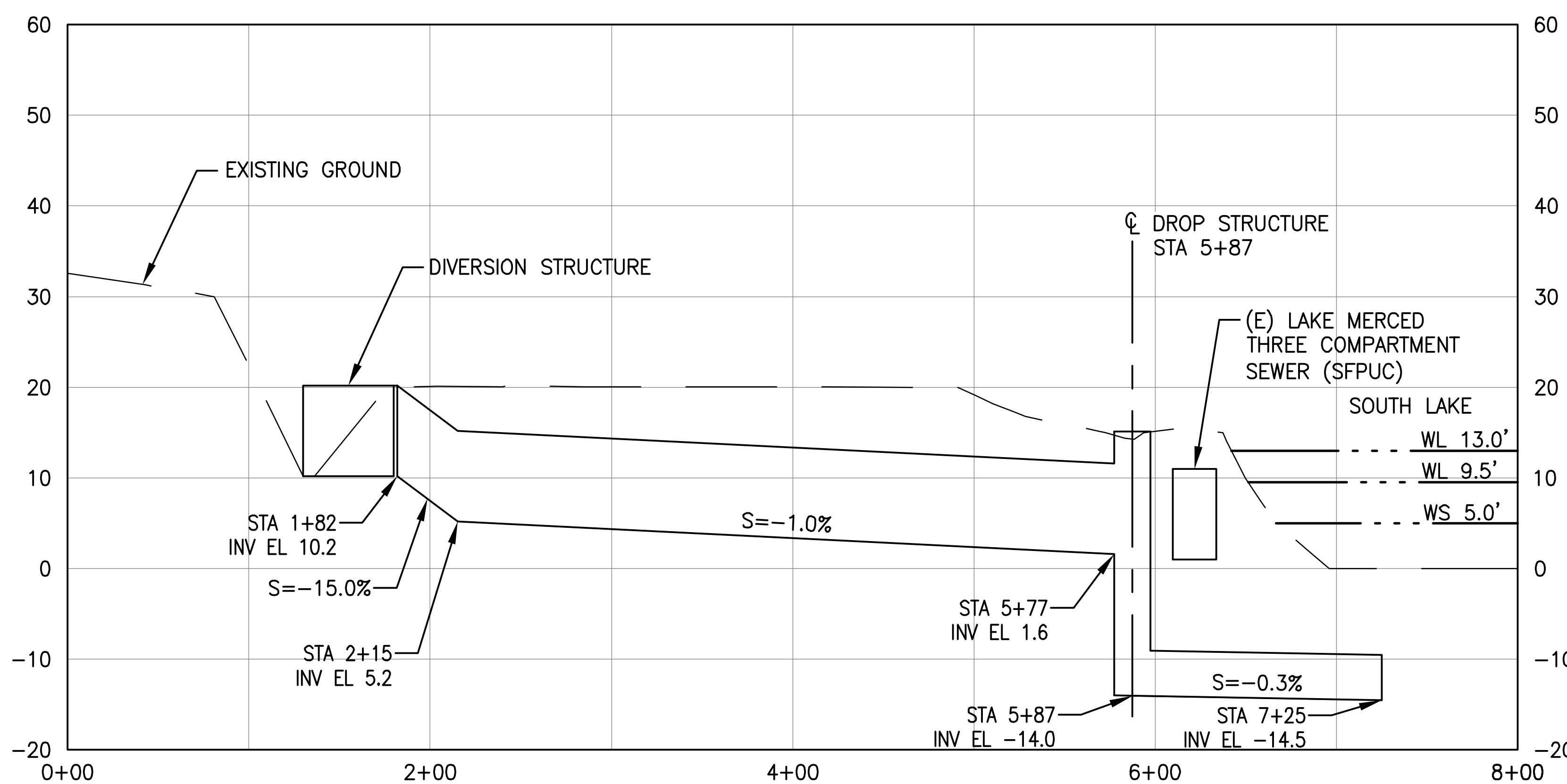
LAKE MERCED ALTERNATIVE GENERAL ARRANGEMENT

DRAWN EGB	DATE 10/2009		
CHECKED RHS	SCALE NOT SHOWN	LMA–01	A REV.
DESIGNED ESH	SF CITY DATUM		



PLAN

SCALE: 1" = 100'



PROFILE

SCALE: HORIZONTAL = 1"= 100'
VERTICAL = 1" = 20'

HORIZONTAL SCALE: 1"=100'
0' 50' 100' 200'
0' 10 20' 40'
VERTICAL SCALE: 1"=20'

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VISTA GRANDE DRAINAGE BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE
STORMWATER DIVERSION
SOUTH LAKE COMBINED DISCHARGE/INLET
PLAN AND PROFILE

DRAWN EGB	DATE 10/2009		
CHECKED RHS	SCALE AS SHOWN	LMA-02	A REV.
DESIGNED ESH	SF CITY DATUM		

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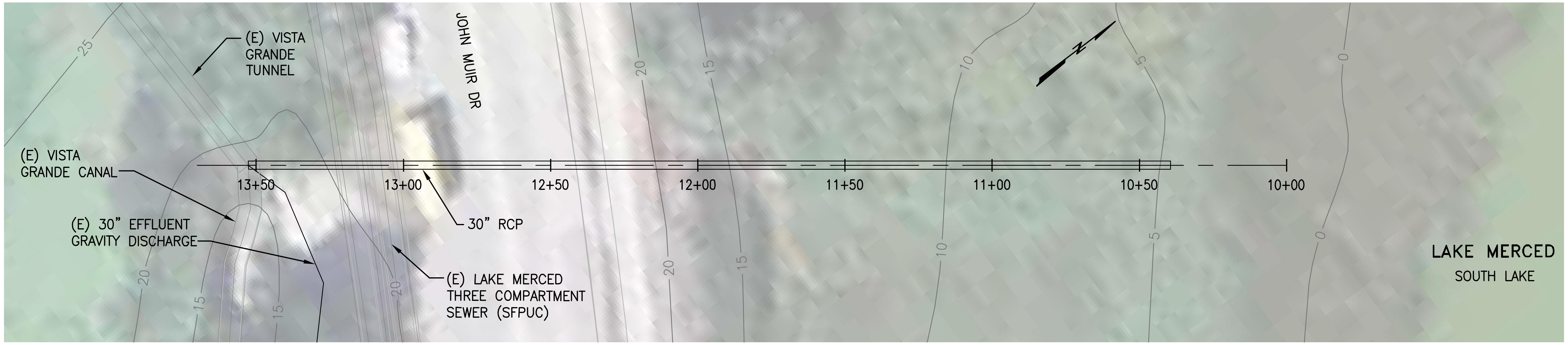
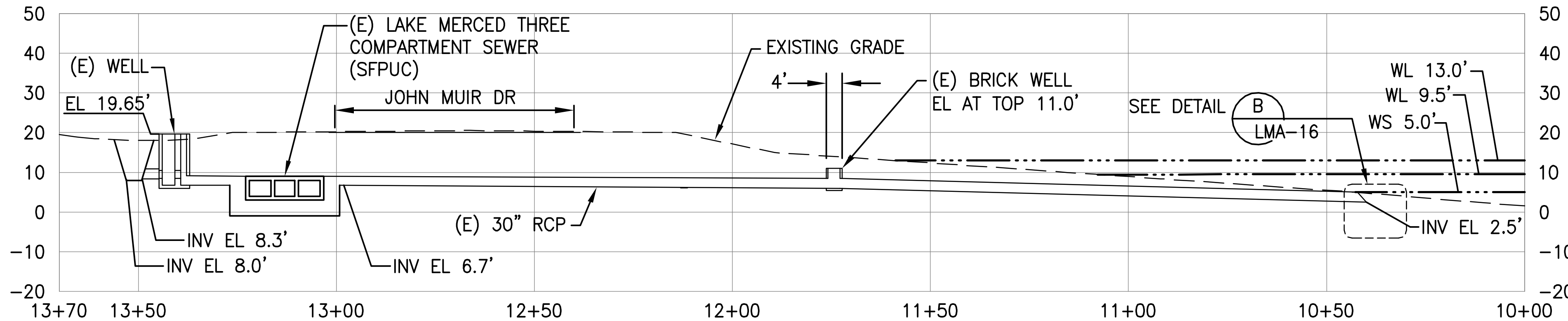


PLAN

SCALE: 1" = 40'



PROFILE

SCALE: 1" = 40'

0' 20' 40' 80'

SCALE: 1"=40'

I:\3957.1 Vista Grande Tunnels (Prime to Daly City)\CAD\Task 8\LMA-03.dwg Oct 22, 2009 - 10:23am

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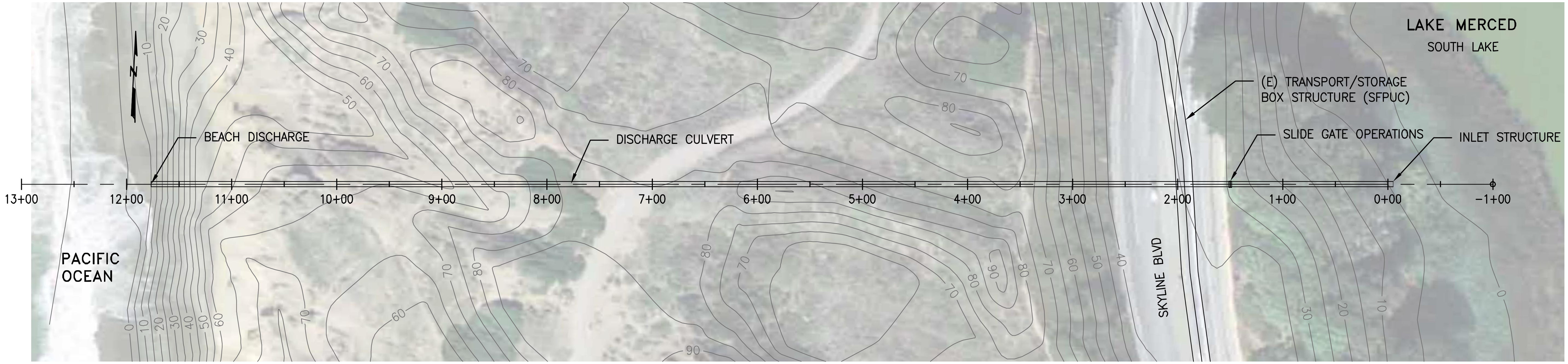
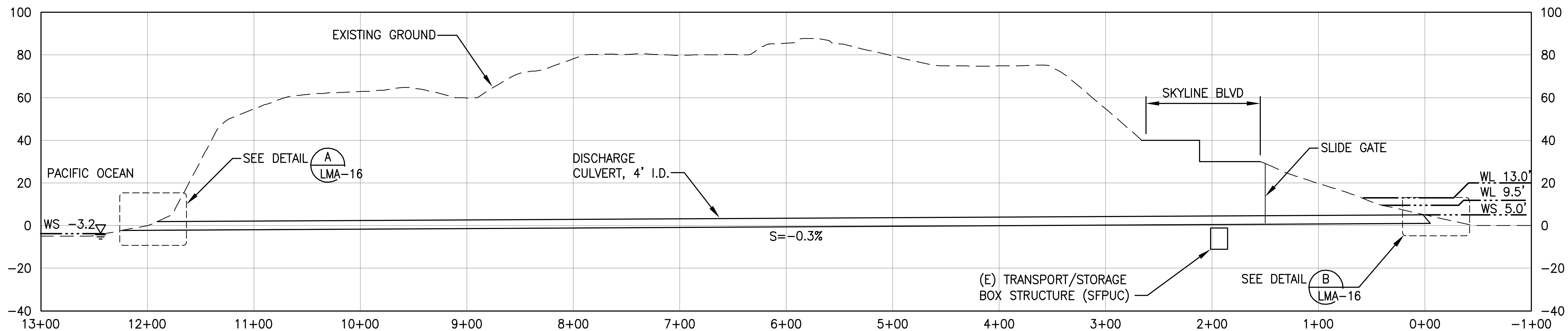
VISTA GRANDE DRAINAGE BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE
SOUTH LAKE OVERFLOW INLET (EXISTING)
PLAN AND PROFILE

DRAWN JAC	DATE 10/2009		
CHECKED ESH	SCALE AS SHOWN		
DESIGNED –	SF CITY DATUM	LMA–03	A REV.



PLAN
SCALE: 1" = 100'



PROFILE
SCALE: HORIZONTAL = 1"= 100'
VERTICAL = 1" = 50'

HORIZONTAL SCALE: 1"=100'
0' 50' 100' 200'
0' 25' 50' 100'
VERTICAL SCALE: 1"=50'

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VISTA GRANDE DRAINAGE
BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE
SOUTH LAKE OVERFLOW INLET (NEW)
PLAN AND PROFILE

DRAWN EGB	DATE 10/2009	
CHECKED RHS	SCALE AS SHOWN	LMA−04
DESIGNED ESH	SF CITY DATUM	REV. A

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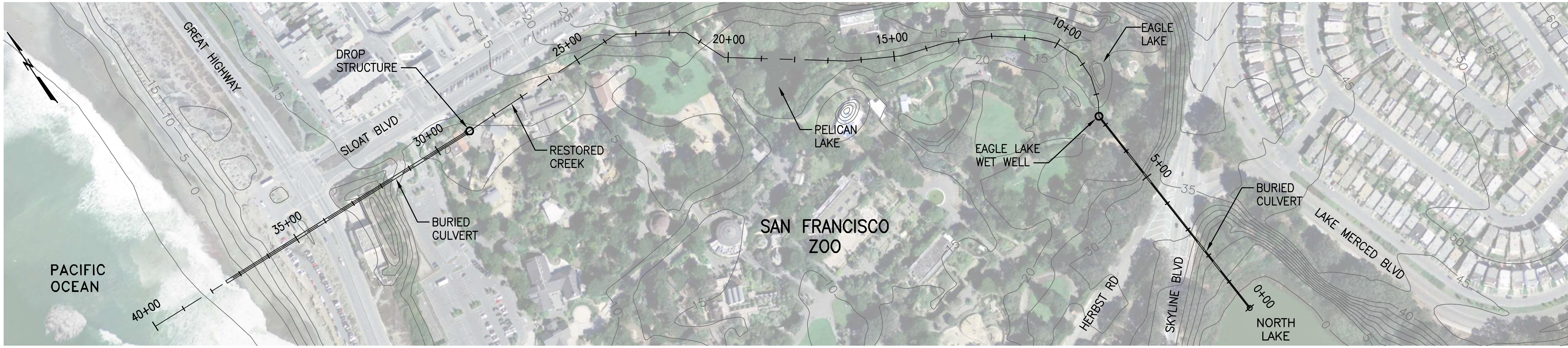
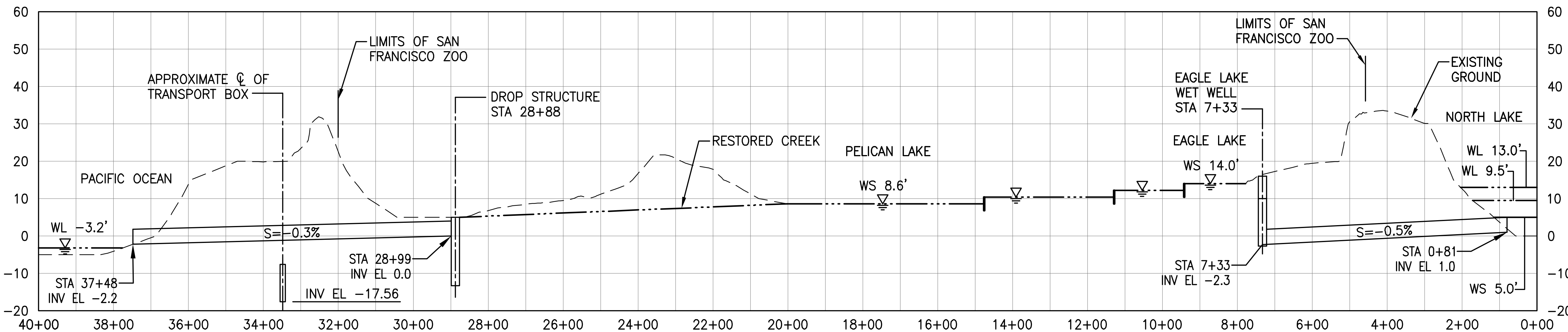


PLAN

SCALE: 1" = 300'



PROFILE

SCALE: HORIZONTAL = 1"= 300'
VERTICAL = 1" = 30'

HORIZONTAL SCALE: 1"=300'
0' 150' 300' 600'
0' 15' 30' 60'
VERTICAL SCALE: 1"=30'

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VISTA GRANDE DRAINAGE
BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE
NORTH LAKE INLET
PLAN AND PROFILE

DRAWN JAC	DATE 10/2009		
CHECKED ESH	SCALE AS SHOWN	LMA-05	A REV.
DESIGNED –	SF CITY DATUM		

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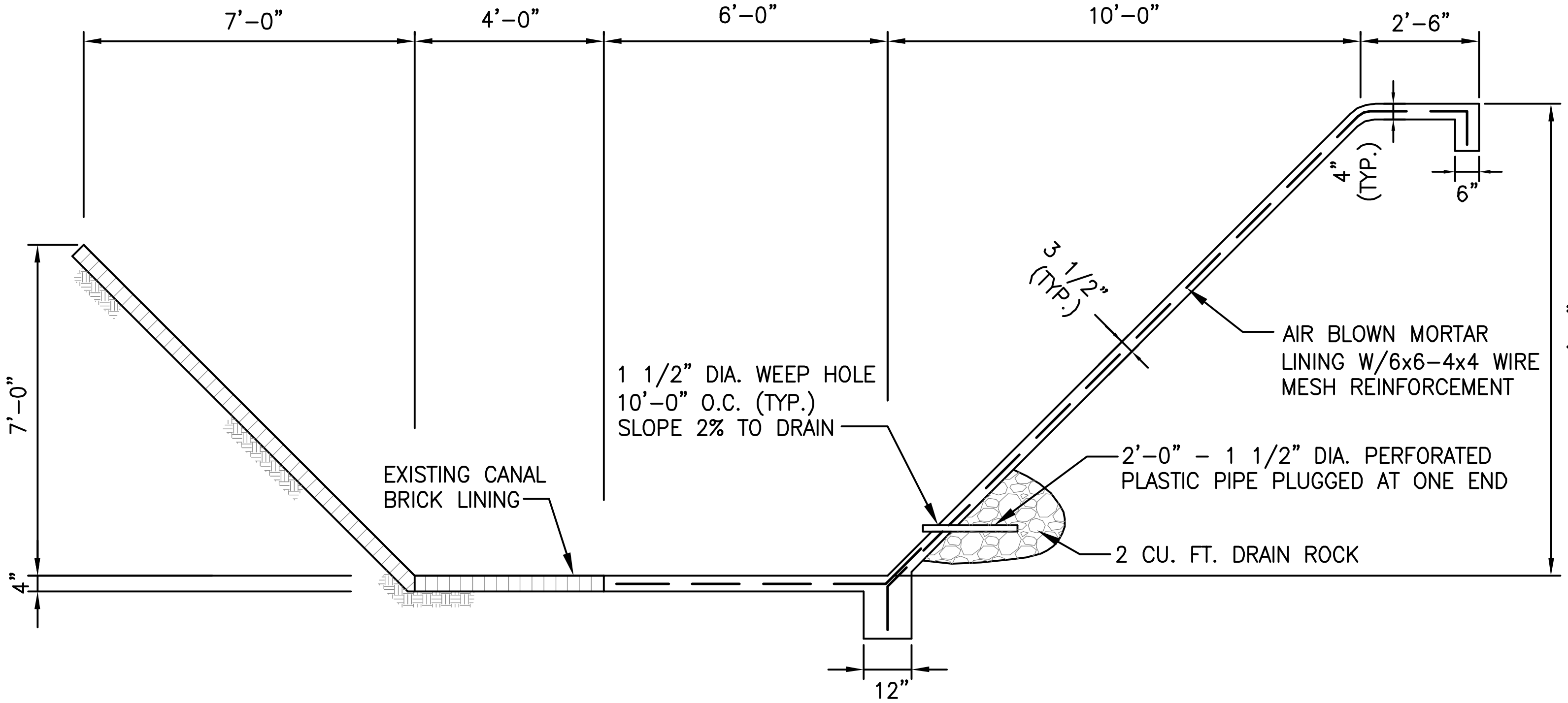
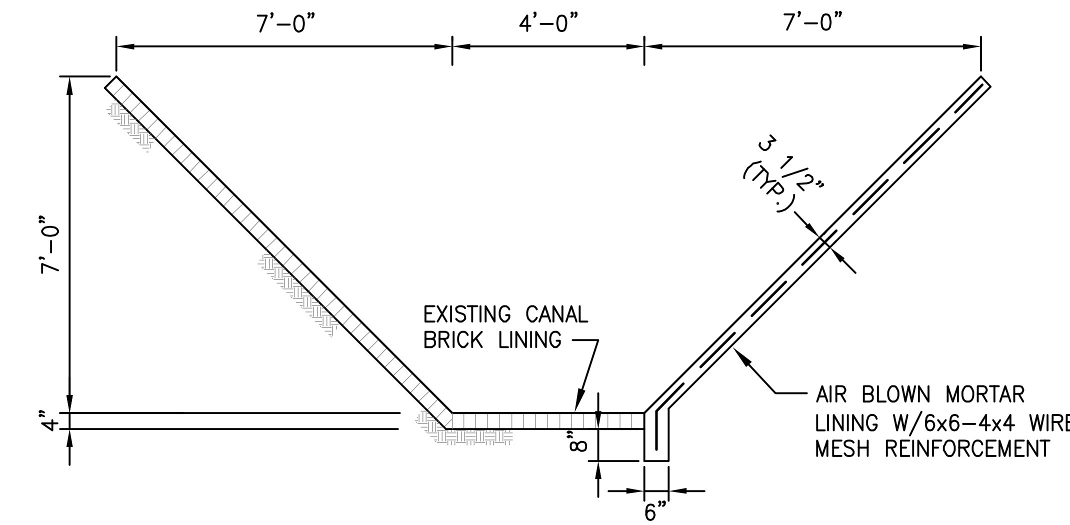
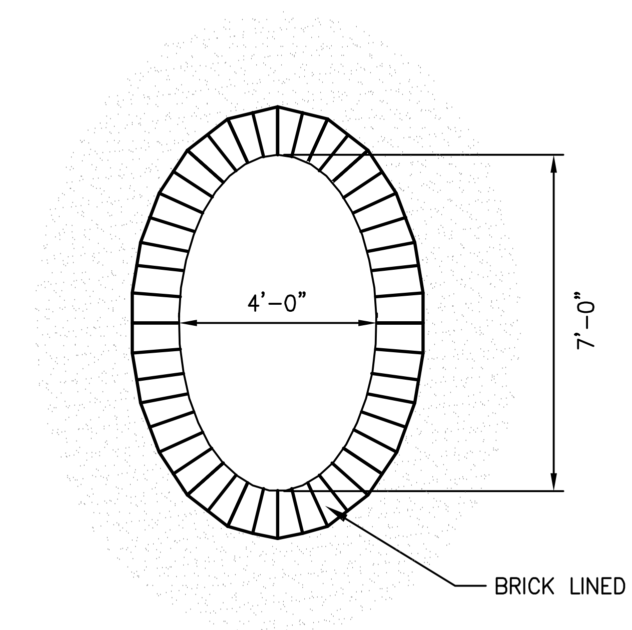


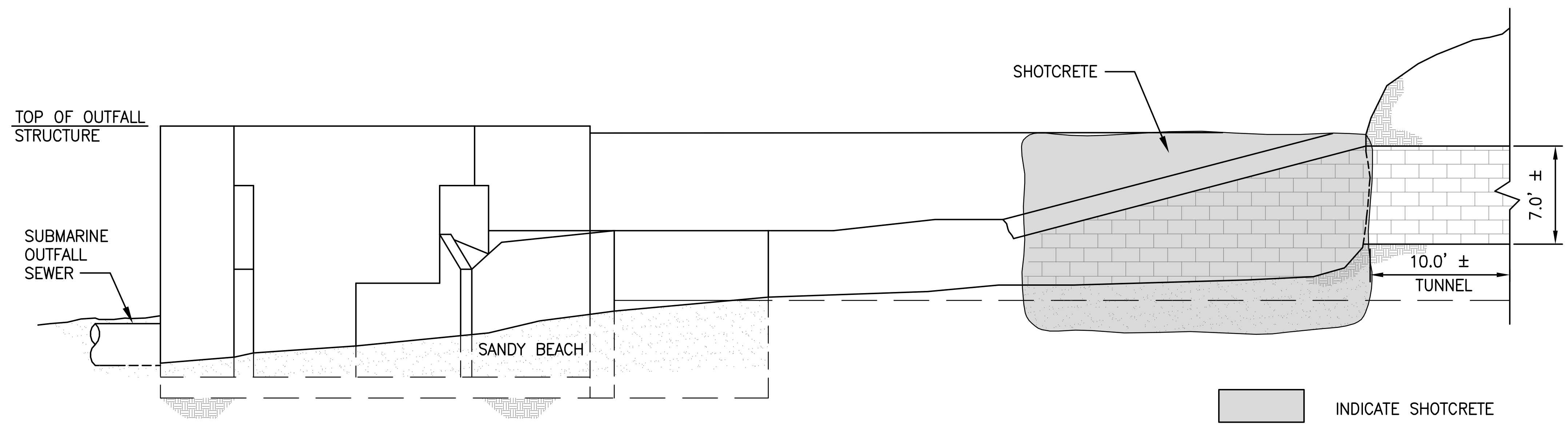
EXISTING TYPICAL WIDE SECTION OF CANAL (A/–)
SCALE: 1"=4'



EXISTING TYPICAL NARROW SECTION OF CANAL (A/–)
SCALE: 1"=4'



EXISTING SECTION OF VISTA GRANDE TUNNEL (C/–)
SCALE: 1/2"=1'



SOUTH ELEVATION OF EXISTING DALY CITY OUTFALL STRUCTURE (B/–)
SCALE: 1"=10'

NOTES:

1. FOR REFERENCE ONLY. REFER TO THE CITY OF DALY CITY–VISTA GRANDE STORM SEWER CANAL WIDENING AND REPAIR AUGUST 1973 DWG. C 73–E–22 FOR FULL DETAILS.

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VISTA GRANDE DRAINAGE
BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE
EXISTING FACILITIES &
AS–BUILT DESIGNS

DRAWN EGB	DATE 10/2009		
CHECKED BY OTHERS	SCALE AS SHOWN	LMA–11	0 REV.
DESIGNED ESH	SF CITY DATUM		

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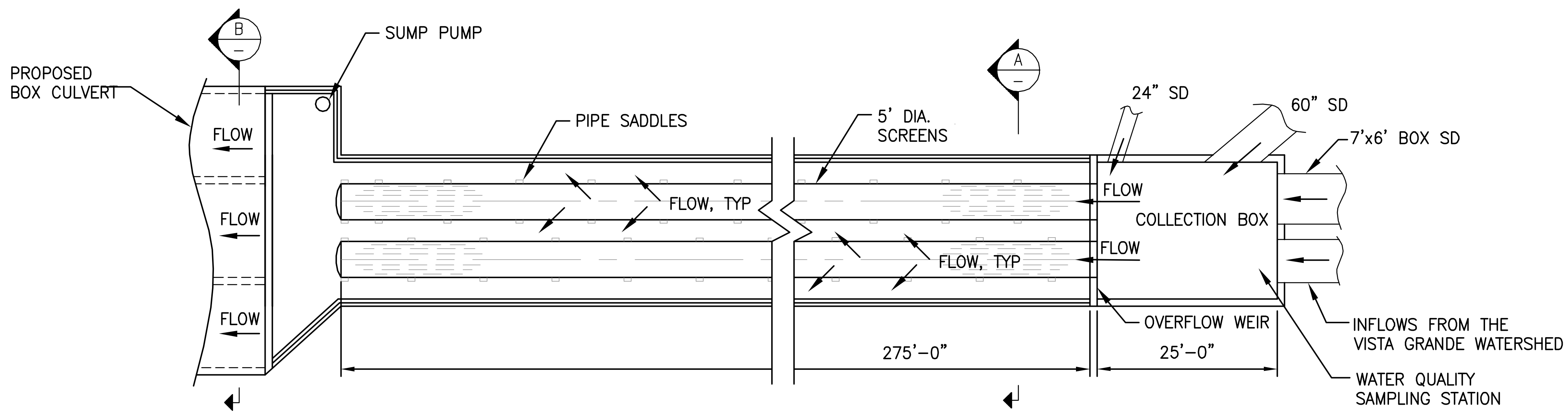
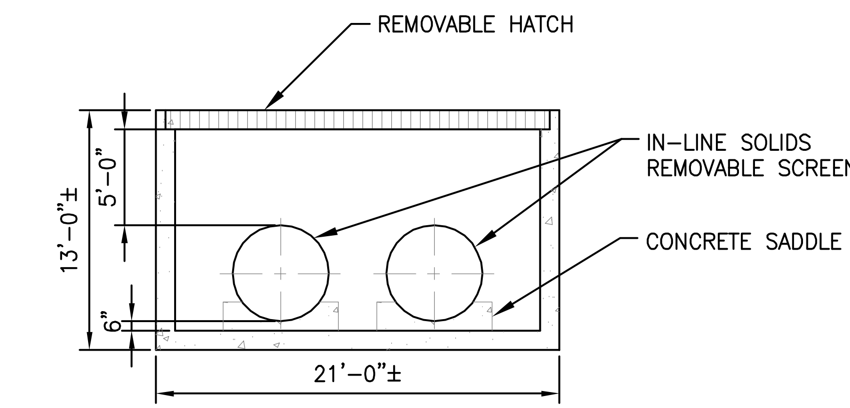


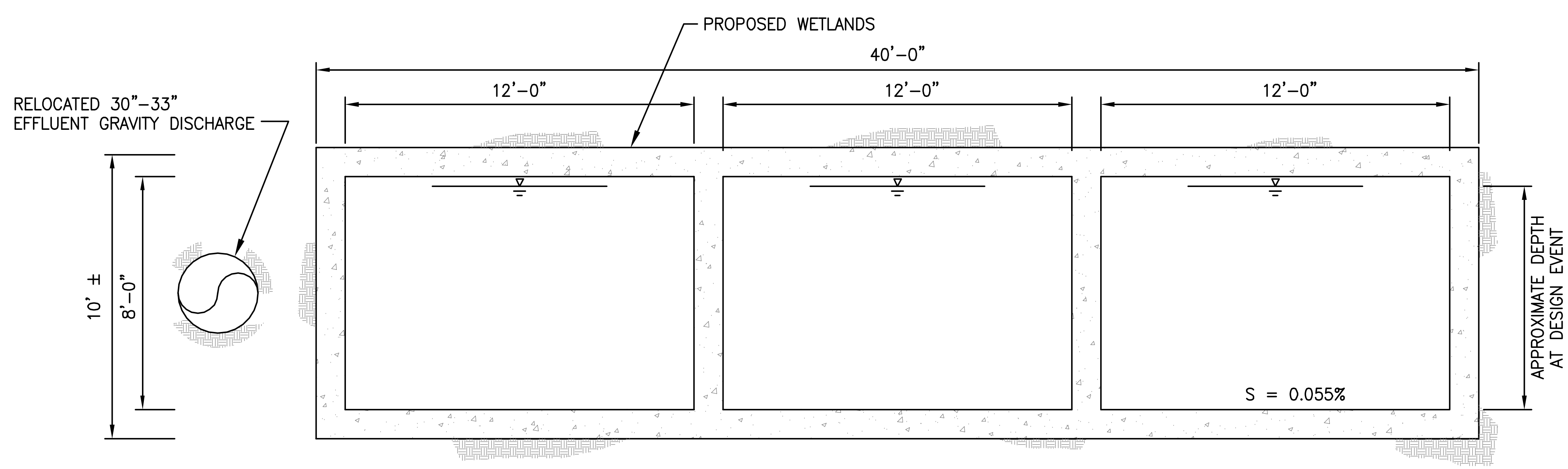
DEBRIS SCREENING DETAIL AT BEGINNING OF CANAL (1)
NOT TO SCALE



SECTION (A)
NOT TO SCALE

NOTE:

1. ACCESS HATCHES NOT SHOWN FOR CLARITY



CANAL BOX CULVERT (B)
NOT TO SCALE

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VISTA GRANDE DRAINAGE
BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE
DEBRIS SCREEN AND CANAL BOX CULVERT
DETAIL AND SECTIONS

DRAWN EGB	DATE 10/2009	
CHECKED –	SCALE NTS	LMA–12
DESIGNED ESH	SF CITY DATUM	A REV.

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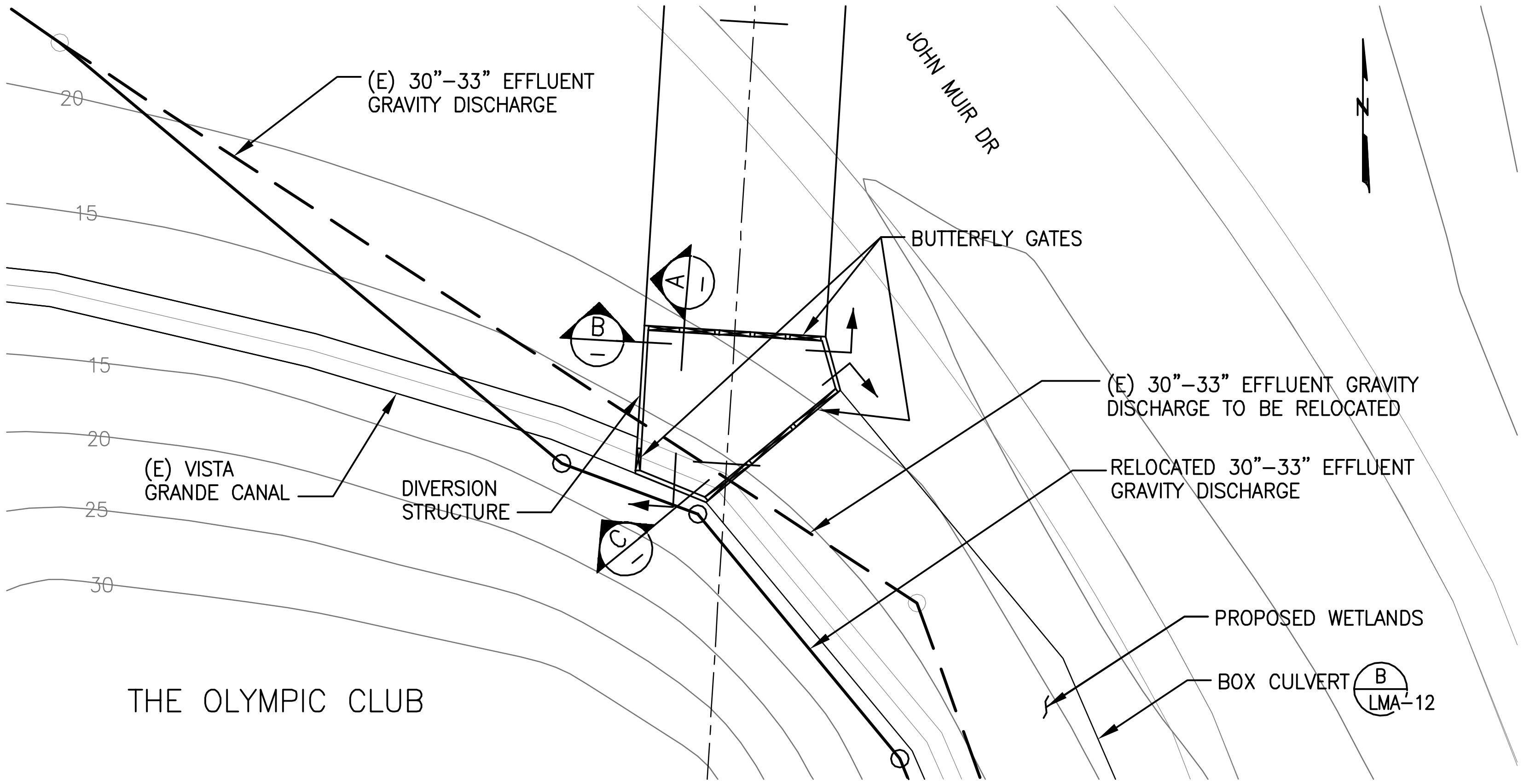
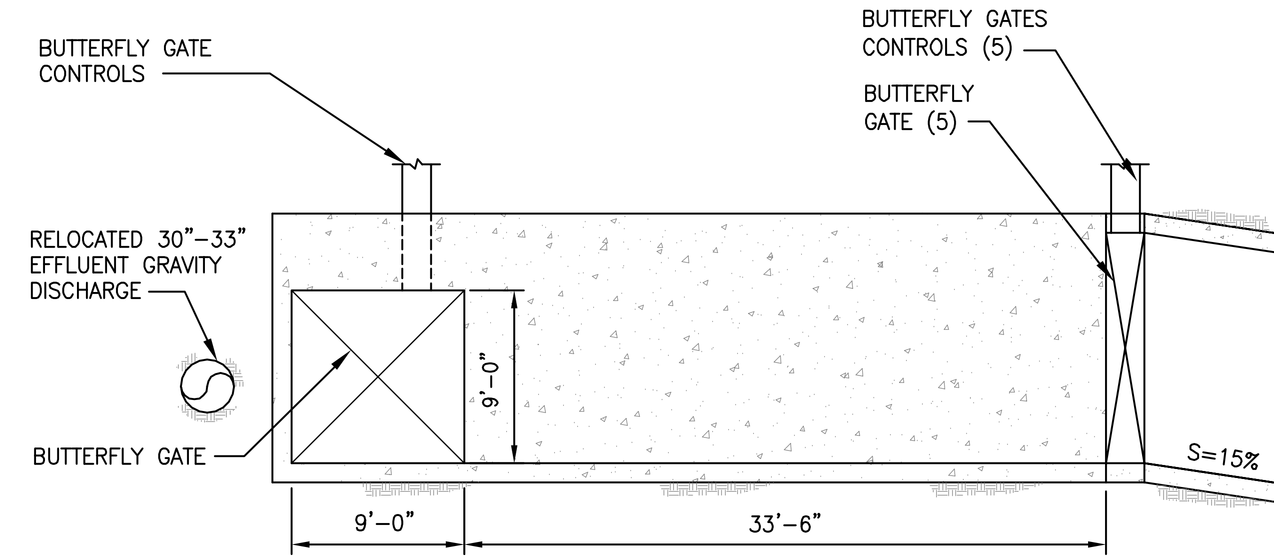
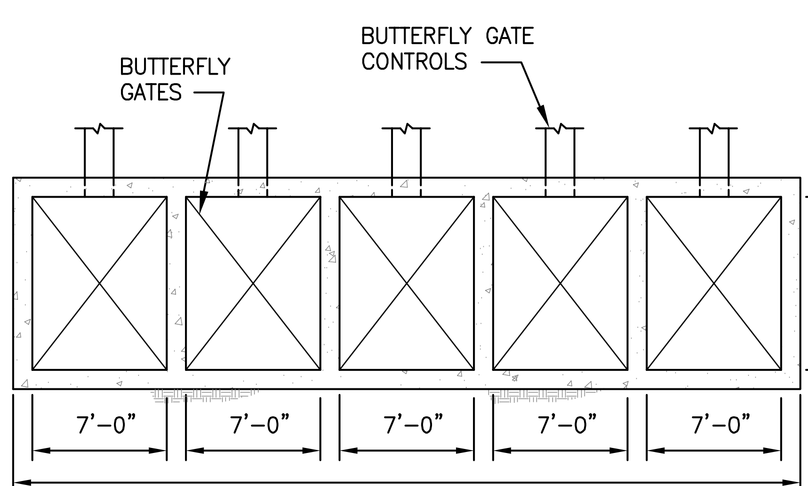
I:\3957.1 Vista Grande Tunnels (Prime to Daly City)\CAD\Task 8\LMA-12.dwg Oct 21, 2009 – 7:09pm



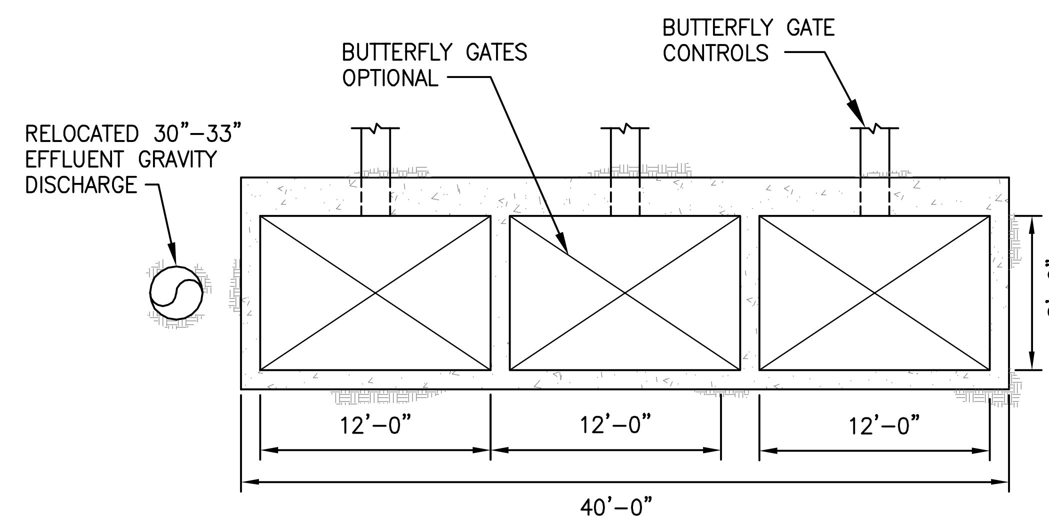
PLAN
SCALE: 1'–20"



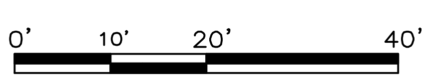
DIVERSION BOX SECTION A
NOT TO SCALE



DIVERSION BOX SECTION B
NOT TO SCALE



DIVERSION BOX SECTION C
NOT TO SCALE



GRAPHIC SCALE
1"=20'

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VISTA GRANDE DRAINAGE BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE DIVERSION STRUCTURE PLAN AND SECTIONS

DRAWN EGB	DATE 10/2009		
CHECKED RHS	SCALE AS SHOWN	LMA–13	A REV.
DESIGNED ESH	SF CITY DATUM		

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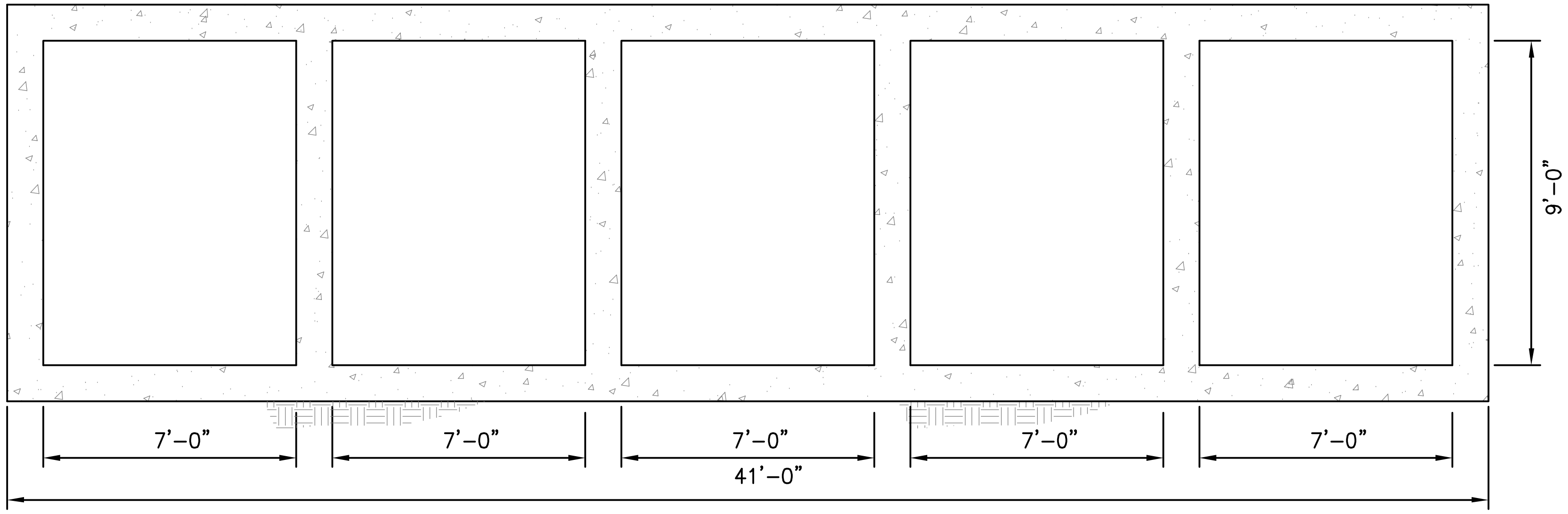
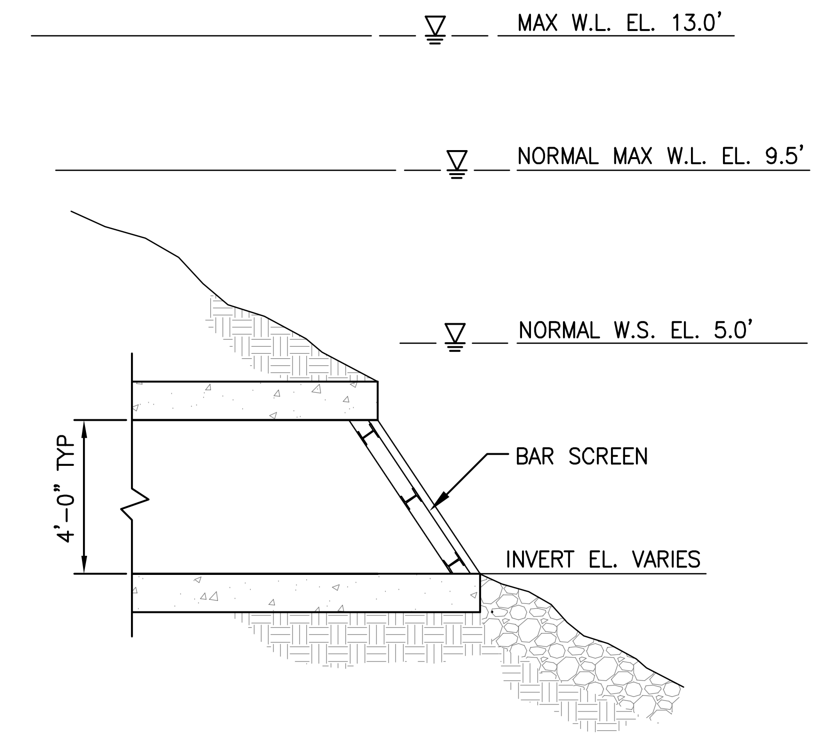
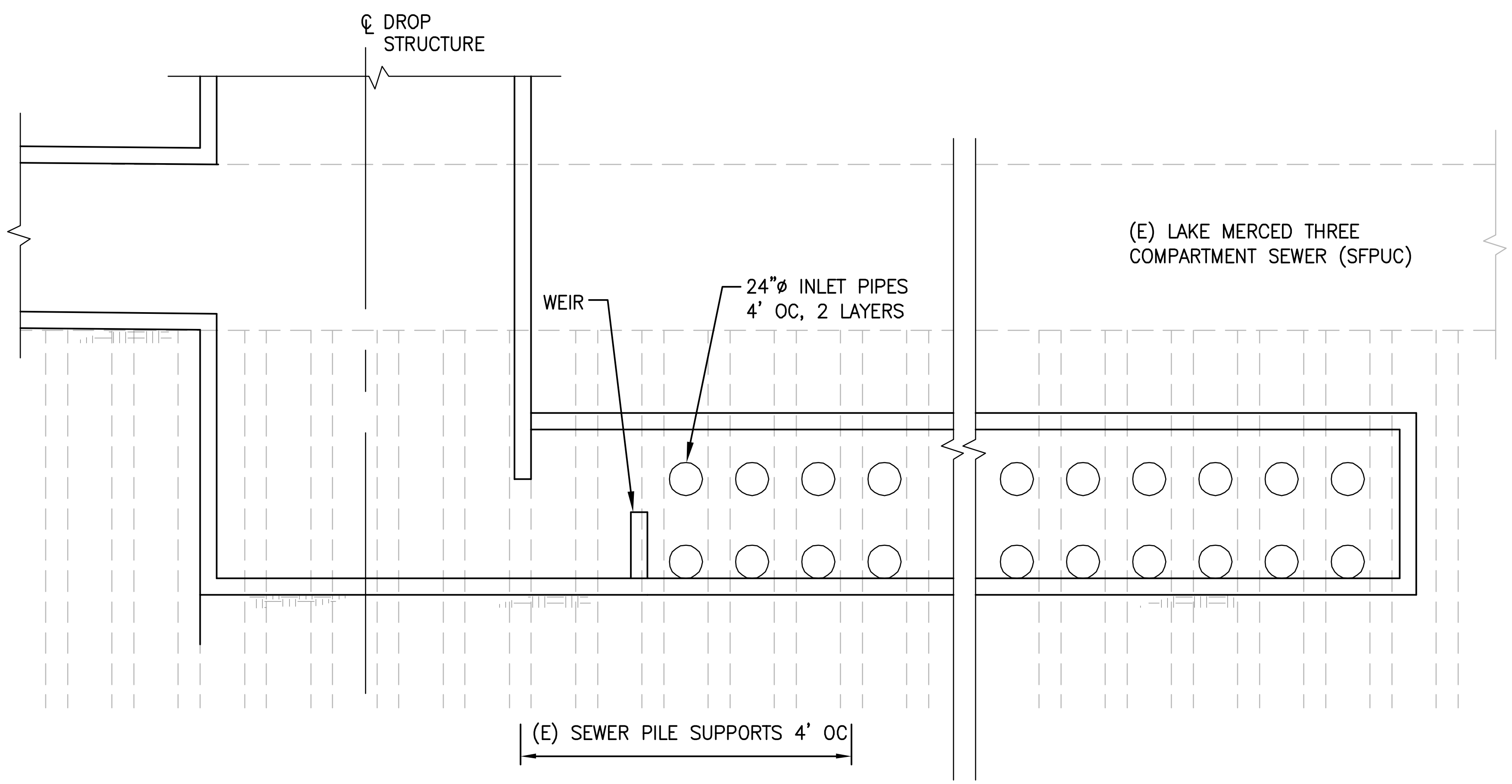


JOHN MUIR DRIVE BOX CULVERT (A/–)
NOT TO SCALE



DISCHARGE/INLET STRUCTURE (1/–)
NOT TO SCALE



INLET BOX CULVERT (B/–)
NOT TO SCALE

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VISTA GRANDE DRAINAGE
BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE
JOHN MUIR DRIVE BOX CULVERT
DETAILS AND SECTION

DRAWN EGB	DATE 10/2009		
CHECKED ESH	SCALE AS SHOWN	LMA-14	A REV.
DESIGNED ESH	SF CITY DATUM		

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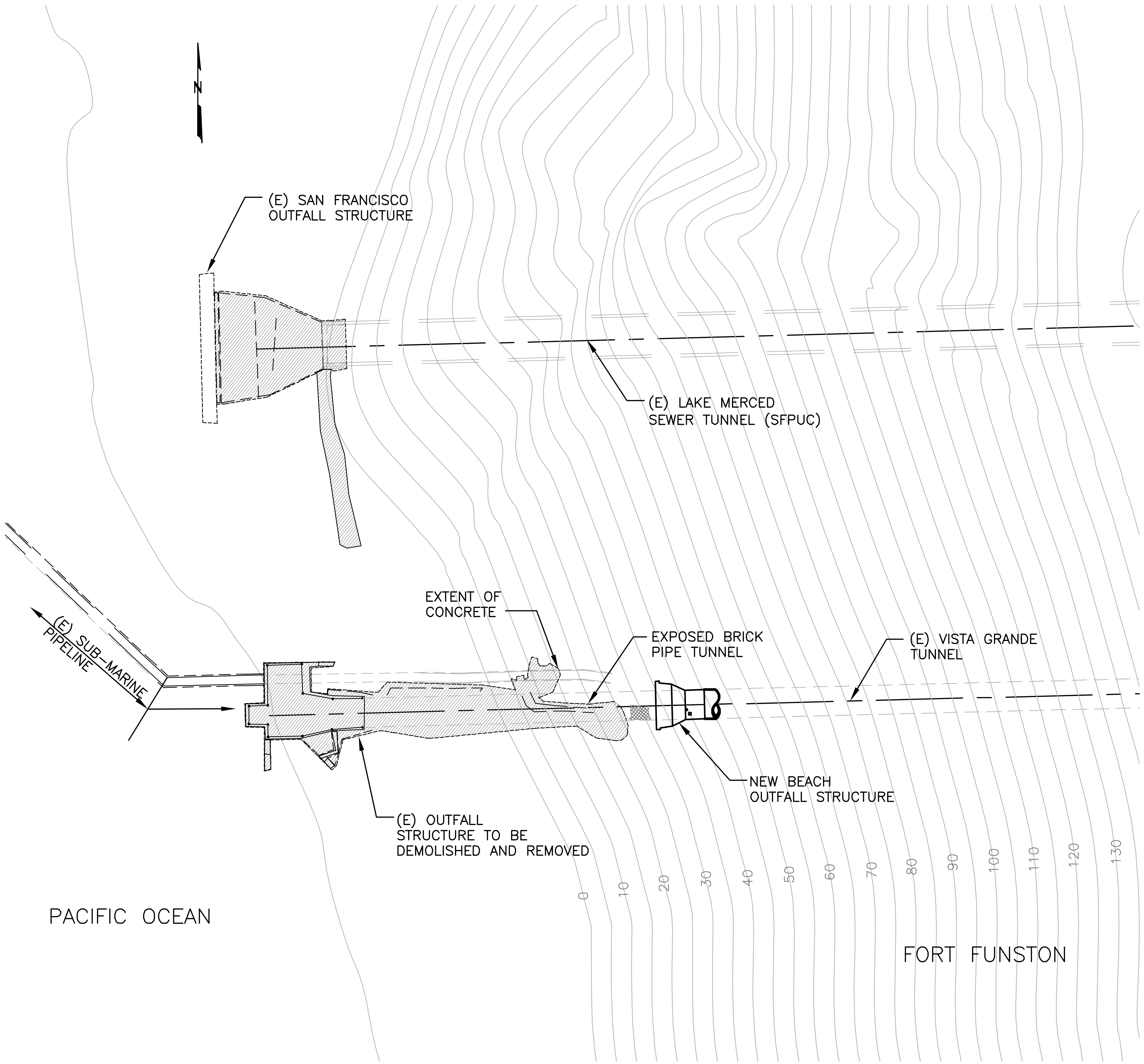


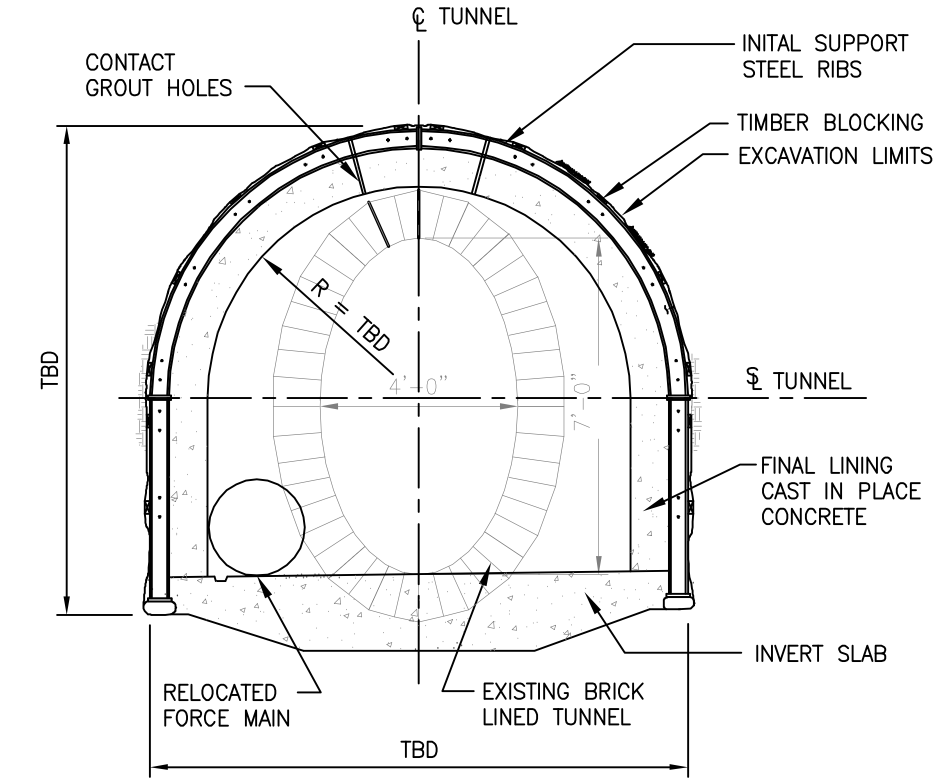
0' 150' 300' 600'

0' 15' 30' 60'

GRAPHIC SCALE: 1"=30'

PLAN VIEW

SCALE: 1" = 30'-0"



ELEVATION

SCALE: 1" = 4'-0"

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VISTA GRANDE DRAINAGE BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE BEACH OUTFALL STRUCTURE PLAN AND RELINED TUNNEL SECTION

DRAWN JAC	DATE 10/2009		
CHECKED –	SCALE SHOWN		
DESIGNED ESH	SF CITY DATUM	LMA–15	A REV.

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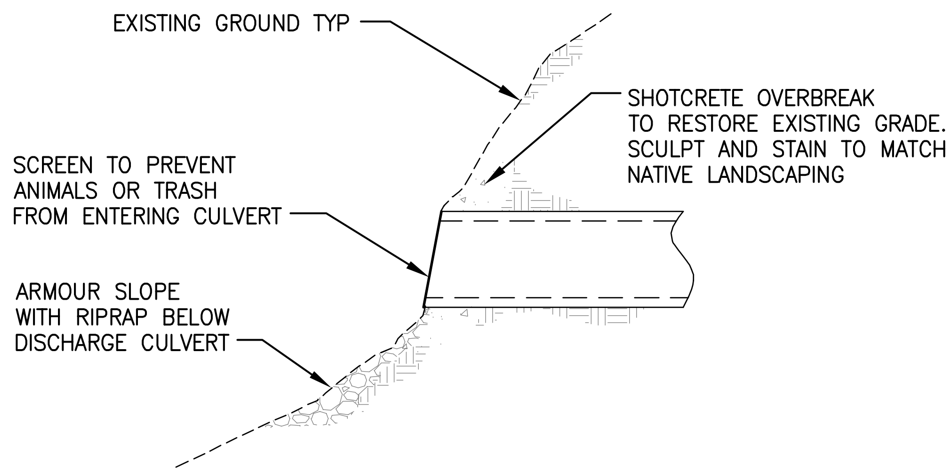
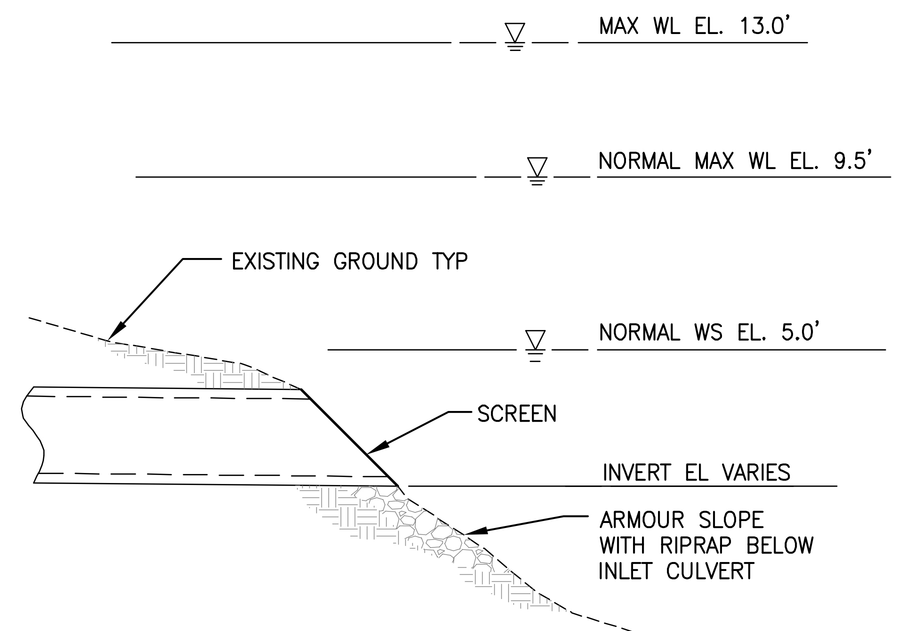


BEACH DISCHARGE (A / –)
NOT TO SCALE



LAKE INLET (B / –)
NOT TO SCALE

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VISTA GRANDE DRAINAGE
BASIN ALTERNATIVES ANALYSIS

LAKE MERCED ALTERNATIVE
BEACH DISCHARGE AND LAKE INLET
DETAILS

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DRAWN EGB	DATE 10/2009		
CHECKED –	SCALE AS SHOWN	LMA–16	A REV.
DESIGNED ESH	SF CITY DATUM		

I:\3957.1 Vista Grande Tunnels (Prime to Daly City)\CAD\Task 8\LMA-16.dwg Oct 21, 2009 – 7:42pm

Appendix B—Budget-Level Cost Estimate

Comparative Conceptual Construction Cost Estimate

#	Cost Elements			South Lake Combined Discharge/Inlet Option	South Lake Overflow Inlet (Existing) Option	South Lake Overflow Inlet (New) Option
1	Intercepts, ≤ 36" dia		EA	-	-	-
2	Intercepts, > 36" dia		EA	1	1	1
3	(N) culvert, trenchless, ≤48" dia		LF	-	160	1,200
4	Lakeside Cofferdam for tunnel drive		EA		1	1
5	(N) culvert, trenched, 72" dia		LF	1,000	1,000	1,000
6	(R) culvert, relined 30" brick sewer		LF		150	-
7	Detention Capacity		Gal	-	-	-
8	Pump system & forced main		EA	-	-	-
9	(N) Collection Structures		EA	1	1	1
10	(N) Debris Screen box culvert w/ access hatch		LF	275	275	275
11	(N) Auto SW Sampling/Analysis Recorder		EA	1	1	1
12	(N) Debris Screens		LF	275	275	275
13	(N) New 3x box culvert		LF	1,400	1,400	1,400
14	(N) Diversion structure		CY	500	500	500
15	(N) Diversion slide gates, installed		EA	9	9	9
16	(N) New 4x box culvert		LF	750	750	750
17	(N) Drop shaft (20' x 20' I-dim)		VF	25	25	25
18	(N) Lake Discharge Difuser		LF	200	200	200
19	(N) Fish exclusion structure		SF	2,000	2,200	2,200
20	Header Box Structures (8' x 10') w/ slide gate		VF	-	15	35
21	Wet well and lift pump		VF	1	1	
22	Debris Screen @ (E) Tunnel Inlet		EA	1	1	1
23	Canal Improvements		LF	2,600	2,600	2,600
24	Rehab Tunnel & Provide Beach Access, 8' ID		LF	3,200	3,200	3,200
25	Drill & encase (N) Forced Main drop shaft		Allow	1	1	1
26	Demo & Rem (E) Outfall Structure		Allow	1	1	1
27	New Outfall Structure, SF		SF	80	80	80
28	Intercepts, < 36" dia	50,000	$/ EA	-	-	-
29	Intercepts, > 36" dia	100,000	$/ EA	100,000	100,000	100,000
30	(N) culvert, trenchless, <48" dia	960	$/ LF	-	153,600	1,152,000
31	Lakeside Cofferdam for microtunnel drive	500,000	$/ EA	-	500,000	500,000
32	Impound/South Lake Cofferdam	9,000	$/ LF	1,800,000	9,000,000	9,000,000
33	(N) culvert, trenched, 72" dia	220	$/ LF	220,242	220,242	220,242
34	(R) culvert, relined 30" brick sewer	750	$/ LF	-	112,500	-
35	Detention Capacity	2.0	$/ Gal	-	-	-
36	Pump system & forced main	1,500,000	$/ EA	-	-	-
37	(N) Collection Structures	200,000	$/ EA	200,000	200,000	200,000
38	(N) Debris Screen box culvert w/ access hatch	2,500	$/ LF	687,500	687,500	687,500
39	(N) Auto SW Sampling/Analysis Recorder	100,000	$/ EA	100,000	100,000	100,000
40	(N) Debris Screens	3,000	$/ LF	825,000	825,000	825,000
41	(N) New 3x box culvert	5,000	$/ LF	7,000,000	7,000,000	7,000,000
42	(N) Diversion structure	500	$/ CY	250,000	250,000	250,000
43	(N) Diversion slide gates, installed	500,000	$/ EA	4,500,000	4,500,000	4,500,000
44	(N) New 4x box culvert	6,666	$/ LF	4,999,500	4,999,500	4,999,500
45	(N) Drop shaft (20' x 20' I-dim)	2,045	$/ VF	51,136	51,136	51,136
46	(N) Lake Discharge Difuser	2,600	$/ LF	520,000	520,000	520,000
47	(N) Fish exclusion structure	100	$/ SF	200,000	220,000	220,000
48	Header Box Structures (8' x 10') w/ slide gate	1,750	$/ VF	-	76,250	111,250
49	Wet well and lift pump	1,000	$/ VF			-
50	Debris Screen @ (E) Tunnel Inlet	200,000	$/ EA	200,000	200,000	200,000
51	Canal Improvements	500	$/ LF	1,300,000	1,300,000	1,300,000
52	Rehab Tunnel & Provide Beach Access, 8' ID	1,900	$/ LF	6,080,000	6,080,000	6,080,000
53	Drill & encase (N) Forced Main drop shaft	1,600,000	Allow	1,600,000	1,600,000	1,600,000
54	Demo & Rem (E) Outfall Structure	5,000,000	Allow	5,000,000	5,000,000	5,000,000
55	New Outfall Structure, SF	10,000	$/ SF	800,000	800,000	800,000
	Relative Direct Construction Cost			$ 36,433,379	$ 44,495,729	$ 45,416,629
	Mobilization/ Demobilization		10%	3,643,338	4,449,573	4,541,663
	Contractor's Overhead & Profit		50%	18,216,689	22,247,864	22,708,314
	Design & Permitting Allowance		10%	5,829,341	7,119,317	7,266,661
	Construction Mgmt & QA/QC Allowance		10%	5,829,341	7,119,317	7,266,661
	Mitigation Allowance		10%	5,829,341	7,119,317	7,266,661
	Subtotal			$ 75,781,428	$ 92,551,116	$ 94,466,588
	Escalation (~5 years)	%/yr	3%	$ 12,070,017	$ 14,740,993	$ 15,046,078
	Recommended Contingency		50%	37,890,714	46,275,558	47,233,294
	Relative Cost			$ 125,742,159	$ 153,567,667	$ 156,745,960
	Rank (Least Relative Cost = 1)			1	2	3

Appendix C—Evaluation Methodology

Project Alternatives Evaluation

			South Lake Combined Discharge/Inlet Option	South Lake Overflow Inlet (Existing) Option	South Lake Overflow Inlet (New) Option
Deliver Public Benefits					
	Community benefits	Satisfaction Rating: 1 (satisfied) to 5 (dissatisfied)	1	1	1
	Public inconvenience (temporary, interim, & permanent)		1	2	3
	Water Re-Use Opportunities		1	1	1
	Flood protection	Satisfaction Rating: 1 (completely) to 5 (minimal)	3	1	1
	Reduce potential for overflow into Lake Merced		3	1	1
	Debris screening		1	1	1
	Wetlands enhancement	Satisfaction Rating: 1 (complements) to 3 (supports) to 5 (no support)	3	3	3
	Groundwater recharge potential				
See Sensitivity Matrix below	**Score (sum of ratings)**		13	10	11
Operability	Facility operations	Operability Rating: 1 (convenient) to 5 (inconvenient)	1	2	3
	Stormwater screening effectiveness	Operability Rating: 1 (completely) to 5 (minimal)	2	2	2
	Stormwater screening maintainability	Operability Rating: 1 (convenient) to 5 (inconvenient)	1	2	2.5
See Sensitivity Matrix below	**Score (sum of ratings)**		**4**	**6**	**7.5**
Environmental Compliance	Impacts on the environment	Environmental Impact Rating: 1 (minimal) to 5 (significant)	3	3.5	4
	Effects on sensitive species		3	3.5	4
	NEPA/CEQA requirements	Permitting Rating: 1 (simple and well understood) to 5 (complex and time consuming)	3	3	3.5
	Water Quality Permit requirements (RWQCB)		5	5	5
See Sensitivity Matrix below	**Score (sum of ratings)**		**14**	**15**	**16.5**
Minimize Land Acquisition Costs	Land acquisition and right-of-way requirements	Land Use Rating: 1 (simple and well understood) to 5 (complex and time consuming)	1	1	3
	Temporary easement requirements		1	1	3
	Utility interference issues and relocation requirements		2	1	3
See Sensitivity Matrix below	**Score (sum of ratings)**		**4**	**3**	**9**
Maximize Constructability	Construction working space and access	Constructability Rating: 1 (simple) to 5 (complex)	1	2	2.5
	Spoils management		2	2	4
	Constructability		3	3	3
	Construction Duration		3	3	3
	Pipeline connections				
	Anticipated Ground Conditions				
See Sensitivity Matrix below	**Score (sum of ratings)**		**9**	**10**	**12.5**
Minimze Lifecycle Costs	Relative construction costs from relative cost sheet	Cost Ranking: 1 (lowest cost-risk) to n (highest cost-risk)	1	2	3
	Relative O&M costs-- debris removal & disposal, water treatment, pump maintenance & pumping costs	O&M Rating: 1 (low cost-risk) to 5 (high cost-risk)	2	2	2
See Sensitivity Matrix below	**Score (sum of ratings)**		**3**	**4**	**5**
	Overall Score (x10)		*See Sensitivity Matrix below*	*See Sensitivity Matrix below*	*See Sensitivity Matrix below*

Weighting Sensitivity Matrix

	Deliver Public Benefits	Operability	Environmental Compliance	Minimize Land Acquisition Costs	Maximize Constructability	Minimze Lifecycle Costs	Description				
A	100%	100%	100%	100%	100%	100%	Equal weight distribution	**Weighted Overall Score**	470	480	615
								Rank	**1**	**2**	**3**
B	15%	5%	10%	15%	5%	50%	65% cost + 35% non-cost	**Weighted Overall Score**	61	63	82
								Rank	**1**	**2**	**3**
C	33%	5%	10%	15%	5%	33%	48% cost + 52% non-cost	**Weighted Overall Score**	79	73	92
								Rank	**2**	**1**	**3**
D	33%	10%	10%	17%	5%	25%	35% cost + 65% non-cost	**Weighted Overall Score**	80	74	94
								Rank	**2**	**1**	**3**
E	0%	0%	0%	0%	0%	0%		**Weighted Overall Score**	0	0	0
								Rank	**1**	**1**	**1**
									7.0	7.0	13.0