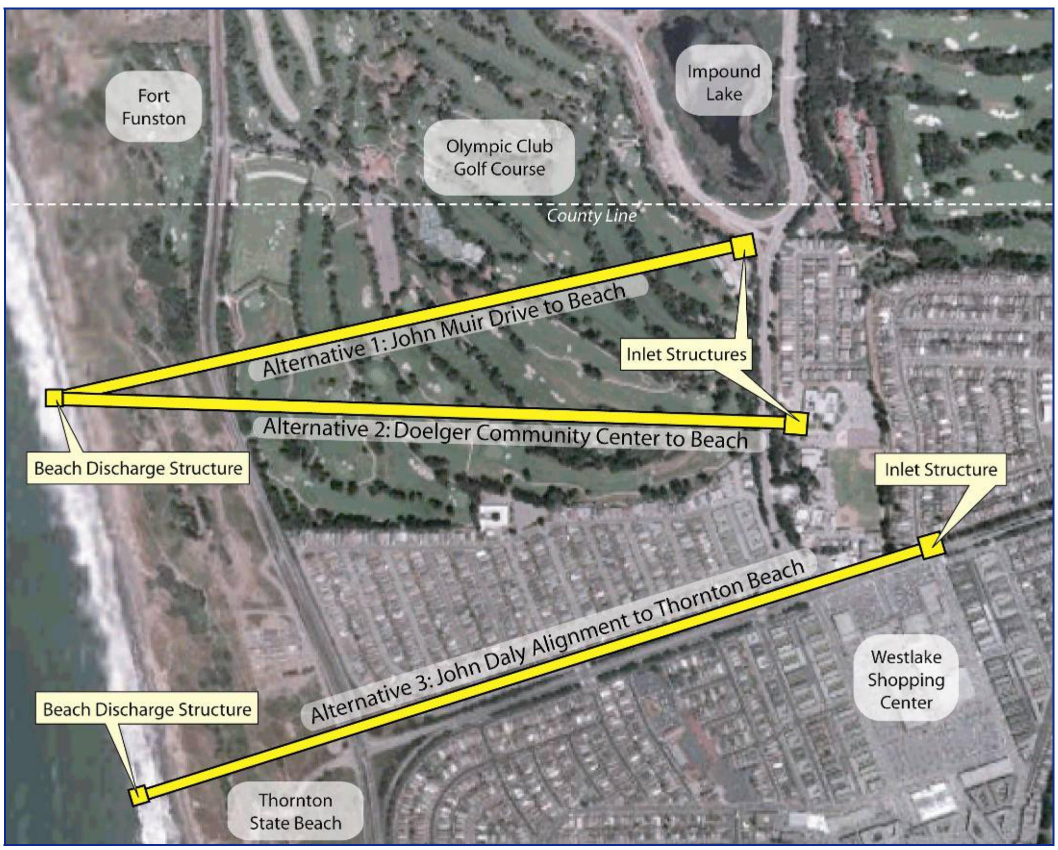
5.2 Tunnel South of County Line

5.2.1 Description & Location

The Tunnel South of County Line is the long-term, downstream flood protection component of the preliminary program recommendations of the Vista Grande Watershed Study. The tunnel would convey stormwater from Daly City to a beach discharge structure south of the San Mateo/San Francisco County line. The following section presents a preliminary analysis of potential options for the layout and design of the Tunnel South of County Line. It also presents an overview of the concepts that will need to be considered if the Tunnel South of County Line is selected for implementation. Further investigation and detailed design would be necessary prior to project implementation.

Three alternatives were developed for the tunnel alignment as part of this preliminary analysis. Figure 5-2 shows the locations of each alternative. These three alignments were included as examples to evaluate conceptual feasibility and general planning level cost ranges of the Tunnel South of County Line. A detailed alternatives analysis will need to be conducted in order to select the most cost effective, beneficial alignment. This alternatives analysis will evaluate a number of different alignments, including, but not limited to, the three alignments evaluated as part of this study. Since all options will require further investigation, a preferred alternative has not yet been selected.

Figure 5-2 Tunnel South of County Line Alternative Map



5.2.2 Objectives

The primary objective of the Tunnel South of County Line is to eliminate flooding in the lower Vista Grande watershed. As previously indicated, the existing Vista Grande canal and tunnel do not have adequate capacity to convey stormwater flows for design storm conditions. This insufficient capacity is responsible for recent overflows and flooding across John Muir Drive into Lake Merced. The new tunnel would circumvent the existing Vista Grande canal and tunnel by taking flow from the existing storm drain system before it is released into the canal, thereby providing flood protection and ensuring public safety in the Lake Merced area. Additionally, the elimination of downstream flooding would reduce Lake Merced bank erosion and protect the water quality of lake.

The long-term, upstream component to the watershed study is to improve the Daly City storm drain system to provide conveyance for the 10-year design storm event. This would increase the amount of flow conveyed downstream. The hydrologic and hydraulic design assumptions for the tunnel are discussed below.

5.2.3 Design Assumptions

The following design assumptions served as the basis for the conceptual design of the Tunnel South of County Line.

Hydrologic Assumptions

The tunnel is intended to have the capacity to transport storm drain flows after upstream improvements have been made. The design criteria for upstream system improvements in this study were based on the 10-year, 4-hour storm event. The 10-year event has become a typical storm drain design level because it provides a balance between level of service and affordability. The 25-year storm event capacity was chosen for the preliminary evaluation of tunnel improvements in lieu of a 10-year storm event to ensure downstream flooding for larger events can also be conveyed. Additionally, from an economic perspective, the incremental cost of building a tunnel for 10-year peak flows vs. 25-year peak flows is minimal compared to the overall cost of implementing the tunneling project. These levels of protection (10-year and 25-year for upstream and downstream improvements, respectively) were used to establish a base line for the preliminary alternatives comparison and planning level cost estimates only. The final design storm for the Tunnel South of County Line would be determined as part of a detailed alternatives analysis to determine the optimal design.

Hydraulic Assumptions

The peak stormwater flow entering into the Vista Grande canal for a 4-hour, 25-year storm event is approximately 1,500 cfs (see Section 1.2 and Appendix A for more information). For preliminary sizing calculations, this peak flow represents the peak design flowrate for the stormwater tunnel. Preliminary site investigations and mapping exercises established approximate tunnel lengths and invert elevations. These initial assumptions were refined throughout the planning process and are reflected in the description of each alternative. Manning’s equation was used to determine an approximate tunnel diameter for the established hydraulic conditions. An interior diameter of 15 ft was calculated. Table 5-2 presents the hydraulic design criteria.

Table 5-2 Hydraulic Design Criteria

Criteria	Value	Units	Description
Tunnel Design Capacity	1,500	cfs	4-hour, 25-year storm event
Tunnel Interior Diameter	15.0	ft	Based on preliminary design calculations
Tunnel Length	4750-5400	ft	Based on preliminary tunnel layouts
Tunnel Material	Concrete	-	
Manning's n	0.013	-	Average value for concrete pipe[a]
Initial Invert Elevation	~ 8	ft	Based on SF city datum
Final Invert Elevation	4	ft	Based on SF city datum
Slope	0.0008	-	Based on invert elevations and tunnel lengths
Velocity	<10	fps	To limit tunnel corrosion

Footnotes:

a. From Civil Engineering Reference Manual, Appendix 19.A (Lindeburg, 2003). For the type of precast, concrete sections that may be used for construction of the tunnel, initial tunnel conditions may be more closely approximated by using a Manning's coefficient of 0.015. However, experience has shown that an operational tunnel will soon approximate standard concrete pipe conditions, so a Manning's coefficient of 0.013 was used.

Groundwater Assumptions

The groundwater conditions in the project area have been investigated in recent years through monitoring well data and groundwater model simulations. A summary of pertinent findings as they relate to the Tunnel South of County Line is presented here. Refer to information developed by Yates (October, November 2005) in Appendix E for additional groundwater information.

- The groundwater in the project area is dominated by the Serra Fault, a buried thrust fault that runs southeast to northwest through the project area (as seen in Figure 5-3). The fault separates an area of relatively low and flat groundwater elevations on the east side of the fault from a ridge of elevated groundwater levels on the west side.
- The area to the west of the fault consists of a tilted and possibly folded block of primarily Merced Formation rock. This deformation results in low horizontal hydraulic conductivity, contributing to the high water level in the area to southwest. The water level drops steeply to a seepage face near the toe of the beach bluff cliffs.
- East of the fault, the regional water table slopes southward toward a major pumping depression in the Westlake area. Shallow clay layers that support the shallow aquifer become discontinuous between Impound Lake and John Daly Boulevard. As the clays become discontinuous, the downward slope steepens and the water table plunges to an elevation of approximately 100 feet below sea level (SF city datum) in the Westlake area. The exact shape of the water table as it slopes southward is poorly known.

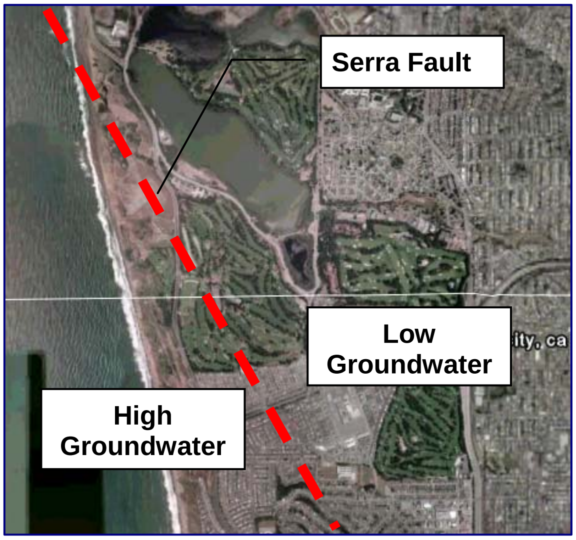


Figure 5-3 Serra Fault Location

General conclusions regarding the groundwater table are that tunnel construction would be above the water table at the eastern end of the project area but would encounter the water table about halfway to the coast. Groundwater elevations as they relate to the alternative tunnel alignments are evaluated in Section 5.2.4.

Construction Assumptions

Construction of the Tunnel South of County Line is expected to be below the water table for a significant reach of the tunnel. As such, construction assumes the use of an Earth Pressure Balance tunnel boring machine (EPBM), which can operate below the water table so that dewatering is not required. The EPBM, greatly refined over the last 30 years, has contributed to improved safety, faster construction completion, and fewer environmental impacts associated with tunnels, especially in soft ground conditions similar to those found in the Daly City/San Francisco area. The tunnel boring machine has been used successfully on many projects, such as the Richmond Transport Tunnel in San Francisco. The Richmond Transport Tunnel is a 2-mile long, 14-ft diameter tunnel built for combined stormwater/wastewater overflows into San Francisco Bay. The tunnel was constructed in extremely variable ground conditions, ranging from sandstones and siltstones, to mélange/fault gouge materials, to soft ground conditions consisting of dune sands. The project was successful in balancing a number of issues, such as construction staging within limited areas, city sound ordinances, and traffic control. The project also minimized damage as a result of tunneling-induced settlement as it passed under the Palace of the Legion of Honor and the Seacliff residential area (Woodward-Clyde, 1995).

Figure 5-4 Typical tunnel boring machine

Figure 5-5 Typical construction layout

Figure 5-6 Typical tunnel portal

A tunnel boring machine (TBM) typically consists of one or two shields (large metal cylinders) and trailing support mechanisms. A rotating cutting wheel is located at the front end of the shield and transfers dirt onto a conveyor belt and into a cart for removal at the tunnel portal. Forward pressure along with a system to balance internal and external pressure keeps water and mud from seeping into the tunnel and minimizes surface settlement (VTA, 2002). Behind the dirt conveyance chamber there is a set of hydraulic jacks supported by the finished part of the tunnel which are used to push the TBM forward. The action here is caterpillar-like. The rear section of the TBM is braced against the tunnel walls and used to push the TBM head forward. At maximum extension the TBM head is then braced against the tunnel walls and the TBM rear is dragged forward (Boyce, 2005; Wikipedia, 2005).

Behind the shield, inside the finished part of the tunnel, several support mechanisms can be found: dirt removal, slurry pipelines if applicable, control rooms, rails for transport of the precast segments, etc. (Boyce, 2005; Wikipedia, 2005).

The cutting wheel will typically rotate at 4 to 10 rpm (depending on size and geology), cutting the rock face into chips or excavating soil (muck). Depending on the type of TBM, the muck will fall onto a conveyor belt system and be carried out of the tunnel, or be mixed with slurry and pumped back to the tunnel entrance (Boyce, 2005; Wikipedia, 2005).

The TBM operates primarily underground so there are minimal impacts on the surface to traffic and the surrounding community. Tunnel construction would be primarily visible only at the openings at each end of the tunnel, known as portals (VTA, 2002). Construction staging would focus on minimizing impacts such as traffic interruption, dust and noise, and maintenance of auto and pedestrian access at key locations (Boyce, 2005).

The follow are a list of construction considerations common to all tunnel alternatives:

- The tunnel was estimated to be supported using bolted, gasketed precast concrete segments, thereby eliminating the need for a final cast-in-place concrete lining.
- Tunnel muck (i.e., spoils) was estimated to be disposed of on local beaches or other sites (within 10 miles) as remediation material. Discussions with GGNRA and California State Parks staff have indicated that this remediation material could be applied to beneficial uses.
- The downstream end of the tunnel is assumed to terminate at a concrete outlet structure located on the beach. The structure is assumed to be founded on mini-piles, socketed into the cliff face, and equipped with a steel grate and sand pocket. Construction of an ocean outfall would increase the project expense significantly. An ocean outfall was not assumed for the tunnel alternatives due to the fact that there are no regulatory or permitting requirements dictating the use of ocean outfalls for the discharge of stormwater. The primary reason for using an ocean outfall would be to take advantage of the dispersion capability it provides. However, the Clean Water Act does not stipulate numerical limits regarding water quality of stormwater. Stormwater discharges are regulated by NPDES permits which require BMPs for operation. For these reasons at a conceptual level, an ocean outfall is not

Figure 5-7 Typical construction shaft

assumed necessary and construction of a beach discharge structure is assumed for all tunnel alternatives.

5.2.4 Preliminary Layout and Facilities

Alternative 1 – John Muir Drive Site

The tunnel inlet structure of Alternative 1 would be located at the upstream end of the existing Vista Grande canal, at the intersection of John Muir Drive and Lake Merced Boulevard. The three Daly City storm drain trunk lines converge at this location. The inlet of the tunnel would be located at the storm drain convergence point and extend west-southwest under the hill at the edge of the Olympic Club. The tunnel would be approximately 4,750 ft long and terminate at a beach outlet structure south of Fort Funston. Figure 5-8 shows the profile view of the tunnel alignment with approximate groundwater levels. Figure 5-9 presents the inlet area of Alternative 1. As shown, an inlet structure would collect the flow from the storm drains and feed it into the tunnel.

Construction Considerations

The following are a list of construction considerations specific to the John Muir Drive site:

- A 32-foot diameter access shaft sized to permit subsequent tunneling and construction of a permanent, cast-in-place inlet structure. The access shaft would be located at the intersection of John Muir Drive and Lake Merced Boulevard.
- A temporary diversion structure to handle up to 680 cfs of flows into the canal along John Muir Drive for the entire construction period. The temporary diversion would be filled in after construction is complete and the tunnel is operational.
- Construction of a 4,200 gpm pump station and approximately 400-ft 12-inch force main to convey flows from the Daly City storm drain system to the tunnel. The pump station would be installed underground.

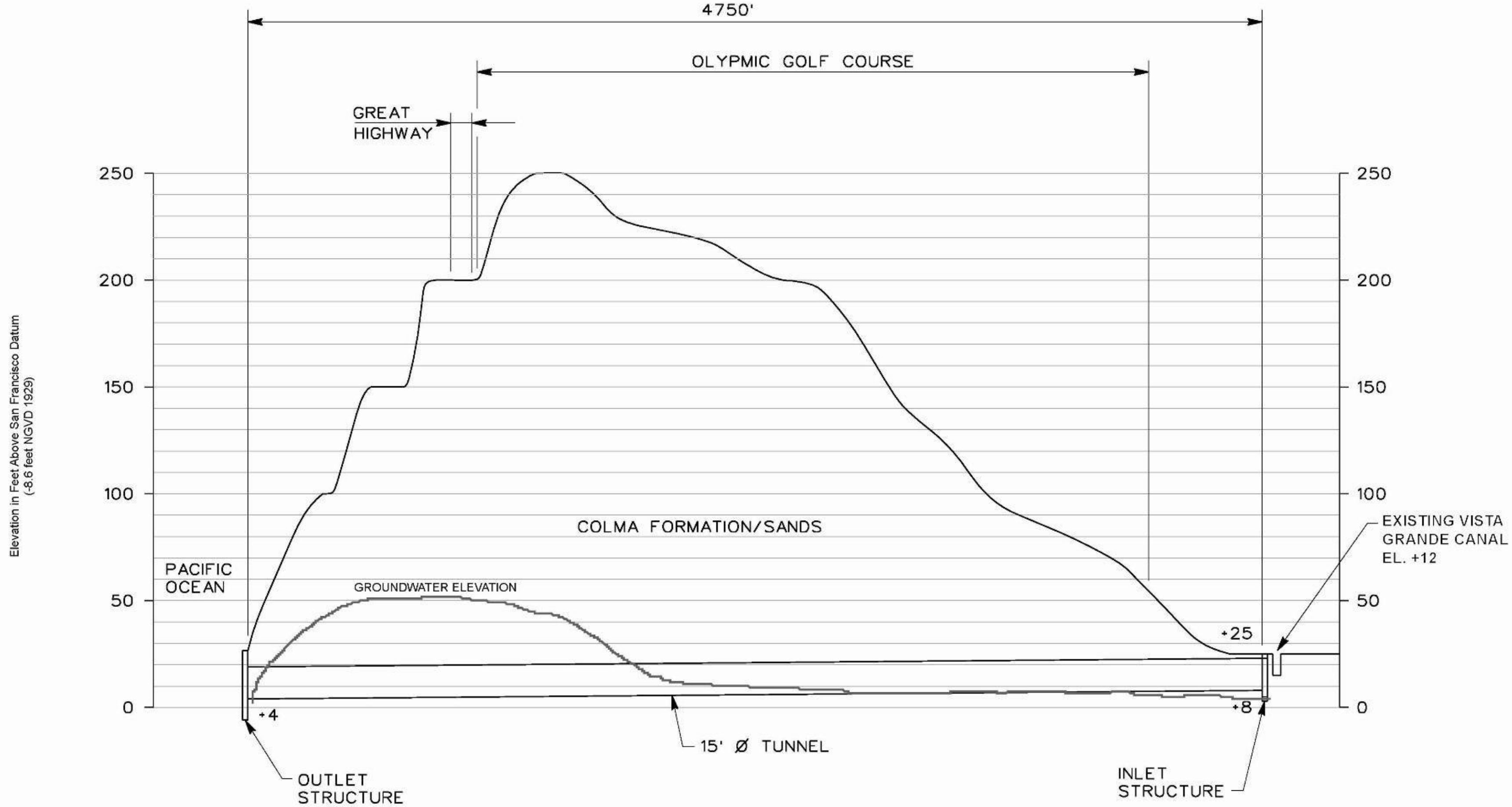


Figure 5-8 Alternative 1 Tunnel Profile

DRAWN BY D.H.	JACOBS ASSOCIATES	CITY OF DALY CITY AND SFPUC RMC WATER & ENVIRONMENT, INC	SCALE AS NOTED JOB NUMBER 3957	REV.
DATE 10/05	Engineers/Consultants 465 California Street, Suite 1000 San Francisco, CA 94104	VISTA GRANDE PROJECT PROFILE FROM JOHN MUIR	DRAWING NUMBER PROFILE 1	0

Figure 5-9 John Muir Drive Site

Outlet Structure

The beach outlet structure for Alternative 1 is assumed to be south of Fort Funston. The outlet location was chosen due to the nearby cliff-line configuration which reduces the visual impacts of the outlet. Also, this location is expected to minimize impacts to animal habitat and not obstruct public access. The structure would be similar in design to the existing San Francisco combined sewer overflow (CSO) beach outlet. The concrete outlet structure is assumed to be socketed into the cliff face and equipped with a steel grate and sand pocket. Construction is estimated to be staged entirely from within the tunnel. Figure 5-10 and Figure 5-11 shows the location of the outlet structure and the CSO structure, respectively.

Figure 5-10 Fort Funston Beach Outlet Location

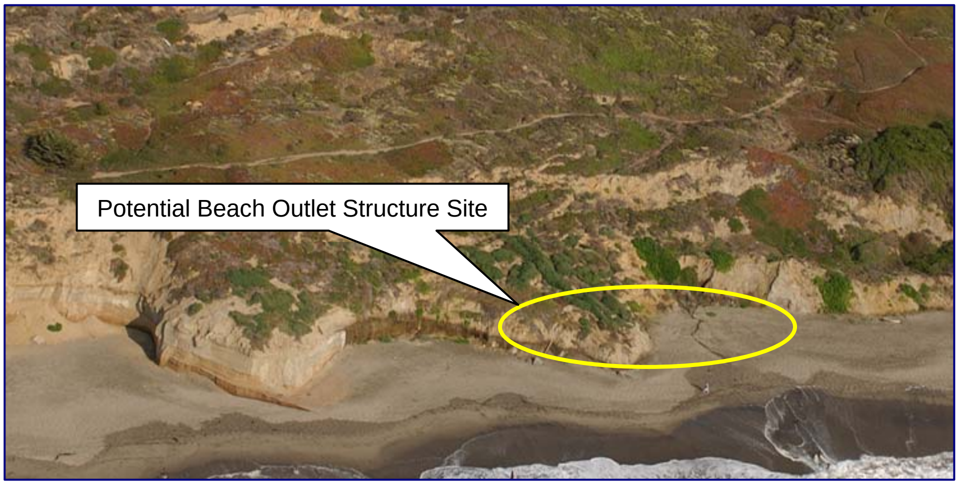


Figure 5-11 San Francisco CSO Structure

Alternative 2 – Doelger Community Center Site

The inlet of Alternative 2 would be located in the parking lot of the Doelger Community Center. The tunnel inlet structure would be located underground and the tunnel would extend west under Lake Merced Boulevard and the Olympic Club Golf Course. Figure 5-12 shows the profile view of the tunnel alignment with approximate groundwater levels. The tunnel would be approximately 4,900 ft long. Figure 5-13 presents the inlet area of Alternative 2. As shown, the three Daly City storm drain trunk lines would be rerouted to converge at the Doelger Community Center parking lot. Additionally, a pump station and force main would convey flow collected in the storm drain system downstream of the tunnel. This "remainder" stormwater would flow toward the existing Vista Grande canal but then be pumped back to the tunnel inlet structure. The force main would be installed in an existing box storm drain on Lake Merced Boulevard.

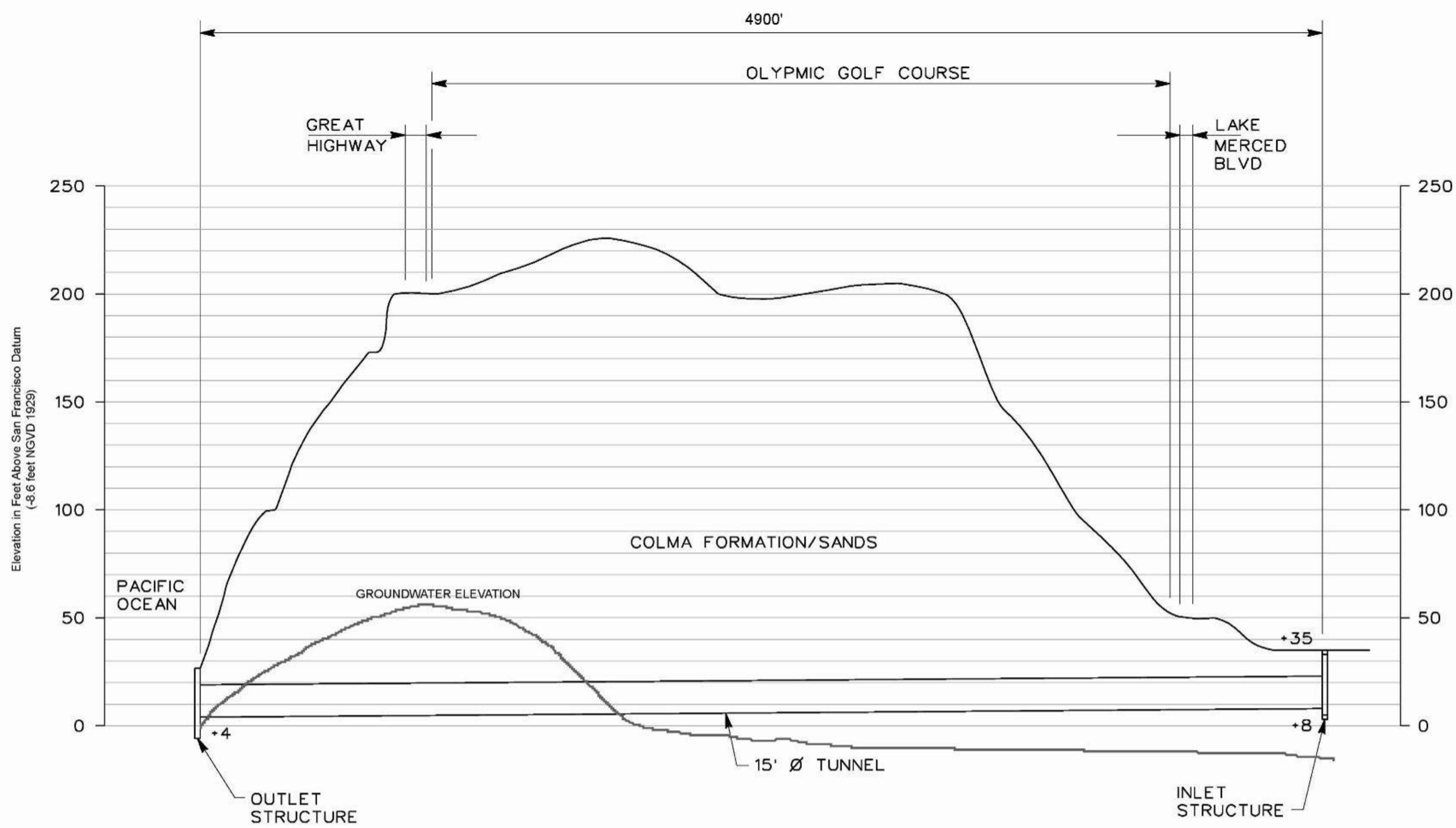


Figure 5-12 Alternative 2 Tunnel Profile

DRAWN BY D.H.	JACOBS ASSOCIATES	CITY OF DALY CITY AND SFPUC RMC WATER & ENVIRONMENT, INC	SCALE AS NOTED JOB NUMBER 3957	REV. 0
DATE 10/05	Engineers/Consultants 465 California Street, Suite 1000 San Francisco, CA 94104	VISTA GRANDE PROJECT PROFILE FROM SENIOR CENTER	DRAWING NUMBER PROFILE 2	

Figure 5-13 Doelger Community Center Site

Construction Considerations

The following are a list of construction considerations specific to for Doelger Community Center site:

- A 32-foot diameter access shaft sized to permit subsequent tunneling and construction of a permanent, cast-in-place inlet structure. The access shaft would be located in the Doelger Community Center parking lot. The lot would be restored after construction.
- Construction of a 550-ft long microtunnel between the new inlet structure work area and a tie-in point to the 60-inch storm drain located on Cliffside Drive. This includes construction of an access shaft over the tie-in location used to recover the microtunneling machine and affect the tie-in.
- Construction of 300 linear feet of box culvert connecting a tie-in with the existing 7-ft by 6-ft box culvert and 24-inch storm drain along Lake Merced Boulevard and the new inlet structure.
- Construction of a 21,000 gpm pump station and approximately 1300-ft of 27-inch force main to convey stormwater flows from the drainage basin cut off by the tunnel alignment. The force main would be set in the existing box culvert, attached to the roof.

Outlet Structure

The beach outlet structure for Alternative 2 is assumed to be in the same location as the beach outlet structure for Alternative 1. Details regarding the outlet structure are assumed to be similar to those described for Alternative 1.

Alternative 3 – John Daly Alignment

The location of the John Daly alignment is shown in Figure 5-2. The tunnel inlet structure of Alternative 3 would be located near the Westpark Shopping Center. The tunnel would extend west along John Daly Boulevard to Thornton State Beach. The primary construction site for Alternative 3 is located near the termination of John Daly Boulevard at Skyline Boulevard, between Daly City's Thornton Beach Vista and the horse stables to the north. Excavation of the tunnel would be staged from this location. Figure 5-14 illustrates this construction area. Figure 5-15 shows the profile view of the tunnel alignment with approximate groundwater levels. The tunnel would be approximately 5,400 ft long.

Figure 5-14: John Daly Alignment Primary Construction Site

Note: The figure does not show Daly City's recent construction of the Thornton Beach Vista.

Construction Considerations

The Alternative 3 tunnel would be mined in two sections. The first section would be mined with a tunneling shield and would extend from an access shaft at the primary construction site to the beach. The second section of the tunnel would extend east from the access shaft to a secondary construction site near the Westlake Shopping Center.

Alternative 3 would require the following construction work at the primary construction site:

- A 215-ft deep, 32-ft diameter access shaft sized to permit subsequent tunneling, in two directions with limited disturbance to the general public. The access shaft would be located near Daly City's Thornton Beach Vista and access would be obtained from the vista parking area or Olympic Way.
- A permanent, 12-ft diameter access shaft to be installed in the excavation shaft after tunnel construction is complete. Excavation material would be used to fill in the remainder of the shaft.

The secondary construction site would serve as the retrieval location, the site where a construction shaft is excavated and the EPBM is retrieved. The retrieval location and the upstream inlet of the alternative would be located at the intersection of South Mayfair Avenue and Park Plaza Drive, as shown in Figure 5-16.

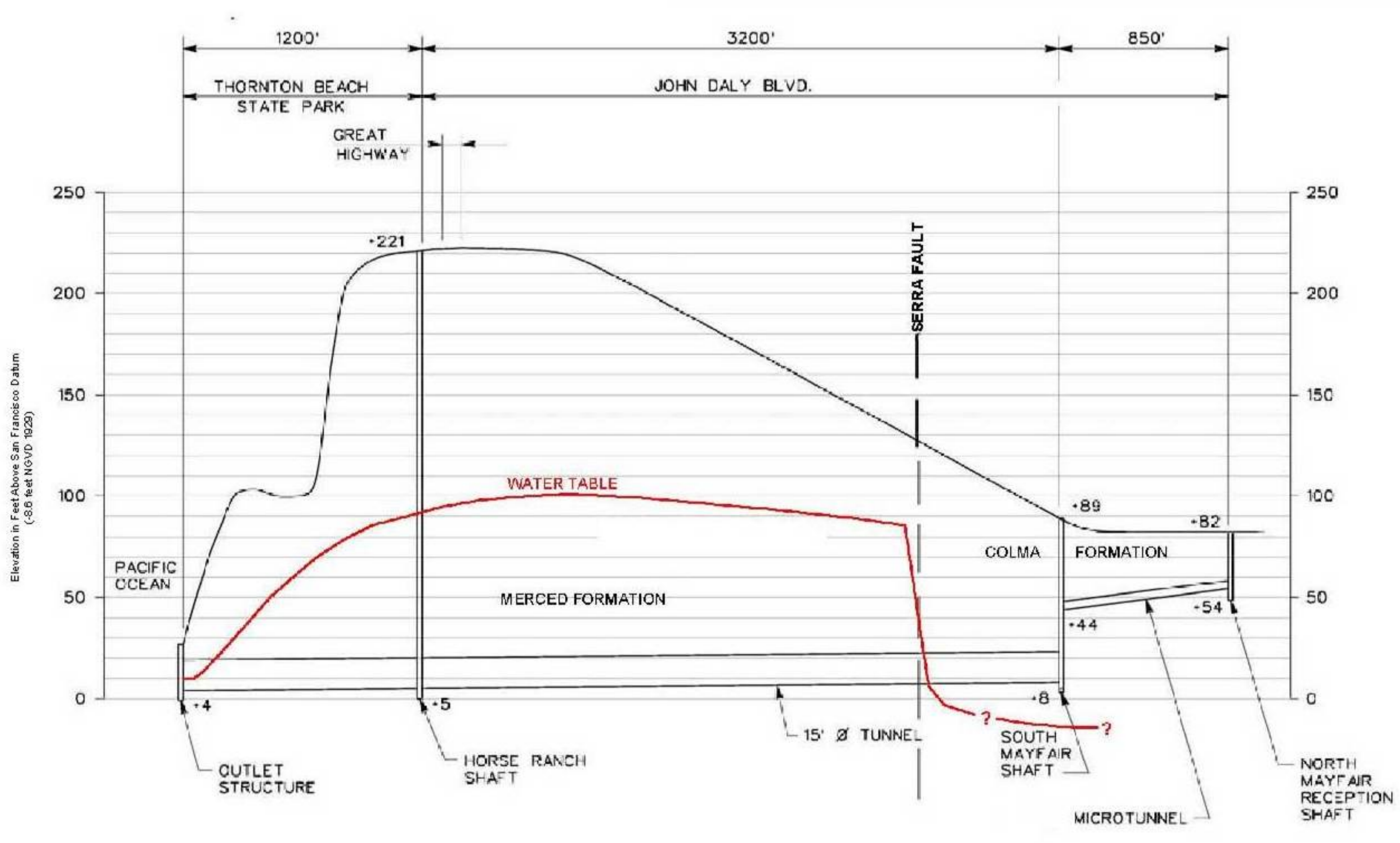
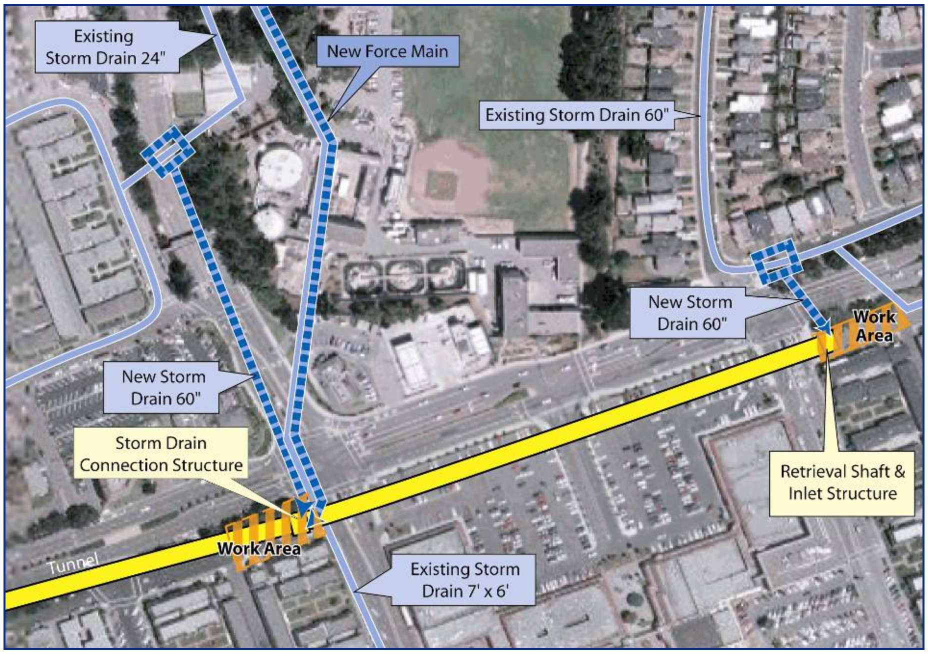


Figure 5-15 Alternative 3 Tunnel Profile

DRAWN BY D.H.	JACOBS ASSOCIATES	CITY OF DALY CITY AND SFPUC RMC WATER & ENVIRONMENT, INC	SCALE AS NOTED JOB NUMBER 3957	REV. 0
DATE 01/06	Engineers/Consultants 465 California Street, Suite 1000 San Francisco, CA 94104	VISTA GRANDE PROJECT PROFILE ALONG JOHN DALY BLVD.	DRAWING NUMBER PROFILE 3	

Note: The profile shown here is representative of Alternative 3 with an alternate retrieval location. Refer to Appendix G for more information on the alternate retrieval location.

Figure 5-16 John Daly Alignment Retrieval Location Construction Site



Extensive storm drain connections are required to connect Daly City's three storm drain sub-basins to the tunnel. As illustrated in Figure 5-16, the following construction work would be required:

- An 80-ft deep, 25-ft diameter retrieval shaft sized to allow recovery of the EPBM and construction of a permanent, cast-in-place inlet structure. The retrieval shaft would be located at the intersection of South Mayfair Avenue and Park Plaza Drive.
- Construction of a 200-foot long, 60-inch micro-tunnel connecting the existing 60-inch storm drain to the tunnel at the retrieval shaft location. This work includes construction of an access shaft at the connection location to recover the micro-tunneling machine and a tie-in structure.
- Construction of an 80-ft deep storm drain connection structure located at South Mayfair Avenue and Lake Merced Boulevard. This structure would facilitate connections to the 24-inch and 7-ft x 6-ft box stormwater sub-basins.
- Construction of approximately 20-ft of reinforced concrete pipe, pipe-jacked tunnel, connecting the existing manhole in Lake Merced Boulevard (7-ft x 6-ft storm drain) to the new connection shaft and inlet structure.
- Construction of a 700-foot long, 60-inch micro-tunnel connecting the new inlet structure with the 24-inch storm drain at an existing manhole. This work includes construction of an access shaft at the connection location to recover the micro-tunneling machine and a tie-in structure. Both micro-tunnel connections for Alternative 3 were assumed to use the same micro-tunnel size for construction cost savings. The size of both micro-tunnels would be refined during the design process based on the findings of the upstream storm drain improvements program included in the Vista Grande Watershed Study.
- Installation of a 27,000 gpm pump station and 33-inch force main to convey stormwater collected in the sub-basins downstream of the connection points. The pump station would be located underground near the Vista Grande canal and the force main would be installed in the existing 7-ft x 6-ft box storm drain.

Through field visits and discussions with Daly City staff, an alternate retrieval location at the intersection of South Mayfair Avenue and Lake Merced Boulevard was also investigated. Details regarding this alternate retrieval location can be found in Appendix E.

Outlet Structure

The beach outlet structure for Alternative 3 would be located at Thornton State Beach, a California State Park that is currently closed. The outlet structure design is assumed to be similar to Alternatives 1 and 2 and could be socketed into the cliff face and equipped with a steel grate and sand pocket. Construction is estimated to be staged entirely from within the tunnel. Figure 5-17 shows the location of the outlet structure for Alternative 3.

Figure 5-17: Thornton State Beach Outlet Location

5.2.5 Planning Level Cost Estimate

Preliminary planning level cost estimates were developed for each of the tunnel alignment alternatives. These cost estimates include construction of all project components as described above and represent the current expected low bid for construction. A 30-percent allowance was included for contingency to reflect the current bidding climate in the underground construction industry and the recent volatility in material prices for such items as steel and cement. The estimates do not include right-of-way and land acquisition costs.

The cost estimates were prepared using all available information, with judicial assessments where no information was available, and comprise production-type cost estimating methods, including the following assumptions:

- Current prevailing labor rates were taken from California Department of Industrial Relations and are fully burdened rates, including payroll taxes and insurance, and worker's compensation and commercial general liability insurance.
- Equipment rates were developed using the current USACE Construction Equipment Ownership and Operating Expense Schedule (Region VII), published in 2003 for the western states (USACE, 2005).
- Material and subcontract costs are based on current market prices. Quotes were obtained for large items such as bolted, gasketed tunnel segments.

Table 5-3, Table 5-4, and Table 5-5 provide summaries of the planning level cost estimates for each of the tunnel alternatives. Detailed cost estimate information can be found in Appendix E. Total capital project cost estimates for Alternative 1, Alternative 2, and Alternative 3 are $56.1 million, $63.2 million, and $81.6 million, respectively (December 2005 dollars).

Costs for the tunnel alternatives were escalated to the assumed approximate midpoint of construction (winter 2010/2011). Escalated costs for Alternative 1, Alternative 2, and Alternative 3 are $71.6 million, $80.7 million, and $104.1 million, respectively. Note that this escalated cost does not include origination costs associated with bond financing, which typically equate to about 10 percent of the bonded amount.

Table 5-3 Estimated Costs for Tunnel South of County Line
Alternative 1 – John Muir Drive Site

Description	Cost
TUNNEL CONSTRUCTION	
Prepare Site & Construct Shaft	$471,000
Assemble Earth Pressure Balance TBM and Backup	$238,000
Excavate/Support Tunnel	$15,497,000
Disassemble Earth Pressure Balance TBM / Backup through Tunnel	$334,000
Construct Outlet Structure	$363,000
Construct Inlet Structure	$268,000
Remove Tunnel Services & Restore Site	$41,000
Backfill Temporary Diversion and Effect Tie-in	$59,000
STORMDRAIN CONNECTIONS	
N/A	
PUMP STATION AND FORCEMAIN	
Construct Pump Station and Install Force Main	$2,340,000
MOBILIZATION/INDIRECT COSTS	
Mobilization/Demobilization	$6,981,000
General Operation, Tunnel Support & Other Indirect Costs	$2,552,000
Markup	$3,599,000
Cost Estimate Subtotal:	$32,743,000
Contingency (30% Allowance):	$9,823,000
Construction Cost Estimate:	$42,566,000
Implementation (30% Allowance):	$12,770,000
Environmental Compliance:	$750,000
Project Total (2005 dollars):	**$56,100,000**
Cost Escalated to Approximate Midpoint of Construction (Winter 2010):	**$71,600,000**

Table 5-4 Estimated Costs for Tunnel South of County Line
Alternative 2 – Doelger Community Center Site

Description	Cost
TUNNEL CONSTRUCTION	
Prepare Site & Construct Shaft	$228,000
Assemble Earth Pressure Balance TBM and Backup	$238,000
Excavate/Support Tunnel	$16,129,000
Disassemble and Retrieve Earth Pressure Balance TBM	$334,000
Construct Outlet Structure	$363,000
Construct Inlet Structure	$268,000
Remove Tunnel Services & Restore Site	$41,000
STORMDRAIN CONNECTIONS	
Construct New Box Culvert Connection (7'x6' & 24-inch stormdrain)	$484,000
Construct Microtunnel Connections (60-inch stormdrain)	$1,180,000
Construct Microtunnel Retrieval Shaft and Drop Structure	$185,000
PUMP STATION AND FORCEMAIN	
Construct Pump Station and Install Force Main	$3,513,000
MOBILIZATION/INDIRECT COSTS	
Mobilization/Demobilization	$7,075,000
General Operation, Tunnel Support & Other Indirect Costs	$2,828,000
Markup	$4,074,000
Cost Estimate Subtotal:	$36,940,000
Contingency (30% Allowance):	$11,082,000
Construction Cost Estimate:	$48,022,000
Implementation (30% Allowance):	$14,407,000
Environmental Compliance:	$750,000
Project Total (2005 dollars):	**$63,200,000**
Cost Escalated to Approximate Midpoint of Construction (Winter 2010):	**$80,700,000**

Table 5-5 Estimated Costs for Tunnel South of County Line
Alternative 3 – John Daly Alignment

Description	Cost
TUNNEL CONSTRUCTION	
Prepare Site & Construct Shaft	$1,533,000
Assemble Excavation Shield and Backup	$152,000
Excavate/Support Tunnel with Shield	$4,377,000
Assemble Earth Pressure Balance TBM and Backup	$475,000
Excavate/Support Tunnel	$13,675,000
Disassemble and Retrieve Earth Pressure Balance TBM	$180,000
Construct Outlet Structure	$352,000
Prepare and Excavate Retrieval Shaft	$838,000
Construct Inlet Structure	$365,000
Remove Tunnel Services & Restore Site	$105,000
Construct Permanent Access and Backfill Temporary Shaft	$991,000
STORMDRAIN CONNECTIONS	
Construct RCP Pipe-Jacked Connection (7’x6’ stormdrain)	$178,000
Construct Microtunnel Connections (24-inch and 60-inch stormdrains)	$1,954,000
Microtunnel Retrieval Shafts and Drop Structures	$370,000
Excavate/Support Connection Shaft and Drop Structure	$652,000
PUMP STATION AND FORCEMAIN	
Construct Pump Station and Install Force Main	$4,008,000
MOBILIZATION/INDIRECT COSTS	
Mobilization/Demobilization	$10,353,000
General Operation, Tunnel Support & Other Indirect Costs	$2,383,000
Markup	$4,926,000
Cost Estimate Subtotal:	$47,867,000
Contingency (30% Allowance):	$14,360,000
Construction Cost Estimate:	$62,227,000
Implementation (30% Allowance):	$18,668,000
Environmental Compliance:	$750,000
Project Total (2005 dollars):	**$81,600,000**
Cost Escalated to Approximate Midpoint of Construction (Winter 2010):	**$104,100,000**

5.2.6 Operation and Maintenance

Operation and maintenance (O&M) of the tunnel would include routine inspection and associated maintenance. The tunnel itself has no moving parts, so maintenance is expected to be minimal. Trash racks would be used at the inlet structure and would require regular maintenance. The beach outlet structure, similar to the existing outlet, will have a simple gate mechanism that closes when it is not in use. It is assumed the new outlet structure will require minimal maintenance as well.

Access to the interior of the tunnel could be obtained from the upstream inlet location and the beach outlet location. These access points could be used in the future for maintenance and repairs of the tunnel. Additionally, Alternative 3 includes a permanent, 12-ft diameter access shaft located at the primary construction site. Maintenance crews would be able to enter the tunnel via the shaft and gain access to the entire length of the tunnel. The shaft would include a structure preventing unauthorized access.

Multiple locations have been identified to obtain access to the beach outlet structure. These access points could also be used to facilitate beach construction. They are as follows:

- Great Highway and Lincoln Road – Provides reliable access from the north that the Daly City Department of Water and Wastewater Resources (DWWR) has used before, however, it would require 4 miles of beach travel to reach the outlet structure for the alternatives.
- Great Highway and Sloat Road – Access site that DWWR has used previously, located approximately 2 miles north of the outlet site of the tunnel alternatives.
- Access from Fort Funston North – Approximately 7000 ft north of the outlet for Alternatives 1 and 2, a steep sand ladder connects a paved road to the beach in Fort Funston. Access to the paved road is available from: 1) Great Ocean Road near Oceanside Water Pollution Control Plant, or 2) the Fort Funston parking lot. Temporary road construction mats may be needed to use the sand ladder. Restoration of the site may include permanent erosion control measures and public access facilities.

The O&M considerations presented in this section provide an overview of the type of O&M that would be necessary for the tunnel to establish the feasibility and practicality of this proposed solution. These considerations are not intended to be a comprehensive O&M plan. A detailed O&M plan would be developed as part of project implementation.

5.2.7 Benefits/Objectives Met

The following have been identified as benefits of the Tunnel South of County Line option.

- Eliminates flooding at Vista Grande canal along John Muir Drive, and associated damages and risk
- Locates tunnel completely within San Mateo County
- Bypasses the existing Vista Grande canal
- Limits construction area needed in Daly City and San Francisco jurisdictions
- Eliminates safety hazard of open storm drainage channel
- Enables use of existing Vista Grande tunnel for gravity flows of treated effluent from NSMCSD Wastewater Treatment Plant. This simplifies operation of the wastewater treatment plant and eliminates need for periodic pumping of effluent through the force main.

5.2.8 Implementation Issues

Environmental Impacts

The EPBM operates primarily underground so there are minimal environmental impacts on the surface. Tunnel construction would have impacts at the openings at each end of the tunnel, in the construction work areas, and along access routes (VTA, 2002). While the environmental impacts of the Tunnel South of County Line project would be thoroughly examined during preparation of environmental compliance documents (CEQA/NEPA), the following section highlights some of the issues that are expected to be encountered.

The primary environmental considerations for the John Muir Drive construction site, Alternative 1, would be erosion and runoff into Impound Lake. The water quality of the runoff is expected to be of typical stormwater quality. The primary concerns include sediment and nutrient loaded runoff and stormwater with high concentrations of coliform. An effective construction BMP plan would be necessary to minimize erosion and runoff.

Construction impacts for Alternative 2 at the Doelger Community Center site and for Alternative 3 at the sites on South Mayfair Avenue, would also include erosion and runoff and would require BMP implementation; however, these sites are not located directly adjacent to Lake Merced as with Alternative 1.

Environmental impacts at the outlet structures south of Fort Funston and at Thornton State Beach would include temporary construction and access impacts, as well permanent impacts due to the outlet structure. Impacts due to construction could be minimized with an effective BMP plan. Impacts due to access would be largely dependent on the access route used, however, construction access is currently assumed to be obtained through the tunnel itself.

The cliff face south of Fort Funston and at Thornton State Beach is subject to erosion from wind, sea spray, rain, wave erosion at the base, and animal and human activity. The cliffs south of Fort Funston and at Thornton have also been subject to slides, including a large slide at Thornton State Beach in the early 1980s during El Nino winter storms that closed access to the beach. A failed storm drain was the reported cause of the severe gully erosion, which destroyed a section of road. As an erosion control measure, grout can be injected into the cliff face around the outlet structure for added stability. Permanent impacts due to the outlet structure could include beach wash away or channelized erosion. However, these phenomena have not been observed with the existing Daly City outlet or the San Francisco CSO outlet.

Impacts to plant and animal species from construction and operation of the tunnel would also need to be considered. The coastal zone surrounding Fort Funston provides habitat to certain species of birds including Bank swallows and Western Snowy Plover. Since the presence or absence of these species in the potential project area has not been confirmed, a detailed environmental analysis and survey for these species would need to be conducted prior to project implementation. Because the Western Snowy Plover uses beaches in the Bay Area for both breeding and wintering, any survey for Western Snowy Plover should incorporate both a winter and a nesting season element. Additional species and habitat analyses may include the potential impact to food resources used by large wintering flocks of sea ducks including Surf, White-winged and Black Scoters.

Construction activities and long-term outfall operation may have habitat impacts. Access routes will have to be examined further to determine impacts. A detailed environmental analysis would need to be conducted prior to project implementation to evaluate potential impacts to plant and animal species at the construction sites.

Permitting

The Tunnel South of County Line is expected to trigger regulatory involvement from several State and Federal agencies. Table 5-6 summarizes the permitting requirements that have been identified for this preliminary program component. Chapter 6 provides a more detailed discussion of the regulatory requirements for the Vista Grande Watershed Study.

Table 5-6 Summary of Permit Requirements for the Tunnel South of County Line

Agency	Permit or Requirement	Authority	Cause for Permitting Action	Time Frame
US Army Corps of Engineers (the Corps)	§404 Permit	Clean Water Act	If the Vista Grande canal is deemed part of the "waters of the United States", building the tunnel may trigger this permit due to its direct or indirect impacts to the canal. The outlet structure may fall within the Corps jurisdiction for either a §404 permit or a §10 permit.	4-6 months – Individual Permit 45-60 days – Nationwide Permit An additional year or more if a biological opinion is required.
	§10 Permit	River and Harbors Act		
US Fish and Wildlife Service	§7 Consultation	Endangered Species Act	The area around the Tunnel South of County Line may contain the appropriate habitat for endangered species. The Corps will consult with USFWS during the permit process. If endangered species or their habitat are believed to be affected, USFWS will prepare a biological opinion under a §7 Consultation.	1-3 years
National Marine Fisheries Service	§7 Consultation	Endangered Species Act	The Corps will consult with NMFS during the permitting process. If the Corps or NMFS determines that the stormwater discharge into the ocean or the construction of the beach outlet structure will impact living marine resources, a §7 Consultation with NMFS will be required.	1-3 years
San Francisco Regional Water Quality Control Board (RWQCB)	§401 Permit - Water Quality Certification	Clean Water Act §401	Under §401 of the Clean Water Act, any activity subject to a permit from a Federal agency must be by the appropriate State that the activity meets all State water quality standards.	60 days after application is deemed complete. Up to one year of additional time may be requested from the Corps.
	§402 Permit - NPDES: General Construction Activity Stormwater Permit	Clean Water Act §402	Required for any construction activity that disturbs more than five acres of land, or if the overall program disturbs more than five acres of land.	Approximately six months
	Waste Discharge Requirements	Porter-Cologne Water Quality Control Act	Required for any activity that generates dredged material, fill or any other discharge that may directly or indirectly impacts the "waters of the State". Waived if §401 Permit required.	Approximately three months

Agency	Permit or Requirement	Authority	Cause for Permitting Action	Time Frame
California Coastal Commission (CCC) and/or Local Coastal Programs (LCPs)	Coastal Development Permit or Public Works Plan	California Coastal Act of 1976; Federal Coastal Zone Management Act	Required for any development in the coastal zone. The coastal zone begins at the shoreline and extends from 500 yards to 5 miles inland. The tunnel outlet structure and the inlet structure for the John Muir Drive alignment are within the coastal zone.	Six months to two years
Golden Gate National Recreation Area (GGNRA)	Special Use Permit	The National Park Service Organic Act	Construction on and around GGNRA land.	Six months to several years
	Right-of-Way Permit		The installation of a tunnel through GGNRA property. The National Park Service (NPS) issues right-of-way agreements for utilities to pass over, under or through NPS property.	Six months to several years
Thornton State Beach, California State Parks	Right-of-Way Permit	California Public Resource Code §5012	Permitting requirements similar in nature to GGNRA.	Six months to several years
California Department of Transportation (Caltrans)	Encroachment Permit	California Streets and Highways Code	Required for any project that occurs within, under, or over a State highway right-of-way. Both of the proposed tunnel alignments pass under State Highway 35.	60 days after application is deemed complete
California State Lands Commission	General Lease – Right-of-Way	California Public Resources Code - Division 6 Public Lands	Required for any project within the California State Lands Commission's jurisdiction. Any work below the ordinary high-water mark in areas that are subject to tidal action would be within their jurisdiction. Thus, the tunnel outlet may fall within their jurisdiction.	1-3 years

Footnotes:

a. Alternatives 1 and 2 would not require permitting from Thornton State Beach. Only Alternative 3 would require permits from Thornton. These permit requirements may need to satisfy GGNRA permitting requirements as the ownership of Thornton State Beach may be transferred to the GGNRA in the future.

Right-of-Way

Right-of-way and easement considerations for the Tunnel South of County Line alternatives include the following:

- Alternative 1 – The construction site is located partially on John Muir Drive and extends up to the existing Vista Grande canal. The canal is located on Olympic Club property but is under an easement held by the CCSF. An easement would be required for the length of the tunnel under the Olympic Club and at the construction site. Construction may also require temporary permissions from the CCSF and the GGNRA. This is particularly relevant to Alternatives 1 and 2.
- Alternative 2 – The construction site is located on Daly City property. Construction activities to reroute storm drains would also occur on Daly City property. Trenchless storm drain construction from the existing 60-in. storm drain to the inlet structure would necessitate an easement from a home owner in the neighborhood. Similar to Alternative 2, an easement would be required for the length of the tunnel under the Olympic Club. Access to the beach outlet for construction may require temporary right-of-way agreements from the GGNRA.

- Alternative 3 – The Alternative 3 tunnel is located primarily in the public right-of-way. An easement would be required from Thornton State Beach (California State Parks) for the beach outlet structure. The primary construction site may require an easement from land owners in the area, however Thornton Beach Vista, a public look out point owned by Daly City, could be used to facilitate tunnel construction.

Additional Implementation Issues

A number of other considerations are necessary to examine. They include:

- Coordination with Olympic Club Golf Course – The Olympic Club is an established golf course known for the quality of its courses and grounds. It will host the US Open in June of 2012. Close coordination with the Olympic Club is necessary to ensure project implementation does not disrupt the golf course's normal activities.
- Details regarding liability assumptions for use of Thornton State Beach for Alternative 3 would have to be developed further with California State Parks. Additionally California State Parks may require that the project satisfy requirements set forth by the Golden Gate National Recreation Area (GGNRA) as the site may be the subject of a future land transfer between the organizations.
- Traffic – Traffic control would be necessary at inlet locations during construction including the following:
  - Alternative 1 – On John Muir Drive, the right-hand turning lane onto Lake Merced Boulevard would be used for construction. Temporary traffic control measures, such as a stop light at the intersection or a stop sign on Lake Merced Boulevard, would need to be implemented to ensure public safety.
  - Alternative 2 – At the Doelger Community Center site, the entrance from Lake Merced Boulevard would still be used, but the construction area would temporarily reduce the available parking.
  - Alternative 3 – The primary traffic considerations would include South Mayfair Avenue between Park Plaza Drive and the alleyway east of Park Plaza Drive, necessary to excavate the retrieval shaft, extract the EPBM, and install stormwater connections. Also, the construction sites at South Mayfair Avenue adjacent to Lake Merced Boulevard would have traffic impacts to excavate the connection shaft, install the drop down structure, and tie into the existing storm drains.
- Construction noise and light impacts – The construction schedule assumes that the tunnel excavation would operate 24-hours a day during peak construction periods. The majority of construction would be done in the tunnel itself and away from residential areas. Potential sources of noise include ventilation fans and a crane to lift and dump the spoil into a pile. Sound walls would help deflect noise. During the late evening and swing shift, muck would be stockpiled to be loaded and removed during the day. Back-up alarms for any trucks could be silenced and replaced with lights. The Richmond Transport tunnel constructed for the SFPUC had the main portal in a residential area and the amount of noise was controlled. There would also be lights at the site, but the lights can be directed away from the residential areas.

5.2.9 Implementation Schedule

The implementation for the tunnel alternatives assumes the same activities for all alternatives. The duration of the activities is the same for all alternatives except for construction, as listed below.

- Permitting and Environmental Compliance – 36 months
- Design – 12 months

- Bid Process – 4 months
- Construction:

  Alternative 1 – 18 months

  Alternative 2 – 21 months

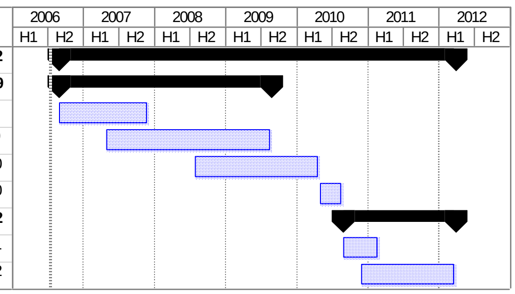
  Alternative 3 – 14 months

The construction schedule of the tunnel alternatives varies according to length of the tunnel and the ability to perform multiple construction activities simultaneously. The Alternative 3 construction schedule is shorter than the other alternatives due to construction activities occurring concurrently, such as the excavation of the retrieval shaft occurring while the EPBM excavates the tunnel.

Final tie-in of the existing storm drain system to the tunnel would be done in the dry season (April to October) and would not occur until the tunnel is fully operational. Typical construction activities are not expected to be affected by seasonal storm events, however conventional construction BMPs would be necessary to protect project sites from surface runoff. Figure 5-18 presents an example implementation schedule for Alternative 1. This implementation schedule includes only permitting, design and construction phases and is dependent on funding availability.

Figure 5-18 Alternative 1 Implementation Schedule

ID	Task Name	Duration	Start	Finish
1	**Tunnel**	**1456 days**	**Fri 9/1/06**	**Fri 3/30/12**
2	**Permitting**	**780 days**	**Fri 9/1/06**	**Thu 8/27/09**
3	Applications	327 days	Fri 9/1/06	Mon 12/3/07
4	Approval	608 days	Tue 5/1/07	Thu 8/27/09
5	Design	458 days	Wed 7/30/08	Fri 4/30/10
6	Bid & Award	85 days	Mon 5/3/10	Fri 8/27/10
7	**Construction**	**415 days**	**Mon 8/30/10**	**Fri 3/30/12**
8	Contractor Mobilization	132 days	Mon 8/30/10	Tue 3/1/11
9	Field Construction	349 days	Tue 11/30/10	Fri 3/30/12



5.2.10 Summary and Next Steps

Summary

Table 5-7 provides a summary of the three alternative tunnel alignments analyzed as part of the Vista Grande Watershed Study. There is no preferred alternative at this point, and all three alignments will merit further investigation as part of the permitting and predesign process.

Table 5-7 Alternative Summary and Comparison

Criteria	Alternative 1	Alternative 2	Alternative 3
Capacity	1,500 cfs for a 25-year storm, 15-ft diameter		
Length	• 4,750 ft	• 4,900 ft	• 5,400 ft
Construction	• Primary construction at Vista Grande Canal entrance • Tunnel outlet south of Fort Funston	• Primary construction at Doelger Community Center • Tunnel outlet south of Fort Funston	• Primary construction shaft at the Horse Ranch • Retrieval shaft and connection shaft on South Mayfair Dr. • Tunnel outlet at Thornton State Beach

Criteria	Alternative 1	Alternative 2	Alternative 3
Advantages	• Minimal rerouting of storm drain utilities required • Shorter construction schedule • Shorter tunnel, less expensive	• Portal site is on Daly City property • Larger construction area available	• Shorter construction schedule • Alignment primarily in public right-of-way
Disadvantages	• Impacts to traffic on John Muir Drive • ROW/land acquisition from Olympic Club at construction site	• Longer tunnel, more expensive • Requires extensive rerouting of storm drains • Impacts to the Community Center during construction	• Longest tunnel, most expensive • Requires extensive rerouting of storm drains • Requires easement from property owners and California State Parks
Construction Schedule	• 18 months	• 21 months	• 14 months
Project Cost (2005 dollars)	• $56 million	• $63 million	• $82 million
Escalated Cost (2010 dollars)	• $72 million	• $81 million	• $104 million

Next Steps

The project alternatives were defined at the planning level. Additional work is necessary to refine key details and make a determination on the best course of action for downstream flood protection. The following activities have been identified as “next steps” in the implementation plan associated with the Tunnel South of County Line. Additional next steps are included in the Chapter 6, Implementation Strategies.

- Beach Outlet Location – For each alternative alignment investigated the location of the beach outlet structure and construction access at the coast will be of vital importance. Any beach outlet structure will likely be located south of Fort Funston and may use the park for access. Potential beach outlet locations should be further examined to determine potential benefits, construction methods, and environmental impacts.
- Spoils Disposal – For cost estimating purposes, excavated material was assumed to be disposed of on local beaches within 10 miles as remediation material. Discussions with the GGNRA indicate that there is potential for reuse of the excavated material; however no specific use has been identified. Research into potential uses of the spoils should be conducted.
- Geotechnical Investigation – A preliminary geotechnical investigation would provide information to refine construction cost estimates and better characterize the project.
- Site Survey – A topographic survey would provide information necessary to refine inlet and outlet elevations and excavation requirements.
- Alternatives Analysis – A detailed alternatives analysis should be conducted to determine the final alignment of the Tunnel South of County Line. This analysis would incorporate information gained from further investigation into locations for the beach outlet structure and the site survey. This analysis may include the alternative alignments in this study, as well as additional alignments such as one from the Doelger Community Center to Thornton State Beach.
- Preliminary Design – The preliminary design of the Tunnel South of County Line should be conducted in parallel with permitting and environmental compliance activities. Preliminary design would include selection of the design storm level of protection, definition of final design criteria, selection of the recommended alternative, definition of tunnel profile and size, further

definition of storm drain connections, preparation of preliminary drawings and refined costs estimate and construction schedule.