ALTERNATIVES ANALYSIS REPORT FOR COASTAL ADAPTATION STRATEGIES FOR SOUTH OCEAN BEACH WASTEWATER SYSTEMS

PROJECT NO. CWWFAC01

Prepared for:
Wastewater Enterprises
San Francisco Public Utilities Commission
525 Golden Gate Avenue, 9th Floor
San Francisco, CA 94102

Prepared by:
Engineering Management Bureau
02/15/2018

This page intentionally left blank

TABLE OF CONTENTS

TABLES

LIST OF FIGURES

APPENDICES

ACRONYMS / ABBREVIATIONS

AACE	American Association of Cost Estimators
AAR	Alternatives Analysis Report
CCC	California Coastal Commission
CCSF	City and County of San Francisco (also "City")
CDP	Coastal Development Permit
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CER	Conceptual Engineering Report
GGNRA	Golden Gate National Recreation Area
LMT	Lake Merced Transport Tunnel
MGD	Million Gallons per Day
MOB	Middle Ocean Beach
MOU	Memorandum of Understanding
NOB	North Ocean Beach
NPS	National Park Service
OBMP	Ocean Beach Master Plan
OSP	Oceanside Water Pollution Control Plant
ROW	Right-of-Way
RWQCB	Regional Water Quality Control Board
SFPW	San Francisco Public Works
SFPUC	San Francisco Public Utilities Commission
SF Rec and Parks	San Francisco Recreation and Parks Department

SFMTA	San Francisco Metropolitan Transportation Agency
SOB	South Ocean Beach
SSIP	Sewer System Improvement Program
SWOO	Southwest Ocean Outfall
T/S	Transport/Storage Structure
USACE	U.S. Army Corps of Engineers
WSFM	Westside Force Main
WSS	Westside Pump Station
WST	Westside Transport
WWE	Wastewater Enterprise

1.0 EXECUTIVE SUMMARY

The San Francisco Public Utilities Commission (SFPUC) South Ocean Beach Wastewater Systems (Systems) provide treatment for the Oceanside watershed. The Oceanside watershed drains towards the Pacific Ocean and occupies over 9,000 acres. It represents roughly 35 percent of the total area of San Francisco and is divided into three sub drainage basins: Richmond, Sunset, and Lake Merced (from north to south; see **Figure 1-1**).

From the late 1970s until 1993 the SFPUC, through the Clean Water Program, constructed a major complex of sewer and stormwater infrastructure within the Oceanside watershed at Ocean Beach. The major components are located at South Ocean Beach (SOB). This elaborate system, some of which is located underneath the Great Highway, reduced coastal water pollution events by a factor of 10. This area is in need of coastal protection due to the narrowing of SOB as a result of coastal dynamics and sediment transport. As a result, components of the system face risk of exposure and damage due to current and future erosion in the face of sea level rise and extreme storm events.

Historic efforts by the City and County of San Francisco (CCSF) to protect infrastructure along SOB have generally consisted of ad-hoc responses to extreme storm events, including sand berms and sandbag walls, and construction of rock revetments following El Nino storm seasons in 1999 and 2010. Recognizing the need for an integrated long-term management strategy for SOB, in 2009, the SFPUC partially funded efforts to begin the planning process for development of the Ocean Beach Master Plan (OBMP). The OBMP was a multi-agency effort to develop a sustainable long-term vision for Ocean Beach, addressing public access, environmental protection, and infrastructure needs in the context of erosion and climate-related sea level rise.

While the OBMP planning efforts were underway, the CCSF sought from the California Coastal Commission (CCC) a coastal development permit (CDP) authorizing the yet unpermitted 1997/1999 and 2010 revetments, as well as additional armoring. In the summer of 2011, the CCC denied the CDP application. In its denial, the CCC made clear that it would no longer accept ad-hoc responses at SOB, and that any future proposals should consider the OBMP recommendations.

Through its participation in the OBMP planning process (completed in 2012), collaboration with regulators, and drawing upon new and better information related to climate change, sea level rise, and coastal dynamics, the CCSF has embraced a new approach. This updated approach is compatible with the OBMP and seeks to protect critical wastewater infrastructure at SOB in a manner that emphasizes the use of low impact techniques, and provides opportunities for integrated management (e.g., structural protection, improved public access, minimal environmental impact).

This Alternatives Analysis Report (AAR) documents the alternatives development and evaluation phase of the Coastal Adaptation Strategies for SOB Wastewater Systems. The evaluations conducted during the AAR phase used a consistent decision methodology, supported by engineering analysis, and informed by the Coastal Protection Measures & Management Strategy for SOB (SPUR et al. 2015). A summary of the AAR's planning criteria, findings, and next steps is presented below.

SOURCE: SFPUC

Figure 1
Urban Watersheds of
San Francisco

1.1 Planning Criteria

The goal for the project is:

- Maintain function and operational capacity of Oceanside facilities in a manner that incorporates the guiding principles of the OBMP and complies with regulatory requirements.

The objectives for the project are:

- Maintain current operational capacity
- Increase resilience to sea level rise
- Comply with applicable laws and regulations
- Improve beach access, recreation and habitat
- Remove shoreline armoring and rubble

1.2 Summary of Evaluations

The AAR considered 10 options, including no action and various project options involving onshore, offshore, structural, and non-structural interventions. As the Lake Merced Tunnel (LMT) is the seaward-most component of the existing wastewater system, it features prominently in the options considered. The project options were screened based upon the Project Goal and Objectives. Four alternatives were carried forward for detailed analysis:

- Alternative A. Protect LMT with exterior low-profile wall
- Alternative B. Protect LMT with interior reinforcement + new storage
- Alternative C. Remove LMT + new tunnel alignment
- Alternative D. Remove LMT + new pump station, pipeline & storage

Each alternative was evaluated against eight criteria concerning cost, environmental impact, and operational complexity. The criteria were drawn, in part, from the list of suggested investigation topics presented in SFPUC's Procedures Manual, and from additional project- and site-specific considerations. The alternatives were scored and ranked based upon their relative performance. Alternative A ranked highest among the alternatives.

1.3 Next Steps

Consistent with SFPUC's Infrastructure Division procedure for the AAR phase, the AAR must be sequentially reviewed and approved by SFPUC managers. Following approval of the AAR, the Conceptual Engineering Phase (CER) will commence. Conceptual engineering will include a series of additional, detailed engineering evaluations and decisions, resulting in a report establishing an engineering definition and a set of 10 percent design drawings. The California Environmental Quality Act (CEQA) analysis and documentation will be conducted concurrent with the 10 percent design effort (CER) and continue through detailed design.

This page intentionally left blank

2.0 INTRODUCTION

2.1 Overview

This Alternatives Analysis Report (AAR) presents an evaluation of shoreline management options to address persistent coastal erosion hazards at South Ocean Beach, in the City and County of San Francisco (CCSF or City). Preparation of an AAR is an important initial step in the San Francisco Public Utilities Commission's (SFPUC) capital planning process. The purpose of the AAR is to evaluate the merits of feasible project options by focusing on their distinctions, and ultimately to identify the project that best suits the SFPUC's project need consistent with its broader goals and objectives. Accordingly, this report will be used to inform SFPUC management's decision regarding the project option that should be carried forward for further analysis in a conceptual engineering report, the next phase of the capital planning process.

2.2 Project Need, Goal, and Objectives

The need, goal, and objectives for the project that is the subject of this AAR are presented below. These factors influenced the identification of alternatives for initial consideration, the screening of those alternatives for 'fatal flaws', and the development of criteria for evaluating the potentially feasible alternatives carried forward for detailed analysis.

2.2.1 Project Need

Protection of South Ocean Beach to address chronic coastal erosion and sea level rise impacts that:

- threaten wastewater infrastructure
- degrade access and recreation
- degrade ecological condition

2.2.2 Project Goal

Maintain function and operational capacity of Oceanside facilities in a manner that incorporates the guiding principles of the OBMP and complies with regulatory requirements.

2.2.3 Project Objectives

- Maintain current operational capacity
- Increase resilience to sea level rise
- Comply with applicable laws and regulations
- Improve beach access, recreation and habitat
- Remove shoreline armoring and rubble

2.3 Project Context

2.3.1 Project Location

The project study area generally encompasses the portion of San Francisco's South Ocean Beach extending south from Sloat Boulevard to the Fort Funston bluffs, and landward from the beach to Skyline Boulevard. An overview of the project area is presented in **Figure 2-1**. As the figure indicates, the project area is bisected by the Great Highway, which is owned and maintained by the California Department of Transportation (Caltrans). The lands to the west of the highway (e.g., parking lots, bluffs, and beach) are owned by CCSF, and managed by the National Park Service (NPS) as part of the Golden Gate National Recreation Area (GGNRA), and the City (e.g., San Francisco Public Works [SFPW]); areas to the east (e.g., San Francisco Zoo) are under the ownership of various City departments (e.g., Recreation and Parks [SF Rec and Parks], SFPW, SFPUC), as well as various non-City entities (e.g., California National Guard).

2.3.2 Project Setting

Ocean Beach is a three-and-a-half-mile-long sandy shoreline bordering the Pacific Ocean on the western San Francisco Peninsula. The beach is exposed to large breaking waves, high wave power and high sand transport potential (Battalio 2014; Battalio and Trivedi 1996). Over the past 100+ years, the back-beach area was filled to create the Great Highway and adjacent development stretching the entire length of beach. Ocean Beach can be characterized as three primary reaches: North Ocean Beach (NOB), Middle Ocean Beach (MOB), and South Ocean Beach (SOB). The reach that is the primary subject of this AAR is SOB.

The NOB Reach extends approximately 5,600 feet from the Cliff House and Seal Rocks southward to Lincoln Way, which forms the southern border of Golden Gate Park in the City and County of San Francisco. NOB is accumulating sand, and wind-blown sand often blows on to roads and parking areas near the beach, causing management actions. The Middle Ocean Beach (MOB) Reach extends approximately 10,500 feet from Lincoln Way to Sloat Boulevard. This section of shore consists of a beach backed by vegetated sand dunes and a seawall, and a linear sandy embankment. MOB is eroding due to a sediment deficit and sea level rise (Battalio 2014).

The SOB Reach extends from the termination of Sloat Boulevard south for approximately 7,500 feet to the bluffs at Fort Funston. The backshore zone along SOB transitions from low, sandy dune at the north end near Sloat Boulevard to a bluff about 50 feet tall in front of the Oceanside Water Pollution Control Plant at the south end of this reach. This area has a narrow sandy beach encroached upon by rubble and rock placed to mitigate erosion. The shore has been filled seaward about 200 to 300 feet (Olmsted and Olmsted 1979; Battalio and Trivedi 1996), and the beach has narrowed as the shore has receded while the bluffs have receded less.

The SOB Reach is the primary focus of this AAR. This area is in need of coastal protection due to the narrowing of SOB as a result of coastal dynamics and sediment transport. These forces have eroded the beach and bluffs, undermining the beach parking lots, the roadway (southern extension

SOURCE: ESA, ESRI, SOA

Figure 2-1
Project Study Area

ESA

of the Great Highway), and raising concerns about the vulnerability of substantial wastewater treatment facilities (see Section 2.4).

Existing conditions at SOB are characterized by:

- Chronic, ongoing erosion of the beach and bluffs by wave action and episodic coastal storms
- Variable degrees of exposure along the beach and bluffs to erosion; existing erosion protection includes engineered revetments and sandbags, sand nourishment (see Section 2.5), and exposed rubble (i.e., materials used during the construction of the roadbed associated with the Great Highway, parking lot asphalt, etc.).
- Vulnerability of wastewater treatment infrastructure to coastal erosion in some locations, and increasing in extent and severity over time.
- Degraded access conditions, including a narrow beach, hazardous engineered revetments, exposed rubble and debris, and eroded parking lots and storm drains.
- Degraded ecological conditions, including a narrow beach, minimal vegetation, and a lack of continuity with adjacent dune and bluff systems.

Representative photographs of conditions along SOB are presented in **Figure 2-2**. As indicated by the above list and representative photographs, CCSF has historically responded to intense erosion jeopardizing city infrastructure with the construction of engineered revetments (boulder embankments) in order to protect the existing shoreline. However, implementation of these projects has affected the beach's natural conditions and access for recreational users. New information related to climate change, sea level rise, the impacts of several significant El Nino events, etc. have modified CCSF's approach to protect SOB and it is now focused on managed retreat. This updated thinking emphasizes the use of low impact technologies inland of the current shoreline that provide multiple benefits and opportunities for integrated management (e.g., protect critical infrastructure and provide for the protection and enhancement of natural resources).

2.4 Existing Wastewater System

The City is naturally divided by a ridgeline running roughly north-south into two main drainage watersheds: Bayside and Oceanside (Figure 1-1). The Oceanside watershed drains towards the Pacific Ocean and occupies over 9,000 acres. It represents roughly 35 percent of the total City area and is divided into three sub drainage basins: Richmond, Sunset, and Lake Merced (from north to south). In 1974, the SFPUC issued its Sewer System Master Plan, which called for upgrading sewer infrastructure citywide to reduce pollution caused by combined sewer-stormwater overflows and to bring the city into compliance with the 1972 Clean Water Act. From the late 1970s until 1993 the SFPUC, through the Clean Water Program, constructed a major complex of sewer and stormwater infrastructure within the Oceanside Drainage Basin at Ocean Beach. This elaborate system, some of which is located underneath the Great Highway, reduced coastal water pollution events by a factor of 10. Its construction included the narrowing and redesign (i.e., 8 lanes to 4) of the Great Highway, the installation of existing dune-like sand embankments and considerable restoration of vegetation and amenities.

North Parking Lot, erosion and rubble north of Sandbags

EQR reach at low tide

Erosion and rubble north of 2010 Emergency Bluff Toe Protection

Rubble and exposed infrastructure at former South Parking Lot

SOURCE: ESA

Figure 2-2
Conditions at SOB
Representative Photos

2.4.1 Wastewater System Operations

In a combined system, the overall wastewater load fluctuates depending on weather conditions. In dry weather, sewage travels through a network of pipes to the Westside Pump Station from the Lake Merced, Sunset and Richmond Basins. Sewage flows by gravity through the Westside Transport Box (draining the Sunset and Richmond basins) and the Lake Merced Tunnel (draining the Lake Merced basin) to the Westside Pump Station. Once the material arrives at the Westside Pump Station, it is pumped through the Westside Force Main to the Oceanside Water Pollution Control Plan (OSP). The treated effluent is discharged in to the ocean, 3.5 miles offshore, through the 80-foot-deep Southwest Ocean Outfall (SWOO).

2.4.2 Wastewater System Facilities

San Francisco is the only major city in California with a city-wide combined sewer-stormwater system. As noted previously, the 1974 Sewer System Master Plan resulted in substantial improvements to the Oceanside Drainage Basin treatment system facilities, expanded wet-weather treatment, and substantially reduced the number of annual wet-weather overflows, among improvements. Today, the Oceanside Drainage Basin facilities include 250 miles of combined sewers and tunnels, three transport/storage (T/S) boxes, one major pump station, five minor pump stations, seven combined sewer discharge outfalls, one all-weather outfall, and the OSP. In addition, the North San Mateo County Drainage District contributes minor wastewater flows (less than one percent of total dry weather flow) to the Oceanside system. Virtually all (>99%) service connections within the Oceanside collection system drain by gravity via the T/S boxes to the Westside Pump Station. Key elements of the wastewater collection system in the project area are described below and depicted in **Figure 2-3**.

Lake Merced Tunnel

The Lake Merced Tunnel (LMT) was constructed to transport wastewater for further treatment at the OSP, and to store peak flows during large rain events to minimize combined sewer discharges to the Pacific Ocean. The LMT is a 14-foot-diameter tunnel which extends approximate 1.6 miles from a diversion structure at John Muir Drive to a 72-inch-diameter pipeline beneath the Great Highway connecting the LMT to the Westside Transport Storage Box. The top of LMT elevation ranges from approximately 8.5 feet North American Vertical Datum (NAVD) in the north to 12.3 feet NAVD in the south[1], with depth of cover ranging from approximately 20 feet in the north to approximately 38 feet in the south (SPUR et al. 2015). The LMT has a wet-weather storage capacity of 9.5MG within the tunnel and 10.0 MG including connected sewers. The LMT is virtually empty during dry weather.

Westside Transport Box

The Westside Transport Storage (WST) system was constructed to collect both sanitary and combined flows from San Francisco's Sunset drainage area. WST is a 45-foot-deep by 25-foot-wide reinforced concrete box structure running 12,000 feet north to south under the Great Highway, from Fulton Street to Sloat Boulevard, where it enters the Westside Pump

[1] Mean sea level at Ocean Beach is approximately 3.2 feet NAVD (NOAA/Co-ops station 9414290).

Station at the intersection of Sloat Boulevard and the Great Highway. The facility has a useable storage volume of 49.3 MG.

Westside Pump Station

The Westside Pump Station (WSS) was constructed to drain the Westside Transport (WST). The WSP is located at the south-east corner of Sloat Boulevard and the Great Highway, adjacent to the San Francisco Zoo's parking lot. The facility consists of two primary components; west box and east box. The west box includes a sump with three dry-weather submersible pumps sized to transfer wastewater to OSP. The east box includes a sump with four submersible pumps sized to transfer decanted wet-weather effluent to SWOO. The WSS provides a critical primary treatment function by requiring wastewater to pass through mechanical bar screens to remove solids before leaving the pump station.

Westside Force Main

The Westside Force Main (WSFM) is comprised of a 48-inch-diameter precast concrete pipe that connects the WSS to the OSP. A 2,800-foot-long segment of the force main extends south from the dry-weather manifold at WSS along the east shoulder of the Great Highway, and then makes a 90-degree turn into the OSP. Currently, there is no redundancy to the WSFM; it serves as the only influent supply to OSP.

Oceanside Water Pollution Control Plant

The OSP receives wastewater pumped from WSS through WSFM and provides primary treatment for all flows up to the maximum plant capacity. The plant provides secondary treatment for all flows up to 43 MGD using a bypass line to accommodate excess primary effluent, and discharges all treated effluent to the Pacific Ocean via the SWOO. Wastewater receiving secondary treatment passes sequentially through fine screens, grit collectors, primary sedimentation tanks, aeration basins, and secondary clarifiers with gravity discharge to SWOO. During wet-weather events, excess primary effluent bypasses the aeration basins and secondary clarifiers to blend with the treated secondary effluent before discharging to SWOO.

Southwest Ocean Outfall

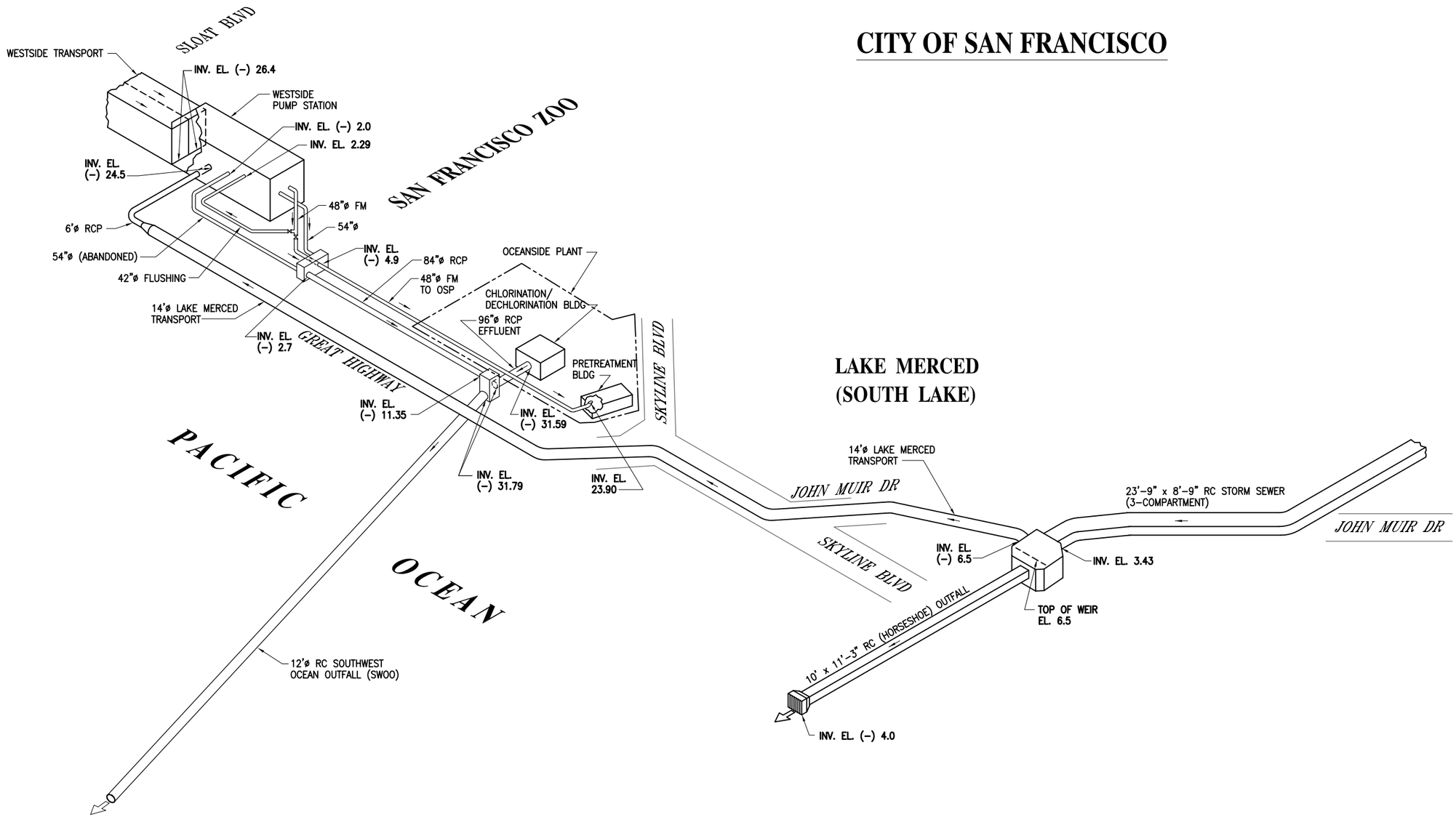
The SWOO is a 12-foot-diameter pipe, designed and constructed for off-shore discharge of treated effluent form the OSP, and overflow discharges when storage and treatment capacities are exceeded. The SWOO discharges into waters approximately 3.5 miles offshore, into federal waters.

Overflow Pipeline to Southwest Ocean Outfall

The overflow pipeline to the Southwest Ocean Outfall (SWOO) is an 84-inch-diameter, reinforced concrete pipe. The main function of the overflow is to convey effluent from the WSS to the SWOO during large rain events (see Westside Pump Station, above for additional discussion). At Westside Pump Station it originates as a 54-inch diameter pipe and then transitions to the 84-inch-diameter pipe at Vault 3, about one-third of the way to the SWOO.

CITY OF SAN FRANCISCO

LAKE MERCED (SOUTH LAKE)



NO.	DATE	DESCRIPTION	BY	APP.

TABLE OF REVISIONS

REFERENCE INFORMATION

WPCD ENG. SECTION

DESIGNED: DATE:

YT 09/03

DRAWN: DATE:

CHECKED: DATE:

WATER POLLUTION CONTROL DIVISION

PUBLIC UTILITIES COMMISSION

CITY AND COUNTY OF SAN FRANCISCO

WPCD/PUC APPROVALS

SECTION MANAGER DATE:

DIVISION MANAGER DATE:

Figure 2-3. SAN FRANCISCO WASTEWATER COLLECTION SYSTEM

SOUTHWEST WASTEWATER COLLECTION SYSTEM

JOB NO. EE–???

DRAWING NO. X–4

FILE NO. CW0000

REV. NO. 0

DATE: Oct 10 2003 13:12
FILE NAME: W:\Environmental\Tech Support Services\Engin Doc Resourses\WPCD\Isometric Wastewater Collection\Wastewater Collection Iso.dwg
XREFS: W:\Environmental\Tech Support Services\Engin Doc Resourses\WPCD\Isometric Wastewater Collection\TBLK –WPCD.dwg

Back page of Figure 2-3

2.5 Historic Responses to Coastal Hazards

As noted in the Section 2.3, since the mid-1990's, erosion has degraded surface conditions and increased the risk of wastewater system exposure. In response, the City has undertaken and participated in a number of studies and planning initiatives aimed at developing a long-term solution to the coastal erosion hazards along Ocean Beach. These initiatives include, among others, the 2012 Ocean Beach Master Plan (OBMP) and the 2015 multi-year Coastal Development Permit (CDP) authorizing placement of sand and sandbags through 2010 (see Section 2.7 for additional discussion).

Despite these initiatives, prior to 2012, the City's practical approach to proactive shoreline management was generally limited toconstructing sand berms. Major structural interventions, including the 1997/1999 600-foot-long Emergency Quarrystone Revetment (EQR) and the 2010 440-foot-long riprap revetment, were ad-hoc responses to erosion damage from El Niño storm events which threatened public access/recreation facilities, parking lots, and wastewater system infrastructure. A summary of notable interventions on the beach and bluff within the project area is provided below.

- 1997: Two rows of armor stone revetment
- 1999: A 600-foot-long rock revetment, commonly referred to as the Emergency Quarrystone Revetment (EQR), placed over the 1997 stone revetments
- 1999: 20,000 cubic yards of sand
- 2001: 12,000 cubic yards of sand
- 2003: 23,000 cubic yards and 15,000 cubic yards of sand (two separate placement events)
- 2010: A 440-foot-long riprap revetment
- 2012: An 80-foot-long sand bag revetment
- 2013: 77,000 cubic yards of sand
- 2016: 25,000 cubic yards of sand
- 2017: 70,000 cubic yards of sand

While the sand generally erodes from the bluff over the course of one or two ensuing storm seasons, each of the stone and sand bag revetments remains on the beach. In addition to these structures, a considerable amount of rubble and debris exists along SOB. This rubble includes fill material used in the construction of the Great Highway that has become exposed with bluff retreat. The debris is from the dumping of construction demolition waste in the 1970s. Together, the revetments, rubble, and debris provide varying levels of structural protection to wastewater system assets in the project area. However, their presence has also had a persistent and adverse effect on the public beach access, recreation, and wildlife habitat.

2.6 Regulatory Agency & Community Response

The prominence of these materials and their effects on the beach have been the subject of regulatory agency and community complaints. Notably, in 2010, the California Coastal Commission (CCC) – the State agency charged with regulating land use and development along the California coast – sent the City letters alleging the EQR and riprap revetment were unpermitted development which constituted violations of the Coastal Act (CCC 2010a; 2010b). In those letters, the CCC urged the City to either remove the revetments or apply for a coastal development permit (CDP) to authorize permanent retention of these structures. In response, the City submitted a CDP application requesting authorization to: retain the EQR and riprap revetment; construct a new 70-foot rock revetment; and construct two new tangent pile walls (270 feet and 175 feet), among other activities.

At the CCC's July 2011 meeting, the Commission denied the City's request, citing inadequate consideration of alternatives to the proposed developments, and the lack of a long-term strategy for shoreline management. The adopted findings supporting the Commission's denial action explain that that the City's application does not establish that that the proposed project is the least environmentally damaging option for shoreline protection. And to underscore its point, the Commission cites the "significant long-term planning under way under the auspices of the San Francisco Planning and Urban Research (SPUR) Association that is looking at larger alternatives for addressing shoreline erosion, protection of infrastructure, and enhancement and protection of beach recreational and other coastal resources". The findings go on to explain that "Given the nearness of completion of the first phase of long-range SPUR planning, it would be premature to approve the proposed revetments" (CCC 2011).

In August 2011, the California Coastal Protection Network (CCPN) filed a lawsuit in San Francisco County Superior Court (*California Coastal Protection Network v. City and County of San Francisco*), seeking to compel the City to take action to address conditions at South Ocean Beach, and to pay monetary penalties for Coastal Act violations. The City answered the complaint denying CCPN's allegations, and the parties ultimately agreed to resolve CCPN's concerns through a settlement agreement. The agreement sets forth a timeline for the City to initiate and implement a long-term adaptive management plan for South Ocean Beach. Specifically, the agreement acknowledges the Ocean Beach Master Plan process underway at the time, and acknowledges that "The City expects to proceed with environmental review of SPUR's Preferred Alternative recommendation, which is considering and may include managed retreat strategies, as well as debris removal and rerouting of the Great Highway from [South Ocean Beach]." The agreement was executed in May 2014 and remains in effect until December 31, 2021 (CCPN and CCSF 2014).

2.7 Current Planning Process

The City's current initiative draws upon the concepts developed through the OBMP process. In the intervening period since OBMP publication, the City has undertaken a number of studies and planning initiatives aimed at both short- and long-term solutions. A summary of the OBMP process and subsequent related planning initiatives is presented below.

2.7.1 Ocean Beach Master Plan

In 2009, the San Francisco Public Utilities Commission partially funded efforts to begin the planning process for development of the Ocean Beach Master Plan (OBMP). The OBMP was a multi-agency effort to develop a sustainable long-term vision for Ocean Beach, addressing public access, environmental protection and infrastructure needs in the context of erosion and climate-related sea level rise. Because of the many overlapping jurisdictions at Ocean Beach, SPUR was selected to manage the process for its capacity, its history of effective engagement in the creation of the Golden Gate National Recreation Area (GGNRA), and its recent body of policy research around climate change. SPUR assembled a team of technical consultants specializing in landscape design and urban planning, coastal engineering, ecology, transportation, and economics, began working on the OBMP in June 2010, and published a final plan in May 2012. The process included several public outreach workshops and presentations, as well as close coordination with the CCSF and regulatory agencies, including the US Army Corps of Engineers, the California Coastal Commission, and the National Park Service.

The OBMP presents a framework for understanding the wide range of issues and challenges across seven focus areas at Ocean Beach, including utility infrastructure, coastal dynamics, and public access, among others. The overarching goal for the OBMP is "To knit the unique assets and experiences of Ocean Beach into a seamless and welcoming public landscape, planning for environmental conservation, sustainable infrastructure, and long-term stewardship" (SPUR et al. 2012). To achieve this goal, the OBMP identifies a series of recommendations, or Key Moves. In total, the Plan presents six Key Moves, two for each of the three Ocean Beach Reaches (North, Middle, South). Each key move includes many individual recommendations; there are more than 40 in total.

The key moves for the South Reach involve relocation of the Great Highway (Key Move 1) and the introduction of a multipurpose coastal protection/restoration/access system (Key Move 2). Drawing upon technical analysis performed in support of concept development, the OBMB's Key Move 2 envisions: 1) relocating the Great Highway landward; 2) constructing a low-profile structure seaward of the Lake Merced Tunnel (LMT); 3) covering the low-profile structure with cobble and sand; 4) restoring the beach surface, and improving coastal access and ecological function; and 5) enhancing stormwater management through an infiltration wetland. The Plan identifies Next Steps to advance the Key Move, including development of an interim coastal protection strategy and a coastal engineering and feasibility study, among others.

2.7.2 Immediate-Term Coastal Erosion Management Plan and Coastal Development Permit

In the wake of the Coastal Commission's 2011 permit application denial, the SFPUC assumed the lead role in advancing a long-term coastal management strategy for South Ocean Beach. Recognizing that the design, permitting, and implementation of any such solution would take several years, and seeking to avoid emergency declarations and associated ad-hoc interventions to address coastal erosion hazards in the interim, the SFPUC commissioned a study of available non-structural, erosion control options that would provide temporary shoreline protection compatible with public access, recreation, and beach ecology. The associated report, *Immediate-Term Coastal Erosion Management Plan for South Ocean Beach* (*Immediate-Term Plan*; SPUR

et al., 2014), recommended three types of non-permanent interventions that would provide the desired level of protection while SFPUC completed the long-term strategy. The recommendations included: 1) continuing sand backpassing, where sand is excavated from North Ocean Beach, transported to South Ocean Beach, and placed in a sacrificial berm on the back beach seaward of the eroding bluff and parking facilities; 2) storage of sand bags for quick placement if needed (permeable sandbags filled with sand and placed at local "erosion hot spots"); and 3) rubble reuse, or the reconfiguration of existing deposits of concrete rock and rubble to form armored slopes at erosion hot spots.

In 2015, the SFPUC and CCC staffs worked together to identify mutually agreeable terms and conditions under which SFPUC could implement its multi-year, Immediate-term Coastal Erosion Management Plan, while finalizing the long-term strategy. This unique agreement, codified in the CDP, authorizes the SFPUC to undertake sand backpassing annually. In addition, it allows the SFPUC to stockpile filled sandbags at a nearby site for rapid deployment in the event that the bluff erodes to within a threshold distance from the LMT specified in the CDP. The permit also provides temporary (6-year) authorization for existing shoreline protection structures that were previously constructed under emergency or without permits (e.g., 1997/1999 EQR, 2010 riprap revetment, 2012 sandbag structure). The CDP requires annual monitoring and reporting regarding work performed during the monitoring period and progress made towards implementation of the long-term solution. The CDP is valid until December 31, 2021, by which time the SFPUC must either submit a CDP application for the long-term solution or plans for removal of the existing shoreline protection system and restoration of the affected areas (CCC 2015). As the CCC has historically not approved proposals to repurpose rubble for shoreline protection, the SFPUC did not seek approval for and the CDP does not authorize rubble reuse.

2.7.3 Coastal Protection Measures & Management Strategy for South Ocean Beach

Concurrent with its immediate-term planning efforts, the SFPUC was also moving forward with development of a long-term strategy for South Ocean Beach. Aided by consultants the SFPUC oversaw preparation of the report *Coastal Protection Measures and Management Strategy for South Ocean Beach* (SPUR et al., 2015). The report further refines the OBMP concepts, and considers their feasibility in light of existing and anticipated future conditions at South Ocean Beach. The report presents an analysis of Lake Merced Tunnel (LMT) vulnerability to coastal hazards over time, and establishes "triggers" for intervention, based upon horizontal and vertical structural stability and safety buffers between the tunnel and soil around the LMT. As shown in **Figure 2-4**, the horizontal trigger is 35 feet, comprised of a 10-foot structural buffer and 25-foot safety buffer. The vertical trigger is 6 feet, the estimated cover required to resist buoyancy forces.

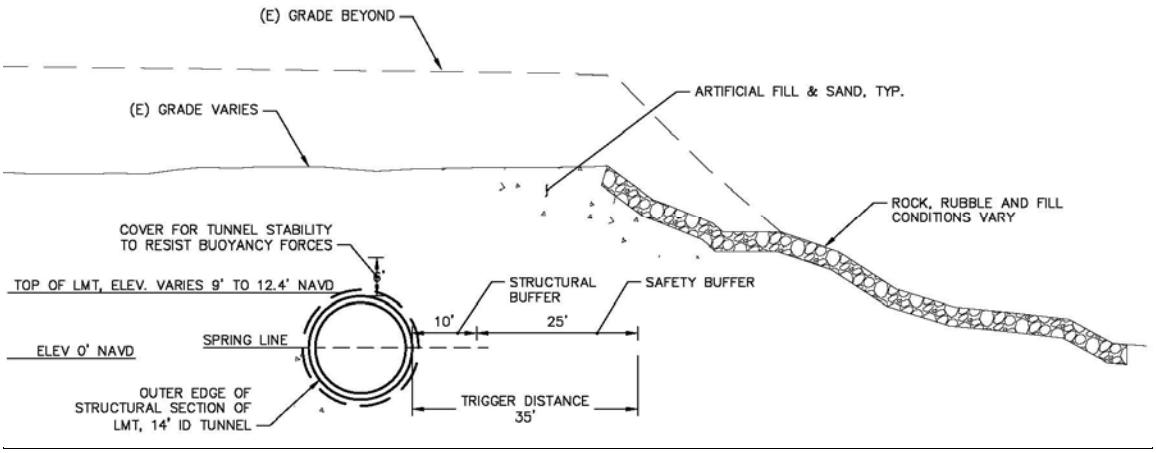


Figure 2-4: Typical Section of LMT and Bluff: Structural Buffer and Trigger Distances

With input from the consulting team and a technical advisory committee (TAC), the OBMP recommendations were refined into a preferred project concept that would be technically feasible, in light of the above-described vulnerability and hazard analyses, and consistent with guiding principles for the long-term solution. The TAC was comprised of technical experts from a range of relevant disciplines, including coastal management, littoral and climate science, infrastructure, and regulatory processes. The guiding principles included the following:

- Multi-objective approach, incorporating
  - Protection of the LMT and associated infrastructure
  - Ecological function
  - Recreation and access
  - Aesthetics and landscape character
- Emphasis on softer solutions wherever possible
- Adaptive management, incremental implementation
- Compatibility with OBMP recommendations

The preferred project concept consists of a low-profile vertical wall to provide lateral constraint of the LMT, placed at the minimum structural buffer distances associated with the above-described intervention triggers. In some locations, a horizontal slab, or cap, would be added on the top of the LMT to provide additional protection, buoyancy resistance and vertical restraint. The report cites the Taraval Seawall, a low-profile seawall constructed at the end of Taraval Street in the 1940s, as an example of how the proposed structure might appear in its finished condition. Consistent with the OBMP recommendations, the preferred project concept includes surface restoration, including improved drainage and rubble removal; sand nourishment, construction of back-beach dunes, and revegetation; and construction of public access improvements.

3.0 POTENTIAL PROJECT OPTIONS AND SCREENING ANALYSIS

3.1 Potential Project Options and Screening Analysis

3.1.1 Potential Project Options

Drawing upon historic studies and proposals, the OBMP process, stakeholder and regulatory agency concerns, and the perspectives and experience of City planning and engineering personnel, the SFPUC developed a list of potentially feasible project options. The only criteria for their inclusion on the list was whether the option could potentially address the identified Project Need (Section 2.2). The options identified ranged from onshore to offshore, and structural and non-structural interventions, and various combinations thereof. As protection of critical infrastructure is a key element of Project Need, and the LMT is the seaward-most component of the existing wastewater system, the LMT features prominently in each of the options considered. As is common practice for SFPUC Alternatives Analysis Reports, a No Project option was also considered. The list of initial no-project and project options is presented below, followed by brief summaries of each.

- No Project Option: Remove Shoreline Structures and Restore Beach
- Project Option No. 1: Protect LMT with Exterior Low-profile Wall
- Project Option No. 2: Protect LMT by Replenishing Sand
- Project Option No. 3: Protect LMT with Rip-rap or Similar
- Project Option No. 4: Protect LMT with Breakwater
- Project Option No. 5: Protect LMT with Artificial Reef
- Project Option No. 6: Protect LMT with Groins or Groin Field
- Project Option No. 7: Protect LMT with Interior Reinforcement + New Storage
- Project Option No. 8: Remove LMT and New Tunnel Alignment
- Project Option No. 9: Remove LMT and New Pump Station, Pipeline & Storage

No Project Option - Remove Shoreline Structures and Restore Beach

Under the No Project scenario, the SFPUC would remove the existing shoreline protection system (EQR, revetment, sandbag structure) and rubble, as required per the 2015 CDP. However, no further interventions would be undertaken.

Project Option No. 1 – Protect LMT with Exterior Low-profile Wall

Project Option No. 1 would consist of building an underground, low-profile seawall along the length of the LMT to protect it from coastal erosion. The seawall could be constructed of reinforced concrete, injected soil mix (“jet-grout”), or secant piles, and would extend deep below the existing tunnel elevation to provide stability in the event of exposure. To address the potential for buoyancy as the overburden is eroded away, a concrete cap would be installed which would help hold the tunnel in place.

Project Option No. 2 – Protect LMT by Replenishing Sand

Project Option No. 2 would involve construction of sacrificial sand berms along South Ocean Beach. Each placement event would utilize approximately 400,000 cubic yards of sand, with up to 2,000,000 cubic yards being placed over a 10- to 30-year period as conditions warrant, but not all at once. Periodic inspections would be done prior to each rainy season and after every severe storm to ensure the LMT is not threatened. If a severe storm were to occur and the beach and bluff were eroded to near the threshold trigger, previously stored sand bags would be installed to mitigate the situation until the next sand placement event. This approach mirrors the current immediate-term coastal management strategy described in Section 2.7. One potential source of this material is sand dredged from the San Francisco Bay Bar by the U.S. Army Corps of Engineers to maintain the shipping channel. If dredged sand were not available, sand would be transported from NOB or other beach site, if available, or imported from a local quarry.

Project Option No. 3 – Protect LMT with Rip-rap or Similar

Project Option No. 3 would involve the placement of rip-rap (or other hard material) along the entire shoreline of South Ocean Beach. Under this option, approximately 13,000 cubic yards (about 24,500 tons) of boulders would be installed as a 4,000-foot-long strip along the toe of the remaining portion of unarmored bluff. The strip would be roughly 20 feet wide and 4 feet thick. To prevent the rip-rap from sinking into the existing sand, the rocks would be laid on top of a geofabric.

Project Option No. 4 – Protect LMT with Breakwater

Project Option No. 4 would involve the installation of a breakwater. Under this option, the breakwater would be built with well-graded cobbles and boulders. The boulders would weigh several tons each. The material would be stacked into three linear groupings ranging from 500 to 1,000 feet in length, and positioned about 500 feet off shore. To be effective, the boulders would rise above the water line by about ten feet. At this location, the ocean floor is about 30 feet deep. Therefore, if the boulders are stacked at a 3 horizontal:1 vertical slope, the base would be over 120 feet wide and 40 feet tall. Once completed, the breakwater would need periodic maintenance to replace dislodged stones.

Project Option No. 5 – Protect LMT with Artificial Reef

Project Option No. 5 would involve the installation of an artificial reef. The artificial reef construction and maintenance would be similar to a breakwater, except that it would not rise above the water surface. The reef would likely be comprised of concrete blocks; however, other man-made objects such as oil drilling platforms, ships, or automobiles could be used. Because the reef would not rise above the water surface, its ability to absorb wave energy would be reduced relative to a breakwater. To address this limitation, the reef could be designed to redirect wave energy toward another part of the shoreline instead of absorbing it.

Project Option No. 6 – Protect LMT with Groins or Groin Field

Project Option No. 6 would involve the installation of groins, or jetties. This option would also be similar to a breakwater, except that the structure would be built perpendicular to the shoreline and extend hundreds to thousands of feet into the ocean. Under this option, two large groins

would be constructed, each approximately 250 feet in length, and located approximately 1,000 feet apart. Two smaller groins, each measuring approximately 150 feet in length, would be built another 1,000 feet to the north and south of the large groins respectively. Each groin would rise approximately 10 feet above the water surface. The groin structures would require periodic monitoring and repositioning or replacement of damaged or displaced armor units.

Project Option No. 7 – Protect LMT with Interior Reinforcement and New Storage

Project Option No. 7 would involve reinforcement of the existing LMT by adding a 2-foot-thick reinforced concrete liner inside the existing tunnel. This liner would be installed along the stretch north of Skyline Boulevard. Similar to Project Option No. 1. Under this option, a new 1.1 million gallon (MG) underground storage reservoir would be constructed to offset the conveyance capacity displaced by the concrete liner. The reinforced tunnel and storage basin would require periodic monitoring and regular maintenance to remove sand.

Project Option No. 8 – Replace and Realign Tunnel

Project Option No. 8 would involve removal of the LMT and routing a new conveyance pipeline around the back of the San Francisco Zoo. Under this option, the existing LMT would be terminated at the intersection of Skyline Boulevard and the Great Highway. At this location, a new tunnel would start and continue north along Skyline Boulevard. As it nears Sloat Boulevard, the new tunnel would curve westward and then follow Sloat Boulevard to the Westside Pump Station. The new tunnel would be tied into the transport boxes that are under the Great Highway. Shorter alignments may be available.

Project Option No. 9 – Replace Existing Tunnel with New Pipeline and Storage

Project Option No. 9 would involve removal of the LMT and replacing it with a new 100-MGD-capacity pump station; 4,200 feet of reinforced concrete cylinder pipe; and a new 3.7 million-gallon storage reservoir. Under this option, sewage from the existing LMT would be intercepted by the new pump station and directed to the reservoir by the new pipeline. The reservoir would be required to replace the storage capacity provided by the existing LMT. Sewage stored in the reservoir would be pumped to the OSP via the WSS.

3.2 Initial Screening (Fatal Flaw Analysis)

Once established, the list of no project and project options was further screened for “fatal flaws”, or issues that would render them impractical and/or infeasible. The primary factors considered in the screening process were the extent to which the project options met the Project Goal and Objectives. Technical and economic feasibility were also considered in the screening process, but were secondary. An overview of the bases for rejecting infeasible options is presented below and summarized in **Table 3-1**, below.

Table 3-1: Project Option Fatal Flaw Analysis

Project Option	Rationale for Rejection	Fatal Flaw
No. 2 – Protect LMT by Replenishing Sand	• No assurance of LMT protection over time with sea level rise (i.e., intervention trigger could be reached in a single storm season) • No assurance of sand availability • Uneconomical due to volume and frequency of sand placement required	• Inconsistent with project Goal & Objectives of maintaining operational capacity and increasing resilience to sea level rise
No. 3 – Protect LMT with Rip-rap or Similar	• Could further impede public access to and along the beach • Could further impact habitat • Less environmentally damaging alternatives exist • Unlikely to be authorized by regulatory agencies with jurisdiction (e.g., CCC, Corps, RWQCB).	• Inconsistent with Project Goal and Objectives related to compliance with applicable laws and regulations and improvement of beach access, recreation, and habitat.
No. 4 – Protect LMT with Breakwater		
No. 5 – Protect LMT with Artificial Reef		
No. 6 – Protect LMT with Groins or Groin Field		

The No Project Option was rejected because it would not meet the Project Need to protect threatened wastewater infrastructure. Rather, in the absence of the existing shore protection, critical infrastructure would be more vulnerable to hazards associated with coastal erosion and sea level rise.

Project Option No. 2 was found infeasible due primarily to its inability to assure protection for critical wastewater system infrastructure over the planning horizon. As noted in Section 2.7.3, a 35-foot intervention trigger has been established for the LMT. Due to the seaward protrusion of the constructed bluff at SOB, it could experience 40 feet of erosion in a single severe storm event (i.e., 25-year return period) (Moffatt & Nichol 2012; SPUR et. al. 2015). Given the amount of bluff cover remaining over the LMT, its susceptibility to erosion during extreme storms, and the critical nature of the asset, the SFPUC concluded that reliance upon sand replenishment alone would present an unacceptable hazard risk, especially when considering for sea level rise and extreme storm events. For example, during the 2016-2017 storm season, the shore was observed to be within 43 feet of the LMT's intervention trigger at its nearest point, also the location of the 2012 sandbag wall (ESA 2017). Under Project Option 2, in the absence of the sandbag wall, and with a few strong storms, the intervention trigger could be reached, thereby necessitating emergency intervention.

Project Options Nos. 3-6 which involve substantial structural interventions on the beach or nearshore were rejected primarily due to their implications for beach access and recreation, and because regulatory agencies such as the CCC would likely find them inconsistent with applicable regulations due to there being other less environmentally damaging alternatives.

Options carried forward for detailed analysis (i.e., Project Option Nos. 1, 7, 8, 9) are addressed in the section that follows.

4.0 PROJECT ALTERNATIVES

4.1 Summary of Alternatives

This section presents the potentially feasible alternatives carried forward for detailed analysis. Alternatives addressed in this section include:

- Alternative A – Protect LMT with Exterior Low-Profile Wall
- Alternative B – Protect LMT with Interior Reinforcement and New Storage
- Alternative C – Remove LMT and New Tunnel Alignment
- Alternative D – Remove LMT and New Pump Station, Pipeline, and Storage

Elements common to all alternatives are briefly summarized, followed by descriptions of elements unique to the individual alternatives. In addition to the key physical components of each alternative, this section also addresses for each alternative the additional characteristics of cost, construction, operation, and land access. These additional characteristics help form the basis for the alternatives evaluation. The alternatives are depicted graphically in **Figures 4-1** through **4-4**. Consistent with the OBMP, the planning horizon for the alternatives presented herein is 40 years (2060), with a reevaluation of effectiveness/necessity assumed after 20 years (2040).

4.2 Elements Common to Alternatives

Consistent with the vision set forth in the OBMP and the requirements of the 2015 CDP temporarily authorizing the existing shoreline protection system and ongoing management (Section 2.7), SFPUC would undertake certain actions regardless of which alternative were selected. Whereas the individual alternatives generally concern structural interventions, elements common to the alternatives generally concern non-structural surface conditions of the beach and bluff portions of the project area. Elements common to the alternatives include:

- Removing shoreline armoring and rubble
- Improving beach access, recreation and habitat
- Rerouting the Great Highway between Sloat and Skyline Boulevard
- Recontouring and revegetating the bluff
- Continued sand nourishment
- Improving stormwater management

In addition to the above actions, the SFPUC would continue sand nourishment of South Ocean Beach. Nourishment activities would include sand placement, planting, and installation of measures to control wind-blown sand. For each alternative, SFPUC would place up to 100,000 cubic yards of sand every three years, at an estimated cost of $12 per cubic yard plus design and contracting costs (2017 dollars). The total cost of annual beach nourishment would be an estimated $700,000. As they would occur under whichever alternative is selected, the above listed actions are not restated under the alternatives descriptions that follow. Moreover, these common elements do not affect the alternatives analysis or scoring.

4.3 Alternative A – Protect LMT with Exterior Low-Profile Wall

4.3.1 Alternative Summary

This alternative would involve constructing a structural low-profile wall seaward of the LMT to protect the structure from ongoing beach and bluff erosion. The wall would be built adjacent to the LMT; the length would be approximately 3,000 linear feet, starting at Sloat Boulevard and extending south. The seawall would utilize a secant pile wall system, with a 4-foot-thick concrete cap to protect the LMT. Concrete grade beams would be used to connect the piles to the concrete cap, forming a protectant "box" around the LMT. A plan view of Alternative A is presented in **Figure 4-1**. A typical cross-section of Alternative A is shown in **Figure 4-5**.

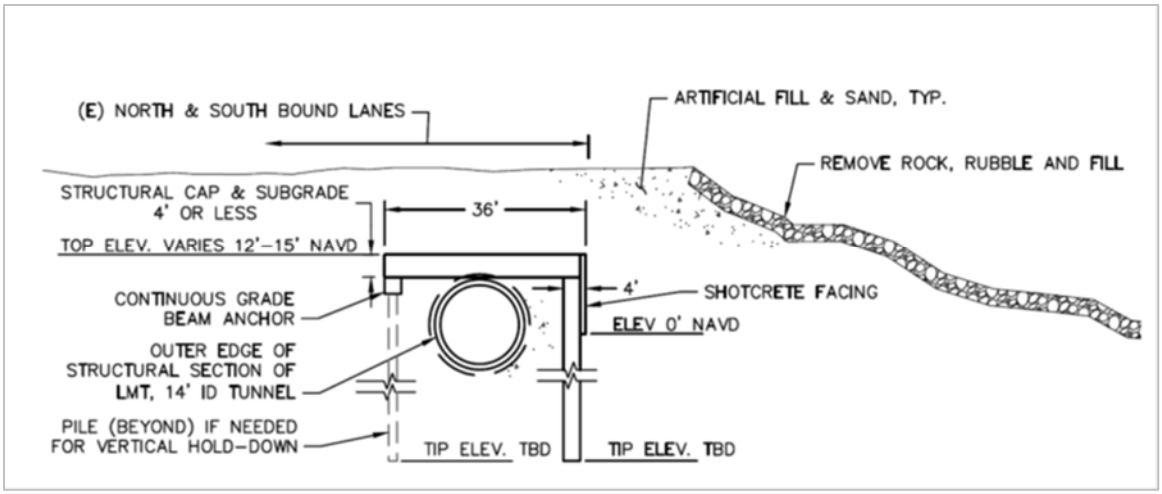


Figure 4-5: Typical Section of Exterior Low-Profile Wall

4.3.2 Cost

The estimated construction cost of this alternative is $91.6M. The estimated cost is based upon American Association of Cost Estimators (AACE) Class 4 estimates (Appendix A), which are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. The estimated Operations and Maintenance (O&M) cost for this alternative is $916,000, representing 1% of the construction cost. This includes ongoing facility maintenance and repair, and detailed inspection once every ten years.

4.3.3 Construction

The construction footprint for Alternative A would be approximately 148,500 square feet, which includes a 50-foot construction corridor along the 2,970-linear-foot-wall alignment. Construction would take approximately 28 months of continuous work to complete. The construction of Alternative A would not disrupt operation to the LMT, as the tunnel would be reinforced externally. This would reduce the risk of unregulated release from the LMT during construction, as the facility will not be out of service and a redundant system would not be required. The wall would be built generally within and proximate to the LMT's original construction footprint; therefore, there would be a low likelihood of encountering unknown utilities or other unforeseen conditions.

Figure 4-1.
Alternative A. Protect LMT with Low-Profile Wall

NOTES:

1. Full road closure between Sloat Blvd and Skyline Blvd.
2. 50' width of road impact along the length of the alignment.

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

LAKE MERCED TRANSPORT AND STORAGE TUNNEL

FIGURE - ALTERNATIVE A

T:\DESIGN\SWFAC01\PHASE-A\EXHIBITS\ACTIVE\LAKE_MERCED_BRIDGE\SLT_101717\FIGURE-01 - ALT A.DWG

Figure 4-2.
Alternative B. Protect LMT with Interior Reinforcement and New Storage

NOTES:

1. Full road closure between Sloat Blvd and Skyline Blvd.
2. 50' width of road impact along the length of the alignment.

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

LAKE MERCED TRANSPORT AND STORAGE TUNNEL

FIGURE - ALTERNATIVE B

Figure 4-3.
Alternative C. Remove LMT and New Tunnel Alignment

40TH AVE
41ST AVE
42ND AVE
43RD AVE
44TH AVE
45TH AVE
46TH AVE
47TH AVE
WAWONA ST
YERBA ST
SLOAT BLVD
SKYLINE BLVD
COUNTRY CLUB DR
BERKSHIRE WAY
LAKESHORE DR
LAKE MERCED BLVD
LAKE MERCED
14'Ø TUNNEL (5,800± LF)
PACIFIC ROWING CLUB
LAKE MERCED
ZOO ROAD
HERBST ROAD
SAN FRANCISCO ZOO
ZOO MAINTENANCE YARD AND OFFICES
CALIFORNIA NATIONAL GUARD ARMORY
OCEANSIDE TREATMENT PLANT (OSP)
WEST SIDE PUMP STATION
GREAT HIGHWAY
GREAT HIGHWAY
SKYLINE BLVD

NOTES:

1. Partial road closure between Sloat Blvd and Skyline Blvd.
2. 50' width of road impact along the length of the alignment.

0 150 300 450
SCALE: 1" = 300'-0"

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

LAKE MERCED TRANSPORT AND STORAGE TUNNEL

FIGURE - ALTERNATIVE C

T:\DESIGN\CWIFAC01\PHASE-A\SCHEMATICS\ALTERNATIVES BROKE\SLT_101717\FIGURE-01 - ALT C.DWG

Figure 4-4.
Alternative D. Remove LMT and New Pump Station, Piopelines, and Storage

40TH AVE
41ST AVE
42ND AVE
43RD AVE
44TH AVE
45TH AVE
46TH AVE
47TH AVE
WAWONA ST
YERBA ST
SLOAT BLVD
SKYLINE BLVD
COUNTRY CLUB DR
BERKSHIRE WAY
LAKESHORE DR
LAKE MERCED BLVD
LAKE MERCED
PACIFIC ROWING CLUB
LAKE MERCED
ZOO ROAD
HERBST ROAD
SAN FRANCISCO ZOO
6'Ø HDPE (3,800± LF)
PUMP STATION (250'100')
CALIFORNIA NATIONAL GUARD ARMORY
SKYLINE BLVD
ZOO MAINTENANCE YARD AND OFFICES
UNDERGROUND STORAGE TANK (420'x150')
ZOO PARKING
WEST SIDE PUMP STATION
OCEANSIDE TREATMENT PLANT (OSP)
GREAT HIGHWAY
GREAT HIGHWAY

0 150 300 450
SCALE: 1" = 300'-0"

NOTES:

1. Partial road closure between Sloat Blvd and Skyline Blvd along the Great Highway and Herbst Road.
2. 50' width of road impact along the length of the alignment.

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

LAKE MERCED TRANSPORT AND STORAGE TUNNEL

FIGURE - ALTERNATIVE D

As noted previously, Alternative A would likely utilize a secant pile wall system. Holes for the concrete piers would first be drilled or augured and stabilized before the concrete is poured. The secant piles would be reinforced with either steel rebar, or with steel beams. The piles would be staggered, allowing for overlap which would create a water-tight wall. Following concrete pile installation, the area would be excavated for grade beams and concrete cap installation. The alternative could require piers to be drilled approximately 40-50 feet below ground surface (bgs) and excavation depths of 15 or 20 feet bgs. If required to counter tunnel buoyancy due to high groundwater, the contractor could install a dewatering system and/or build the wall in segments. Following grade beam system and concrete cap construction, the structure would be backfilled with imported material, regraded, and surface improvements would be installed. South of Sloat Boulevard, the southbound lanes of the Great Highway and parking lots would require closure during construction and traffic would be rerouted.

4.3.4 Operational Functionality

This alternative would not require disruption to or disconnection of the LMT; therefore, the structure's hydraulics, storage, transport capacity, and other operational functions would not be affected. Once completed, Alternative A would be fully compatible with and integrated into the current system. No additional time would be required for adaptation to the system and/or phasing.

4.3.5 Land Ownership/Access Issues

This alternative would involve construction on SFPUC-owned land. As a result, no permanent land acquisition or access permissions would be required. Temporary authorizations for access to laydown, staging, and construction areas would be required from agencies with land ownership and/or management interests in the project area, such as GGNRA, SFPW, SFMTA, and Caltrans. Staging areas could include northbound lanes of the Great Highway and land between the San Francisco Zoo and the OSP.

4.4 Alternative B – Protect LMT with Interior Reinforcement and New Storage

4.4.1 Alternative Summary

This alternative would involve reinforcing the existing LMT with a 2-foot-thick concrete liner along the tunnel's interior. This reinforcement would begin at Sloat Boulevard and extend approximately 3,000 feet south. The new liner would stabilize and provide greater structural integrity to the subject LMT segment. Additional analysis for this alternative would need to be conducted during the design stage to evaluate whether measures to counteract buoyancy were needed beyond the interior reinforcement. The new concrete liner would reduce the capacity of the LMT and the entire Westside Treatment System. To compensate for this loss, a new 1.1 MG underground reservoir would be constructed. The new reservoir would be connected via 6-foot diameter pipe beneath the Great Highway to the WST. A plan view of Alternative B is presented in **Figure 4-2**. A typical section of Alternative B is presented in **Figure 4-6**.

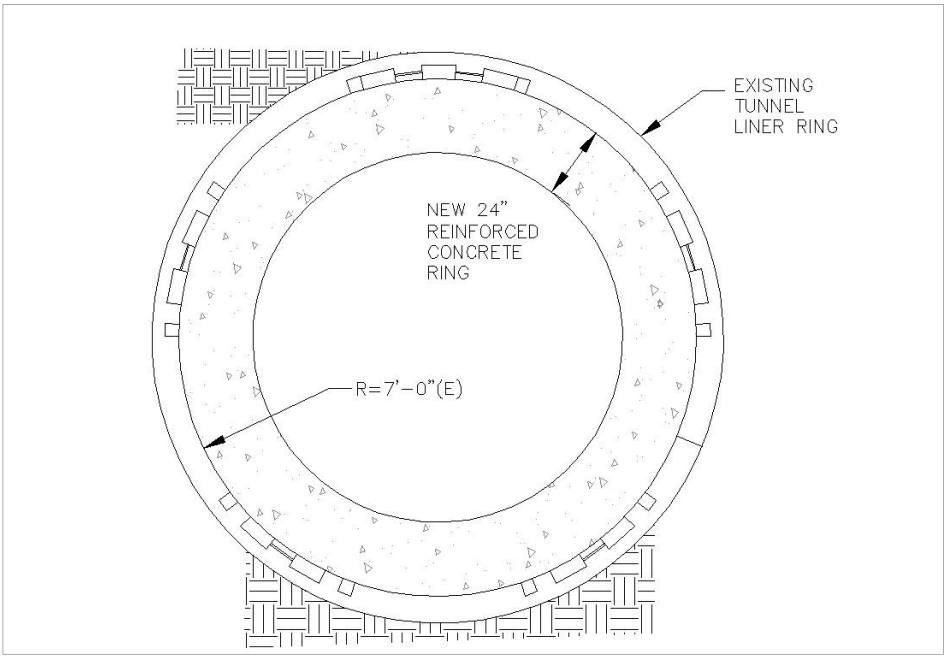


Figure 4-6: Typical Section of Reinforced Concrete Tunnel

4.4.2 Cost

The estimated construction cost of this alternative is $132.2M. Details of the AACE Class 4 cost estimate can be found in Appendix A. The estimated O&M cost for this alternative is approximately $1,320,000, representing 1% of the construction cost. This includes ongoing maintenance and repair of the facility, plus a detailed inspection of the reservoir every five years and of the tunnel every ten years.

4.4.3 Construction

The construction footprint for Alternative B would be approximately 211,500 square feet, which includes a 50-foot construction corridor along 2,970 linear feet of the LMT, plus a 63,000 square-foot reservoir construction area. Construction would take approximately 48 months, spanning three dry seasons, where the internal reinforcement of the tunnel would be constructed only in the dry weather season, from May to October, so that the wet weather function of the LMT will not be disrupted. The reinforcements would be built within the existing footprint and trench of the LMT, and the reservoir would be constructed within the footprint of the existing Zoo parking lot; therefore, there would be a low likelihood of encountering unknown utilities or other unforeseen conditions.

In order to access the tunnel, several access pits would be excavated to depths of 30 feet bgs along the segment of the LMT to be reinforced. The concrete for the tunnel's liner would be installed via these access pits. A portable concrete batch plant would be installed onsite to ensure uniform concrete material installation. The reservoir and connecting pipeline would be constructed prior to the concrete liner construction. South of Sloat Boulevard, the southbound lanes of the Great

Highway and parking lots along Great Highway, along with a portion of the parking lot at the Zoo would require closure and traffic would need to be rerouted accordingly.

4.4.4 Operational Functionality

This alternative would not affect the current role of the LMT. However, it would reduce the capacity of the LMT post-construction. The capacity reduction would be compensated by the new 1.1 MG underground reservoir. The addition of the reservoir would further increase start-up and integration time. It is estimated that approximately 3 months would be required to adapt or integrate this new infrastructure into the system and exercise the operational function and strategy of the new piping and storage system.

4.4.5 Land Ownership/Access Issues

This alternative would involve reinforcement of existing infrastructure on SFPUC-owned land. As a result, the tunnel reinforcement work would not require permanent land acquisition or access rights. Temporary authorizations for access to laydown, staging, and construction areas (e.g., excavation for the tunnel pits) would be required from agencies with land ownership and/or management interests in the project area, such as GGNRA, SFPW, SFMTA and Caltrans. Also, if a shoring system is required for tunnel excavation, additional approvals may be required to allow construction on GGNRA property. Construction of the reservoir would require land acquisition and access permissions from SF Rec and Parks, likely in the form of a Memorandum of Understanding (MOU), for work within the SF Zoo property. Staging areas could include the northbound lanes of the Great Highway and a portion of the SF Zoo parking lot.

4.5 Alternative C – Remove LMT and New Tunnel Alignment

4.5.1 Alternative Summary

This alternative would involve constructing a new 5,800-foot-long, 14-foot-diameter tunnel along a new alignment, running from the WSS at the Sloat Boulevard-Great Highway intersection south to the Skyline Boulevard-Great Highway intersection. The tunnel would be approximately 40 to 50 feet bgs and extend beneath the SF Zoo. Upon completion of new tunnel construction, the current LMT would be demolished and removed. A plan view of Alternative C is presented in **Figure 4-3**. The configuration of the Alternative C components presented in the figure is but one of many potential options. Regardless of configuration, the cost, construction, operational functionality, and land access and ownership issues would be substantially similar to those described for Alternative C, and therefore would be expected to perform similarly, relative to the other alternatives evaluated in this AAR.

4.5.2 Cost

The estimated construction cost of this alternative is $268.4M, which is comprised of $168.4M to construct the new tunnel alignment and $100M to demolish the existing LMT structure. Details of the AACE Class 4 cost estimate can be found in Appendix A. The estimated O&M cost for this alternative is approximately $1,684,000, which represents 1% of the direct

construction cost, excluding the cost of the LMT demolition. This includes ongoing maintenance and repair of the facility, plus a detailed inspection every five to ten years.

4.5.3 Construction

The construction footprint for Alternative C would be approximately 438,500 square feet, which includes a 50-foot construction corridor along a 5,800-linear-foot new tunnel alignment, plus an additional 148,500-square-foot area required for demolition and removal of the existing LMT. New tunnel construction would take approximately 43 months, and demolition of the existing LMT would take approximately 11 months. These actions would occur in sequence so as to minimize disruption to LMT function and avoid the need for a redundant system during construction. Accordingly, the total duration of construction is estimated to be 4 years and 6 months.

A trenchless technique, such as a tunnel-boring, would be utilized for tunnel construction. A deep shaft would be constructed at the SF Zoo parking lot near the Sloat Boulevard-Great Highway intersection, and another at the Skyline Boulevard-Great Highway intersection. These shafts would serve as the tunnel boring machine's launching and receiving pits. A conveyor belt and/or rail car system would be installed to facilitate soil removal and off-haul. In addition, a ventilation system would be installed for worker safety. In the area of the receiving pit, the tunnel would narrow to 6 feet in diameter and connect to the existing Westside transport box. Most of the new tunnel could be constructed independent of the LMT. However, the final connection would require the LMT to be shut down and, therefore, would have to occur in the dry season, from May to October.

South of Sloat Boulevard, the southbound lanes of the Great Highway and parking lots along Great Highway, along with a portion of the parking lot at the Zoo would require closure and traffic would need to be rerouted accordingly. Worker safety risks are high in tunnel construction projects. Accordingly, this alternative would be regulated by the California Department of Industrial Relations, Division of Occupational Safety, also known as Cal OSHA, and a permit would be required from the agency's Tunnel and Mining Division.

4.5.4 Operational Functionality

Upon completion of the new tunnel, a shutdown of the LMT would be required to connect the new tunnel with the existing wastewater collection system. An estimated period of 3 months would be required to adapt or integrate this new infrastructure into the system and exercise the operational function and strategy of the tunnel. Given the short duration of down time and that this would occur during the dry weather season, risk of unregulated release would be minimal and no redundant system would be constructed.

4.5.5 Land Ownership/Access Issues

This alternative would require land acquisition and access permissions be obtained from agencies with ownership and/or management interests in portions of the project area along Skyline Boulevard that are not under SFPUC ownership. Such agencies include, but may not be limited to GGNRA, Caltrans, and SF Rec and Parks. Given the scope of this alternative, the approvals would likely take the form of an MOU, which would likely require a considerable amount of

time to finalize. Temporary authorizations for access to laydown, staging, and construction areas would also need to be obtained from SFPW and SFMTA.

4.6 Alternative D – Remove LMT and New Pump Station, Pipeline, and Storage

4.6.1 Alternative Summary

This alternative would involve replacing the LMT with a new 100-MGD-capacity pump station; 4,200-linear-foot, 6-foot-diameter high-density polypropylene cylinder pipeline; and a 3.7 MG underground reservoir. The new pump station would be located at the Skyline Boulevard-Great Highway intersection. The new underground reservoir would be located beneath the SF Zoo parking lot, near the Sloat Boulevard-Great Highway intersection. The new pipeline would extend south, from the new reservoir through the Zoo property and along Herbst Road and Skyline Boulevard to a point of connection with the new pump station. Under this alternative, the existing LMT would act as a sump for the pump station; the new pump station would lift water from the LMT to the new pipe. The water would then flow through the pipe via gravity to the new reservoir. From the reservoir, the water would flow to the east transport/storage box where it would be connected to the Westside transport system. A plan view of Alternative D is presented in **Figure 4-4**. As also noted for Alternative C, above, the configuration of the Alternative D components presented in the figure is but one of many potential options. Regardless of configuration, the cost, construction, operational functionality, and land access and ownership issues would be substantially similar to those described for Alternative D, and therefore would be expected to perform similarly, relative to the other alternatives evaluated in this AAR.

4.6.2 Cost

The estimated construction cost of this alternative is $244.4M, which is comprised of $144.4M to construct the new pump station, pipeline and reservoir and $100M to demolish the existing LMT structure. Details of the AACE Class 4 cost estimate can be found in Appendix A. The estimated O&M cost for this alternative is approximately $2,166,000M, which represents 1.5% of the construction cost. This includes the cost of staffing (assumes 2 full-time-equivalent staffers), and ongoing operations and repairs for the new facilities.

4.6.3 Construction

The construction footprint for Alternative D would be approximately 446,500 square feet. This includes a 50-foot construction corridor along a 4,200-linear-foot new pipeline alignment, an additional 63,000-square-foot area required for reservoir construction, and a 25,000-square-foot area for pump station construction. The footprint also includes the approximately 148,500-square-foot area required for LMT demolition. Construction and demolition activities would span approximately 45 months, including 34 months for the construction of the new structures and 11 months of demolition for the existing structures. The three new structures would be built simultaneously, but separate from LMT demolition. This would allow for expedited construction, while minimizing disruption to LMT function and avoiding the need for a redundant system

during construction. Accordingly, the total duration of construction is estimated to be 3 years 9 months.

The preferred location for the new pump station is the northeast quadrant of the Great Highway-Skyline Boulevard intersection. A significant amount of hillside excavation and a retaining wall would be required to accommodate the new structure at this location. The new pipeline would be constructed using the open cut method. A dewatering system along the length of the new alignment would need to be installed to control groundwater. Additionally, shoring would be required for new pipeline installation, as the depth of the pipe would vary from 4 feet to 20 feet bgs. The reservoir could also be constructed using open cut methods with shoring. Most of the new infrastructure could be completed independent of the LMT. However, the final connection would require the LMT to be shut down and, therefore, would have to occur in the dry season, from May to October.

South of Sloat Boulevard, the southbound lanes of the Great Highway and parking lots along Great Highway and a portion of the parking lot at the Zoo would require closure, and traffic would need to be rerouted accordingly. In addition, access and recreation in the vicinity of Lake Merced could be limited due to pump station and pipeline construction.

4.6.4 Operational Functionality

Upon completion of the new facilities, a shut-down of the LMT would be required to connect the new system with the existing Westside collection system. Given the substantial complexity and effort required to adapt and integrate the new infrastructure, approximately 6 months would be needed to for start-up, testing, and commissioning of the new pump station, reservoir and pipeline, to ensure that the operational strategy for the facilities is implemented. Given the duration of down-time is about the same as the typical dry-weather season (May to October), it is assumed that the integration work could be completed before the onset of the wet season. However, there would be little room for schedule delays. Therefore, this alternative would have an increased risk of unregulated release due to an unseasonable storm event.

4.6.5 Land Ownership/Access Issues

This alternative would require land acquisition and access permissions be obtained from agencies with ownership and/or management interests in portions of the project area between Sloat Boulevard and Skyline Boulevard that are not under SFPUC ownership. Such agencies include, but may not be limited to GGNRA, Caltrans, and SF Rec and Parks. Given the scope of this alternative, the approvals would likely take the form of an MOU, which would likely require a considerable amount of time to finalize. Temporary authorizations for access to laydown, staging, and construction areas would need to be obtained from SFPW and SFMTA.

5.0 EVALUATION CRITERIA AND ANALYSIS

5.1 Criteria Overview

The criteria used to evaluate the practicability of the alternatives were drawn, in part, from the list of suggested investigation topics presented in SFPUC's Procedures Manual (PD 2.02 Alternatives Analysis and Evacuation), and from additional project- and site-specific considerations. The seven evaluation criteria are distributed among three categories: Cost, Environmental Impact, and Implementation/Operational Complexity. For each criterion a definition is provided and a significance factor, or metric, is established. The metrics include qualitative or quantitative factors (e.g., quantitative for cost, qualitative for complexity), and serve as the bases for scoring and ranking alternatives.

5.2 Scoring Methodology

The alternatives are scored based upon their performance relative to the individual evaluation criteria. The assigned scores range from 1 (worst) to 4 (best). For some criteria, similarly performing alternatives are assigned the same score. The rationale for the assignment of each score is summarized by criterion in Section 5.3, below. In recognition that not all criteria carry the same level of import in the decision-making process, each criterion was assigned a weight. Criteria weighting was determined based upon the Project Objectives and capital cost. The assigned weights are presented in **Table 5-1**. As the table indicates, the criteria related to construction cost, long-term environmental impact, and resiliency to sea level rise were assigned equal weights of 20%, reflecting the SFPUC's commitment to finding a cost-effective solution that minimizes long-term environmental effects in a manner that proves resilient in the face of climate change and rising sea levels. Conversely, criteria related to operations and maintenance cost and construction-period environmental effects were assigned equal weights of 5% on account of their being substantially similar and small or temporary (environmental) relative to that of other criteria. The relative performance of alternatives across the criteria and the overall ranking of the alternatives is presented in Section 6.

Table 5-1: Summary of Evaluation Criteria Weighting

Category	Criterion	Weight
Cost	Construction	20%
	Operations & Maintenance	5%
Environmental Impact	Construction	5%
	Post-Construction (beach width)	20%
Implementation/ Operational Complexity	Construction Risks	10%
	Operational Functionality	10%
	Right-of-Way Access	10%
	Resilience to Sea Level Rise	20%

5.3 Alternatives Evaluation

5.3.1 Cost

The Cost category includes criteria that assess relative capital costs and relative operations and maintenance costs.

Capital Cost

Capital costs are the fixed, one-time expenses incurred to construct a project, including those for the labor, land, buildings, and equipment. The metric by which each alternative is evaluated under this criterion is construction cost. A detailed breakdown of the planning-level cost estimates is presented in Appendix A of this report. Scores were assigned based upon relative construction cost; the alternative with the lowest construction cost was assigned a score of 4 and the alternative with the highest construction cost was assigned a score of 1.

Construction costs are based upon AACE Class 4 estimates (Appendix A), which are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. As Class 4 estimates are generally prepared with limited project information, their accuracy can range from -50% to +100%, depending on the technical complexity of the project. The variation in accuracy can be even more extreme in unusual circumstances.

Estimated construction costs are presented in **Table 5-2**. The estimates include construction costs only. They do not include additional costs for planning, design and environmental services, such as those for project development (i.e., design, project management, construction management, etc.), environmental review and mitigation, and right-of-way access (i.e., land/easement acquisition).

Table 5-2: Estimated Construction Costs

Alt. No.	Description	Constr. Cost	Criteria Raw Score
A	Protect LMT with exterior low-profile wall	$91.6M	4
B	Protect LMT with interior reinforcement + new storage	$132.2M	3
C	Remove LMT + new tunnel alignment	$268.4M	1
D	Remove LMT + new pump station, pipeline & storage	$244.4M	2
NOTE 1: The Criteria Raw Score is based upon a scale from 1 (worst) to 4 (best).			

As shown in the table, Alternatives A and B, which involve protecting the LMT, would have the lowest construction cost and highest scores. Alternative A, which consists of constructing a low-profile wall to protect the LMT in place, would have the lowest construction cost ($91.6M). Alternative B, which involves reinforcing the LMT, would have the next lowest construction cost ($132.3M); the added cost due mainly to the additional 1.1MG storage tank. Alternatives C and D, would involve removal of the LMT and construction of substantial new infrastructure. Therefore, Alternatives C and D would have higher construction costs ($268.4M and $244.4M, respectively)

and lowest scores; the cost of demolishing the existing LMT would be approximately $100M for each of these two alternatives.

Operations & Maintenance Cost

Operations and Maintenance (O&M) costs are expenses associated with facility administration, maintenance, and repairs on a day-to-day basis, including labor, materials, power demand, and sand nourishment. The metric by which this criterion is evaluated is the estimated O&M costs associated with the activities listed above. Scores were assigned based upon relative O&M cost; the alternative with the lowest O&M cost was assigned a score of 4 and the alternative with the highest O&M cost was assigned a score of 1.

The typical annual O&M costs for facilities in the wastewater system are around 1-2% of the total construction cost, with variation based on amount and complexity of infrastructure to be operated. **Table 5-3** summarizes the estimated annual O&M cost per alternative and the associated scoring for each alternative. The O&M cost for each alternative includes the cost of sand nourishment, which is estimated to be approximately $700,000 annually. This cost is based on an assumed nourishment volume and frequency of approximately 100,000 cubic yards every three years. The estimate assumes a cost of $12 per cubic yard of sand, plus additional design and contracting costs. As shown in Table 2-2, Alternatives A and B would have the lowest O&M costs ($916,000 and $1,320,000, respectively), which are based on an estimate of 1% of the direct construction cost. Accordingly, these alternatives were assigned scores of 4 and 3, respectively. Alternatives A and B would require minimal staffing and maintenance; for Alternative A it would generally be limited to an inspection every 10 years for the LMT and low-profile wall, for Alternative B it would generally be limited to an inspection every 10 years for the LMT and every 5 years for the 1.1MG storage tank. Alternatives A and B would have no additional power requirements. Alternative C would have a higher O&M cost ($1,684,000), which is based on 1% of the direct construction cost. Accordingly, Alternative C was assigned a score of 2. The O&M cost for Alternative D would be substantially greater ($2,166,000) due to the complexity of this alternative and the substantial staffing and energy requirements of operating and maintaining the new pump station (assumes two additional full-time staff and about twice the power required for the current LMT). Accordingly, the estimated O&M cost for Alternative D is based upon 1.5% of the direct construction cost, resulting in a score of 1.

5.3.2 Environmental Impact

The Environmental Impact category includes criteria that assess relative construction-period impacts and relative post-construction impacts.

Construction Impact

Construction impacts are the temporary impacts that would be expected in association with an alternative's construction phase. The metric for this criterion is an impact severity index based on the construction footprint size multiplied by construction duration. This metric was developed to represent a range of temporary environmental effects that could result from an alternative's construction phase, such as impediments to public beach access, reduced recreational

Table 5-3: Estimated Operations And Maintenance Impacts

Alt. No.	Alternative	Impacts See Note below.	O&M Cost/Year	% of Direct Construction Cost	Criteria Raw Score*
A	Protect LMT with exterior low-profile wall	• Staffing: Tunnel and wall inspection every 10 years • Maintenance: Minimal maintenance required for the wall and existing tunnel. • Power: No additional power required. • Sand Nourishment at South Ocean Beach: Approx. 100,000 cubic yards every 3 years	Total= $1,616,000 (O&M=$916,000 sand nourishment=$700,000)	1%	4
B	Protect LMT with interior reinforcement + new storage	• Staffing: Tunnel inspection every 10 years, storage tank inspection every 5 years. • Maintenance: Minimal maintenance required for the new tank and existing tunnel. After 30 years, more substantial maintenance and repairs anticipated. • Power: No additional power required. • Sand Nourishment at South Ocean Beach: Approx. 100,000 cubic yards every 3 years	Total= $2,020,000 (O&M=$1,320,000, Sand Nourishment=$700,000)	1%	3
C	Remove LMT + new tunnel alignment	• Staffing: Tunnel inspection every ten years. • Maintenance: Minimal maintenance anticipated for the new tunnel and the new storage tank. After 30 years, more substantial maintenance and repairs anticipated. • Power: No additional power required. • Sand Nourishment at South Ocean Beach: Approx. 100,000 cubic yards every 3 years	Total= $2,384,000 (O&M=$1,684,000, Sand Nourishment=$700,000)	1%	2
D	Remove LMT + new pump station, pipeline & storage	• Staffing: Up to two additional full-time staff required to operate and maintain the new pump station. • Maintenance: Substantial increase in maintenance required in association with new infrastructure (pump station); • Power: Approx. twice current LMT requirements. • Sand Nourishment at South Ocean Beach: Approx. 100,000 cubic yards every 3 years	Total=$2,866,000 (O&M=$2,166,000, Sand Nourishment= $700,000)	1.5%	1

NOTE 1: The Criteria Raw Score is based upon a scale from 1 (worst) to 4 (best).
NOTE 2: Percentage is based on direct construction cost, excluding the cost of removal of the LMT.

opportunities, obstructions of views to and along the coast, and disturbance to wildlife habitat. Scores were assigned based upon relative impact severity; the alternative with the lowest construction impact severity was assigned a score of 4 and the alternative with the highest impact severity was assigned a score of 1.

Given the type of work that would be required under the various alternatives, and the environmental resources in the area of that work, the nature of these impacts would be similar. However, the impacts would vary in severity based upon project footprint and duration. For example, the effects of a shoreline project on beach and bluff habitat would be greater for a large project with longer construction period than one with a smaller footprint and shorter construction period. This is because the former would have a greater likelihood of affecting a larger amount of habitat for a longer period of time.

As shown in **Table 5-4**, Alternative A would have the lowest construction impact severity (4.2); it has construction duration of 28 months (no startup duration) and has the smallest footprint (148,500 square feet). Accordingly, Alternative A was assigned a score of 4. Alternative B has a larger footprint size (211,500 square feet) and construction duration (48 months construction, including 3 months for start-up). Therefore, Alternative B was assigned a score of 3. Alternatives C and D have longer construction durations, due to the time required for the demolition of the existing LMT (54 and 45 months, respectively). Both of these alternatives also have footprints (438,500 square feet and 446,500 square feet, respectively) larger than Alternatives A and B, due to LMT demolition and the addition of new infrastructure. Accordingly, as shown in Table 5-4, these alternatives would be expected to have correspondingly greater impact severity and were respectively assigned scores of 1 and 2.

Post-Construction Impacts

Post-construction impacts are the environmental effects that could continue after construction. The metric for this criterion is a beach width index that considers both average (long-term) and episodic (short-term) changes in beach width over time. Beach width is defined as the distance between the backshore (e.g., toe of bluff, dune or armor structure) and the mean high water shoreline. This metric was established to represent a range of long-term environmental effects that could result from an alternative, such as impediments to public beach access, reduced recreational opportunities, and impacts on beach ecology. Scores were assigned based upon impact severity; the alternative with the greatest beach widths (least impact) were assigned a score of 4 and the alternatives with the narrowest beach widths were assigned a score of 3.

The effects on beach widths over time at South Ocean Beach were analyzed for each alternative using a beach evolution model that was developed for the Regional Sediment Management Plan for the San Francisco Littoral Cell. The model considers beach width as a function of shoreline development, plus ongoing historic erosion rates, beach nourishment events, and accelerated erosion due to sea level rise. Sea level rise amounts used are based on the March 2011 resolution

of the Ocean Protection Council (OPC 2011) [2], and are consistent with those of the OBMP and the CCSF guidance (CCSF 2015).

The short-term erosion impacts from storms were computed separately to assess the short-term or episodic changes in the beach width that occur during a storm event, but are typically seasonally reversible. The model assumes a single sand nourishment scenario for all alternatives (i.e., approx. 75,000 cubic yards, every three years). A more detailed description of the modeling effort is presented in Appendix B.

Table 5-4: Construction Impacts

Alt. No.	Alternative	Footprint Size	Construction Duration (months) See Note below.	Severity of Impact [Footprint size * (Construction Duration+Start-up Duration)] /M Units=SF*mo (M)	Criteria Raw Score
A	Protect LMT with exterior low-profile wall	2,970 LF * 50 ft in width = 148,500 SF	**28**	**4.2**	**4**
B	Protect LMT with interior reinforcement + new storage	2,970 LF * 50 ft width and 420 ft * 150 ft = 148,500 SF + 63,000 SF = 211,500	**27**	**10.2**	**3**
C	Remove LMT + new tunnel alignment	5,800 LF * 50 ft width = 290,000 SF + 148,500 SF (2970 LF of Demo x 50 ft width)= 438,500 SF	**56**	**23.7**	**1**
D	Remove LMT + new pump station, pipeline & storage	4,200 LF * 50 ft width and 420 ft * 150 ft and 100 ft * 250 ft= 210,000 SF + 63,000 SF + 25,000 SF= 298,000 SF + 148,500 SF (2970 LF of Demo x 50 ft width)= 446,500 SF	**45**	**20.1**	**2**

NOTE 1: Construction duration includes time for startup/testing and commissioning.
NOTE 2: The Criteria Raw Score is based upon a scale from 1 (worst) to 4 (best).

The results of the beach width analysis are presented in **Table 5-5**. As the table indicates, on average, the alternatives would perform similarly over the planning horizon (e.g., 2060). With sea level rise, the beach would be expected to erode and narrow. Regular beach nourishment would help maintain a beach width that would be similar across the alternatives. However, in the short-term, the differences would be more noticeable. This is because storms can cause temporary beach erosion, and that erosion can be more pronounced where waves interact with shoreline structures. As reflected in Table 5-5, given that alternatives without structural

[2] Note: the model was used to compare the relative effects of the alternatives on beach width over time, rather than to identify sites for the placement of infrastructure. The sea level rise amounts used in the model (OPC estimates) are: 0.6 feet by 2030, 1.2 feet by 2050, and 4.6 feet by 2100. The CCSF sea level rise guidance recommends using projections of 6 in. by 2030, 11 in. by 2050, and 36 in. by 2100; with adaptive capacity to accommodate upper end ranges of 12 in., 24 in., and 66 in. for these years, respectively. While not identical, the OPC and CCSF estimates are sufficiently similar to inform an analysis of the relative differences between alternatives.

protection (i.e., Alternatives C and D) were found to perform better over the short-term, they were assigned an overall beach width index score of 4, while those with structural protection (i.e., Alternatives A and B) were assigned a score of 3.

5.3.3 Implementation/Operational Complexity

The Implementation/Operational Complexity category includes criteria that assess construction risks, operational functionality, right-of-way access, and resilience to sea level rise.

Construction Risks

Construction risk represents the potential for exposure to loss in terms of schedule or cost, including those related to safety, constructability, and system reliability. The metric for this criterion is a risk score derived from the probability of occurrence of a risk and the severity of

Table 5-5: Post-Construction Impacts

Alt. No.	Description	Long-Term Beach Width (Average)	Short-Term Beach Width (Episodic)	Criteria Raw Score
A	Protect LMT with exterior low-profile wall	4	3	3
B	Protect LMT with interior reinforcement + new storage	4	3	3
C	Remove LMT + new tunnel alignment	4	4	4
D	Remove LMT + new pump station, pipeline & storage	4	4	4
NOTE 1: The Criteria Raw Score is based upon a scale from 1 (worst) to 4 (best).				

impact to cost. The alternatives were ranked on a scale of 1 (worst) to 4 (best), based upon their risk scores. The higher the risk score, the lower the assigned rank, because a higher score indicates greater potential for risk-related cost increases and schedule delays, and the effort required to mitigate that risk in design and construction phases.

As noted above, this criterion considers risks related to safety, constructability and system reliability. Safety risks concern hazards, personal injury or death due to a construction related activity. During construction, consistent safety is the most important goal. Because of this, each alternative is analyzed according to how much effort/complexity would be required to achieve a consistent level of safety. Constructability refers to the overall complexity of project construction. System reliability focuses on the ability to maintain Oceanside Drainage Basin collection system and broader wastewater system reliability during construction; in the absence of a functional LMT and/or redundant system, an unexpected rain event could case unregulated wastewater release.

Table 5-6 presents a risk probability scale. This table is used to assign a scale number to the probability of risk occurrence. The assigned probability is based upon the professional judgment

of the evaluator. The scale ranges from 1 to 5, corresponding to the probability of occurrence (<20% to >80%, respectively).

Table 5-6: Risk Probability Scale

Probability (P)	
Scale	**Range**
5	**> 80%**
4	**60% - 80%**
3	**40% - 60%**
2	**20% - 40%**
1	**< 20%**

Table 5-7 presents a risk severity to cost scale. The scale ranges from 1 to 5, corresponding to a cost impact as a percentage of construction cost (<0.4% to >1%, respectively). Similar to Table 5-6, the assigned impact to cost of each risk is based upon the professional judgment of the evaluator.

Table 5-7: Risk Severity of Impact to Cost Scale

Severity of Impact to Cost (S_{cost})	
Scale	**Range**
5	**>1% of original Contract Amount**
4	**.8%-1% of original Contract Amount**
3	**.6%-.8% of original Contract Amount**
2	**.4%-.6% of original Contract Amount**
1	**<.4% of original Contract Amount**

Table 5-8 shows a "heat map," which lays the framework for how the overall severity of risk is calculated, taking the product of probability and severity of impact to cost. On the vertical or "y" axis of the table is probability and the horizontal or "x" axis is severity of cost impact. Where these two numbers intersect on the heat map table is the assigned overall severity of risk. Color and number in the heat map correspond to increasing severity, the higher the number the more severe the risk. The risk increases in color from blue to green, yellow, orange and red to signify the ascending risk level. Similarly, the numerical scale of severity of risk is represented by a number range of 1 (lowest severity) to 25 (highest severity).

Table 5-8: Severity of Risk

Probability						
	5	8	16	18	23	25
	4	7	10	17	20	24
	3	3	9	12	19	22
	2	2	5	11	14	21
	1	1	4	6	13	15
		1	2	3	4	5
	Severity of Cost Impact (Cost)					

Table 5-9 summarizes the construction risks for each alternative, based upon the methodology described above. The ranking is inversely correlated to overall risk score. That is, the higher the rank, the lower the risk score; the lower the rank, the higher the risk score. The comparison shows that Alternative A has the lowest construction risk, followed by Alternatives D, C, and B in descending order (increasing construction risk). Severity of cost impact was assigned based on the magnitude of potential construction cost increase for each alternative and probability of risk occurrence. The below discussion explains how risk scores were assigned.

Alternative A was found to have the lowest construction risk because would have the lowest probability of safety, constructability, and/or reliability risk occurrence. Alternative A involves external reinforcement of existing infrastructure; the chance of a safety incident is low. The excavation would have engineered shoring and the LMT would be supported in place. The work would occur in the existing trench of the LMT, and therefore the chance for finding unknown utilities and/or experiencing unforeseen conditions is low. Finally, the work would require no disruption to the LMT operation; therefore, the chance of an unregulated release is also low. For these reasons, as Table 5-9 indicates, Alternative A received a total risk score of 23 and a rank of 4 (best).

Alternative B similarly involves retrofitting existing infrastructure. However, it involves construction work inside the LMT, which increases the safety risks. Additionally, the probability for unforeseen conditions due to the tunneling effort and the construction of the new storage tank in a new area is greater. Finally, the tunnel reinforcement would require the LMT to be shut down and non-operational, thereby increasing the probability of system reliability issues. For these reasons, Alternative B received a total risk score of 41 and a rank of 1 (worst).

Alternative C would have the same safety and constructability risk probabilities as Alternative B, because both alternatives involve construction in tunnels and require excavating deep pits for tunnel entry. However, the system reliability risk probability would be lower, because the LMT could remain completely operational while the new tunnel was built. Therefore, the potential for an unregulated release would be low. For these reasons, Alternative C received a total risk score of 37 and a rank of 2.

Table 5-9: Construction Risks

Alternative No.	Alternative	Construction Risk	Probability	Severity of Impact to Cost	Severity of Risk	Total Risk Score	Rank
A	Protect LMT with exterior low-profile wall	**Safety-** Risk of excavation collapse or other safety risk	1	2	4	23	4
		Constructability-Unforeseen conditions (e.g., utilities, excessive groundwater, different soils)	1	2	4		
		System Reliability- Unregulated release of wastewater	1	5	15		
B	Protect LMT with interior reinforcement + new storage	**Safety**- Risk of Excavation Collapse or other safety risk	2	3	11	41	1
		Constructability- Unforeseen conditions including (e.g., utilities, excessive groundwater, different soils)	2	2	9		
		System Reliability- Unregulated release of wastewater	2	5	21		
C	Remove LMT + new tunnel alignment	**Safety**- Risk of excavation collapse or other safety risk	2	3	11	37	2
		Constructability- Unforeseen conditions (e.g., utilities, excessive groundwater, different soils)	2	3	11		
		System Reliability- Unregulated release of wastewater	1	5	15		
D	Remove LMT + new pump station, pipeline & storage	**Safety**- Risk of excavation collapse or other safety risk	1	3	6	33	3
		Constructability- Unforeseen conditions (e.g., utilities, excessive groundwater, different soils)	3	3	12		
		System Reliability- Unregulated release of wastewater	1	5	15		

NOTE 1: The criterion ranking is based upon a scale from 1 (worst) to 4 (best).

Finally, Alternative D would have a low safety risk probability, similar to Alternative A, as there would be no internal tunnel construction. However, the constructability risk probability would be higher, due to the large amount of area that would needed for the new pump station, new tunnel and new storage tank. The potential for encountering unknown utilities and/or unforeseen conditions in the construction area would be higher. As with Alternative C for system reliability, the LMT could remain completely operational while the new tunnel, the new pump station and the new storage tank were built. Therefore, the potential for an unregulated release would be low. For these reasons, Alternative D received a total risk score of 33 and a rank of 3.

Operational Functionality

This criterion concerns operational compatibility with the Oceanside Basin collection system and specifically the LMT and ancillary systems (WSFM and WSS). The metric for operational compatibility is the post-construction time required to fully integrate an alternative into the existing system. The alternatives were ranked on a scale of 1 (worst) to 4 (best), based upon integration time; the longer the time, the lower the assigned score.

The LMT stores up to 9.5 million gallons of wastewater and transports approximately 4.5 million gallons of wastewater per day to the WSS and OSP under dry-weather conditions. Disruptions to or replacement of the LMT would require phasing, commissioning, and start up and testing time to restore or replace the operational function of the LMT and ancillary system. The level of complexity and work required to restore that function would vary among the alternatives. **Table 5-10** presents each alternative's post-construction operational compatibility and corresponding score.

Table 5-10: Adaptability-Level of Construction Phasing Required to Take on Operational Role

Alt. No.	Alternative	Adaptability (Phasing Required) See Note below.	Criteria Raw Score
A	Protect LMT with exterior low-profile wall	No work required to adapt to current role of LMT post-construction	4
B	Protect LMT with interior reinforcement + new storage	Approx. 3 months for testing operational strategy of new storage tank and bypass pipeline	3
C	Remove LMT + new tunnel alignment	Approx. 3 months for testing operational strategy of new pipeline	3
D	Remove LMT + new pump station, pipeline & storage	Approx. 6 months for startup, testing and commissioning new pump station, storage tank and pipeline	2
NOTE 1: The Criteria Raw Score is based upon a scale from 1 (worst) to 4 (best).			

Alternative A would involve constructing a low-profile wall along the exterior of the LMT. The LMT's operations would not be disrupted and no time would be required to reintegrate the LMT back into the system. Therefore, Alternative A was assigned a score of 4. Alternative B would require disruptions to the LMT during construction in order to reinforce the tunnel and install and the storage tank. Post construction, approximately three months would be required to adopt

and exercise the operational strategy involving the valves and piping to adapt the new tank and bypass piping to the LMT and system. For these reasons, Alternative B was assigned a score of 3. Similar to Alternative B, Alternative C would also involve disruption of LMT operation. Under this alternative, the LMT would be demolished and a new landward tunnel would be constructed. Post-construction, Alternative C would also require approximately 3 months to adapt the new pipeline alignment into the system. Valves could require operation and/or testing to route flow. Therefore, Alternative C was also assigned a score of 3. Given the complexity of Alternative D, considerably more effort would be required for system integration, including that associated with start-up, testing, and commissioning the new pump station, storage tank and pipeline, and ensuring that the operational strategy of the new facilities are implemented. It is assumed that up to six months would be required to adapt the new infrastructure to the Ocean Basin System. For these reasons Alternative D was assigned a score of 2.

Land Ownership and Access

This criterion considers permanent land or access acquisition requirements. Obtaining access to non-SFPUC lands for construction and operation introduces additional time and complexity. For example, in some cases, a legal Memorandum of Understanding (MOU) between the land owner and/or responsible agency and the SFPUC would need to be drafted and executed. This process can take up to several years, potentially causing delays to the start of construction. The metric for this criterion is, therefore, probability of delay as a function of access requirements. The alternatives were ranked on a scale of 1 (worst) to 4 (best), based upon their probability of delay. As shown in **Table 5-11**, the lower the probability, the higher the score.

Table 5-11: Probability of Delay Scoring Scale

Probability of Delay	Score
0-10%	4
10%-25%	3
25%-50%	2
Greater than 50%	1

Table 5-12 summarizes land and access requirements for each alternative and ranks each alternative accordingly. Alternative A would require no permanent access permissions or acquisitions, as it involves retrofitting an existing structure located on SFPUC property. Temporary construction access approvals would be required to build Alternative A. Access approvals would need to be obtained from SFPW, SFMTA, and GGNRA. Obtaining these standard approvals would not be expected to delay construction. The probability of construction delay for Alternative A is estimated to be 10%; the associated score is 4. Alternative B would require permission for temporary construction access and additional laydown areas for work on the LMT from the same agencies as Alternative A. Additionally, land would need to be acquired and temporary construction access granted for the new 1.1MG storage from the SF Zoo. The probability of construction delay is therefore estimated to be 25%; the associated score is 3. Alternative C would

Table 5-12: Land Ownership and Access

Alt. No.	Alternative	Land and Access Requirements	Permit Required	Probability of Construction Delay	Criteria Raw Score
A	Protect LMT with exterior low-profile wall	Construction access and laydown areas required to build low-profile wall. Great Highway assumed to be closed for the construction duration.	Temporary construction permits for access and laydown areas.	10%	4
B	Protect LMT with interior reinforcement + new storage	Construction access and excavation areas required for pit excavation to allow access for tunneling equipment. Land acquisition/agreements required for new storage tank. Great Highway assumed to be closed for the construction duration.	Temporary construction permits for access and laydown areas.	25%	3
C	Remove LMT + new tunnel alignment	Large amount of land acquisition/agreements required for new alignment of tunnel. Great Highway assumed to be closed for the construction shutdowns and tie-ins only.	MOU for permanent land and access acquisition for new tunnel alignment. Temporary construction permits for access and laydown areas required.	50%	2
D	Remove LMT + new pump station, pipeline & storage	Large amount of land acquisition/agreements required for new pump station, pipe and storage tank. Great Highway assumed to be closed for the construction shutdowns and tie-ins.	MOU for permanent land and access acquisition for new tunnel alignment, pump station and storage tank. Temporary construction permits for access and laydown areas required.	> 50%	1
NOTE 1: The Criteria Raw Score is based upon a scale from 1 (worst) to 4 (best).					

require substantial access permissions and acquisition along the new tunnel alignment. This could require a formal MOU and acquisition agreements between SFPUC and SF Rec and Parks, Caltrans, and GGNRA, in addition to temporary construction access permissions from SFPW and SFMTA. The probability that this could delay construction is estimated to be 50%; the associated score is 2. Alternative D would require the most substantial access permissions and acquisition; land and access rights for a new pump station, new tunnel alignment and new storage tank could require an MOU between the SFPUC and SF Rec and Parks, Caltrans, and GGNRA. Similar to the other alternatives temporary construction access permissions from SFPW and SFMPTA could also be required. The probability of delay to construction for this alternative is estimated to be more than 50%; the associated score is 1.

Resiliency to Sea Level Rise

Sea level rise (SLR) resiliency concerns the exposure of shoreline infrastructure to coastal hazards over time. In general, sea level rise is expected to lead to multiple changes to the physical environment beyond a simple increase in sea surface elevation. For example, higher

water levels may increase coastal bluff erosion rates, change environmental characteristics, lead to increased ground water levels, and change sediment movement along the shore. These changes can cause disruption and/or damage to infrastructure near the shoreline. The metric for this criterion is the timing of shoreline intersection with a 25-foot safety buffer established for critical wastewater assets in the vicinity of Ocean Beach to the potential erosion hazard. The safety buffer represents an amount of bluff erosion above the annual average erosion rate that could occur from a storm with a 15- to 20-year return period. The assets evaluated include the, WSFM, WSS, Overflow Pipeline to SWOO, and OSP (see Figure 2-3). The LMT is not considered here since it would either be protected using structural protection or removed, with both of these actions potentially altering the timing of future erosion impacts.

Shoreline changes over time with sea level rise were analyzed for each alternative using an existing geomorphic response model. The model considers the rate of shoreline erosion over time based on the historic shoreline erosion rate, the slope of the shoreline, and sea level rise. This approach is known as the modified Bruun rule. Due to assumptions that the existing shore protection structures (e.g., EQR, riprap revetment, sandbag structure) would be removed, the bluff material is composed of sand, and an initial adjustment of the shore by 40 feet to account for immediate erosion after armor removal, the method computes a conservatively high erosion amount. Each alternative was evaluated in plan and section orientations. As discussed below and presented in **Table 5-13**, the model results show how the various alternatives could influence the timing of hazard exposure on critical assets. A more detailed explanation of the modeling effort is presented in Appendix C.

Table 5-13: Timing of Potential Erosion Hazard Impacts to Wastewater Assets for Different Alternatives

Alt. No.	Alternative	84" Overflow to SWOO	Force Main	West Side Pump Station	Oceanside Plant	Criteria Raw Score
A	Protect LMT with exterior low-profile wall	2060	2065	2085	2090	4
B	Protect LMT with interior reinforcement + new storage	2050	2055	2075	2070	3
C	Remove LMT + new tunnel alignment	2045	2050	2070	2065	2
D	Remove LMT + new pump station, pipeline & storage	2045	2050	2070	2065	2

NOTE 1: The Criteria Raw Score is based upon a scale from 1 (worst) to 4 (best).

The modeling results indicate that Alternative A would provide the most protection to the backshore. This is because the vertical wall and horizontal cap would be located at a higher elevation and provide a greater amount of protection from wave runup and overtopping than would be the case with the LMT only or with the LMT removed. As Table 5-13 indicates, under Alternative A, the safety buffer for critical infrastructure could be reached by 2060, the latest of the alternatives evaluated. For this reason, Alternative A was assigned a score of 4. Alternative B

would reinforce the LMT at its existing elevation. While Alternative B would provide a level of protection similar to Alternative A, a greater amount of erosion in response to sea level rise would be expected because the LMT is located lower in elevation and further landward than the top of the wall in Alternative A. As a result, under Alternative B, the safety buffer for key wastewater system assets could be reached by 2050. Accordingly, Alternative B was assigned a score of 3. Demolition and removal of the LMT under Alternatives C and D would allow for a more natural shore geometry, but would be expected to allow for shoreline retreat landward faster than for Alternatives A and B. Under these alternatives, the safety buffer for wastewater system assets could be reached by 2045. For these reasons, Alternatives C and D were assigned scores of 2.

This page intentionally left blank

6.0 RANKING OF ALTERNATIVES

The alternatives considered in this AAR were ranked based upon their overall performance relative to each other. As described in Section 5.2, Scoring Methodology, each alternative was evaluated against individual criteria. For each criterion, the alternative was assigned a score of between 1 (worst) and 4 (best). The criteria were assigned weights in recognition that not all criteria factor equally in the decision-making process. The weighting assignments were determined based upon the Project Objectives and capital cost. The alternatives were then ranked, based upon their weighted score. **Table 6-1** shows the performance of each alternative across the individual criteria, as well as the resulting raw and weighted scores, and final ranking.

As the table indicates, Alternative A (Protect LMT with exterior low-profile wall) ranked 4 (best), while Alternative C (Remove LMT + new tunnel alignment) ranked 1 (worst). Alternative A performed well across all criteria. Based upon the weighting, key factors contributing to its high ranking were relatively low capital cost, minimal post-construction environmental impact (beach width), and high resilience to sea level rise. In contrast, Alternative C had a low to moderate performance across most criteria. While it scored high in the heavily weighted post-construction beach environmental impact, Alternative C scored poorly in the equally important areas of capital cost and resilience to sea level rise. And while the weighting reflects the relative import of the evaluation criteria, a comparison of the table's raw and weighted scores indicates that the ranking would essentially be the same, regardless of weighting.

Table 6-1: Alternatives Scoring and Ranking

	Cost		Environmental Impact		Implementation/Operational Complexity				Score/Rank		
Alt.	**Construction (20%)**	**O&M (5%)**	**Construction (5%)**	**Post-Construction (20%)**	**Construction Risks (10%)**	**Operational Functionality (10%)**	**ROW Access (10%)**	**Resilience to Sea Level Rise (20%)**	**Raw Score**	**Weighted Score**	**Rank**
A	4	4	4	3	4	4	4	4	3.88	3.80	4
B	3	3	3	3	1	3	3	3	2.75	2.80	3
C	1	2	1	4	2	3	2	2	2.13	2.25	1
D	2	1	2	4	3	2	1	2	2.13	2.35	2

7.0 REFERENCES

Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, Shore & Beach, Vol. 82, No. 1, Winter 2014, pages 3-21.

Battalio, R.T., Trivedi D. Sediment transport processes at Ocean Beach, San Francisco, CA; Proceedings of the International Conference on Coastal Engineering, 1996 September 2-6, 1996; Orlando, CA. ASCE. p 2691-2704.

California Coastal Commission (CCC), 2010a. Letter from Jo Ginsberg (CCC) to Frank Filice (SFPW); RE: Alleged Coastal Act Violation No. V-2-10-003 (San Francisco Public Works Department), consisting of the placement of an unpermitted 600-foot-long riprap revetment on the beach at Ocean Beach, and the continued presence of unpermitted beach and bluff posts at Ocean Beach. March 9, 2010.

CCC, 2010b. Letter from Jo Ginsberg (CCC) to Frank Filice (SFPW); RE: Alleged Coastal Act Violation No 2-10-023 (San Francisco Public works Department), consisting of non-compliance with the terms and conditions of Emergency Permit No. 2-10-003-G. November 23, 2010.

CCC, 2011. Proposed Revised Findings, Item W21b [Staff Report for Application No. 2-10-033]. Original Staff Report November 23, 2011; Revised Staff Report. Undated.

California Coastal Protection Network and City and County of San Francisco, 2014. Settlement Agreement and Mutual Release in the case *California Coastal Protection Network v. City & County of San Francisco*, Case No. CGC-11-513176.

ESA, 2017. Ocean Beach Short-Term Erosion Protection Measures Project 2016-2017 Monitoring Report. Prepared for the San Francisco Public Utilities Commission. October 25, 2017.

Moffatt & Nichol, 2012. Great Highway South of Sloat, Interim Shore Protection and Management Strategy. Prepared for San Francisco Department of Public Works. August 8, 2012.

Olmsted, R. and Olmsted. N., 1979. Ocean Beach Study: A Survey Of Historic Maps and Photographs

SPUR, AECOM, ESA PWA, Nelson\Nygaard, Sherwood Design Engineers, Phil D. King, PhD, 2012, Ocean Beach Master Plan, Prepared for State of California Coastal Conservancy, San Francisco Public Utilities Commission, and the National Park Service.

SPUR, ESA PWA, and Moffatt & Nichol, 2014, Immediate-Term Coastal Erosion Management Plan for South Ocean Beach, 2013-2016, prepared for the San Francisco Public Utilities Commission, January 2014.

SPUR, ESA PWA, Moffatt & Nichol, McMillen Jacobs Associates, and AGS, Inc., 2015, Coastal Protection Measures & Management Strategy for South Ocean Beach, Ocean Beach Master Plan: Coastal Management Framework, Prepared for San Francisco Public Utilities Commission, April 24, 2015.

This page intentionally left blank

8.0 APPENDICES

APPENDIX A
AMERICAN ASSOCIATION OF COST ESTIMATORS (AACE) CLASS 4 ESTIMATES

Project name	Alt A - South Ocean Beach
Labor rate table	South Ocean Beach
Equipment rate table	2012 Equip - CA 03
Bid date	12:00:00 AM
Report format	Sorted by 'WORK PKG/WORK AREA/Assembly' 'Detail' summary

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
50 Great Highway Removal South Bound Lane								
01 North Lot Reach								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	570.00 lf	7,994	-	-	3,407	-	11,401
2150.050	Demo AC Pavement	815.00 cy	15,996	-	-	7,950	-	23,946
2150.050	Excavate Road Base & Stock Pile on Site	611.00 cy	7,195	-	-	2,943	-	10,138
2150.500	Trucking Demo Materials Pavement	41.00 hr	4,290	-	-	2,361	-	6,650
2150.500	Dump Fees Pavement	82.00 load	-	-	-	-	8,200	8,200
2150.500	Dump Fees Barriers	14.00 load	-	-	-	-	1,400	1,400
2200.700	Install and Maintain Silt Fence	855.00 lf	818	2,779	-	-	-	3,597
	** unassigned **		*36,292*	*2,779*		*16,661*	*9,600*	*65,332*
	01 North Lot Reach		**36,292**	**2,779**		**16,661**	**9,600**	**65,332**
50 Reach 3								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	393.00 lf	5,511	-	-	2,349	-	7,861
2150.050	Demo AC Pavement	185.00 cy	3,631	-	-	1,805	-	5,436
2150.050	Excavate Road Base & Stock Pile on Site	139.00 cy	1,637	-	-	670	-	2,306
2150.500	Trucking Demo Materials Pavement	10.00 hr	1,046	-	-	576	-	1,622
2150.500	Dump Fees Pavement	19.00 load	-	-	-	-	1,900	1,900
2150.500	Dump Fees Barriers	7.00 load	-	-	-	-	700	700
2200.700	Install and Maintain Silt Fence	195.00 lf	187	634	-	-	-	820
	** unassigned **		*12,012*	*634*		*5,399*	*2,600*	*20,645*
	50 Reach 3		**12,012**	**634**		**5,399**	**2,600**	**20,645**
100 EQR								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	840.00 lf	11,780	-	-	5,021	-	16,801
2150.050	Demo AC Pavement	852.00 cy	16,722	-	-	8,311	-	25,033
2150.050	Excavate Road Base & Stock Pile on Site	639.00 cy	7,525	-	-	3,078	-	10,603
2150.500	Trucking Demo Materials Pavement	43.00 hr	4,499	-	-	2,476	-	6,975
2150.500	Dump Fees Pavement	86.00 load	-	-	-	-	8,600	8,600
2150.500	Dump Fees Barriers	5.00 load	-	-	-	-	500	500
2200.700	Install and Maintain Silt Fence	945.00 lf	904	3,071	-	-	-	3,975
	** unassigned **		*41,430*	*3,071*		*18,886*	*9,100*	*72,488*
	100 EQR		**41,430**	**3,071**		**18,886**	**9,100**	**72,488**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	1,740.00 lf	24,401	-	-	10,401	-	34,803
2150.050	Demo AC Pavement	963.00 cy	18,900	-	-	9,394	-	28,295
2150.050	Excavate Road Base & Stock Pile on Site	722.00 cy	8,502	-	-	3,478	-	11,980
2150.500	Trucking Demo Materials Pavement	49.00 hr	5,127	-	-	2,821	-	7,948
2150.500	Dump Fees Pavement	96.00 load	-	-	-	-	9,600	9,600
2150.500	Dump Fees Barriers	29.00 load	-	-	-	-	2,900	2,900
2200.700	Install and Maintain Silt Fence	870.00 lf	832	2,828	-	-	-	3,660
	** unassigned **		*57,763*	*2,828*		*26,094*	*12,500*	*99,185*
	150 Rubble Reach 12+30 to 18+10		**57,763**	**2,828**		**26,094**	**12,500**	**99,185**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	735.00 lf	10,307	-	-	4,394	-	14,701
2150.050	Demo AC Pavement	407.00 cy	7,988	-	-	3,970	-	11,958
2150.050	Excavate Road Base & Stock Pile on Site	306.00 cy	3,603	-	-	1,474	-	5,077
2150.500	Trucking Demo Materials Pavement	20.00 hr	2,093	-	-	1,152	-	3,244
2150.500	Dump Fees Pavement	41.00 load	-	-	-	-	4,100	4,100

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *								
2150.500	Dump Fees Barriers	12.00 load	-	-	-	-	1,200	1,200
2200.700	Install and Maintain Silt Fence	368.00 lf	352	1,196	-	-	-	1,548
	** unassigned **		*24,344*	*1,196*		*10,989*	*5,300*	*41,829*
	155 Rubble Beach 18+10 to 20+55		**24,344**	**1,196**		**10,989**	**5,300**	**41,829**
200 Reach 2								
* unassigned *								
2150.050	Demo BarriersGuide Rails Misc	945.00 lf	13,252	-	-	5,649	-	18,901
2150.050	Demo AC Pavement	889.00 cy	17,448	-	-	8,672	-	26,120
2150.050	Excavate Road Base & Stock Pile on Site	667.00 cy	7,855	-	-	3,213	-	11,067
2150.500	Trucking Demo Materials Pavement	45.00 hr	4,708	-	-	2,591	-	7,299
2150.500	Dump Fees Pavement	89.00 load	-	-	-	-	8,900	8,900
2150.500	Dump Fees Barriers	24.00 load	-	-	-	-	2,400	2,400
2200.700	Install and Maintain Silt Fence	473.00 lf	453	1,537	-	-	-	1,990
	** unassigned **		*43,716*	*1,537*		*20,125*	*11,300*	*76,678*
	200 Reach 2		**43,716**	**1,537**		**20,125**	**11,300**	**76,678**
250 Reach 1								
* unassigned *								
2150.050	Demo BarriersGuide Rails Misc	1,800.00 lf	25,243	-	-	10,760	-	36,003
2150.050	Demo AC Pavement	1,444.00 cy	28,341	-	-	14,086	-	42,427
2150.050	Excavate Road Base & Stock Pile on Site	1,083.00 cy	12,753	-	-	5,217	-	17,970
2150.500	Trucking Demo Materials Pavement	73.00 hr	7,638	-	-	4,203	-	11,841
2150.500	Dump Fees Pavement	144.00 load	-	-	-	-	14,400	14,400
2150.500	Dump Fees Barriers	45.00 load	-	-	-	-	4,500	4,500
2200.700	Install and Maintain Silt Fence	900.00 lf	861	2,925	-	-	-	3,786
	** unassigned **		*74,836*	*2,925*		*34,266*	*18,900*	*130,927*
	250 Reach 1		**74,836**	**2,925**		**34,266**	**18,900**	**130,927**
	50 Great Highway Removal South Bound Lane		***290,394***	***14,970***		***132,421***	***69,300***	***507,084***
100 Great Highway Removal North Bound Lane								
01 North Lot Reach								
* unassigned *								
2150.050	Demo AC Pavement	852.00 cy	16,722	-	-	8,311	-	25,033
2150.050	Excavate Road Base & Stock Pile on Site	639.00 cy	7,525	-	-	3,078	-	10,603
2150.500	Trucking Demo Materials Pavement	43.00 hr	4,499	-	-	2,476	-	6,975
2150.500	Dump Fees Pavement	86.00 load	-	-	-	-	8,600	8,600
2200.700	Install and Maintain Silt Fence	855.00 lf	818	2,779	-	-	-	3,597
	** unassigned **		*29,564*	*2,779*		*13,865*	*8,600*	*54,808*
	01 North Lot Reach		**29,564**	**2,779**		**13,865**	**8,600**	**54,808**
50 Reach 3								
* unassigned *								
2150.050	Demo AC Pavement	185.00 cy	3,631	-	-	1,805	-	5,436
2150.050	Excavate Road Base & Stock Pile on Site	139.00 cy	1,637	-	-	670	-	2,306
2150.500	Trucking Demo Materials Pavement	10.00 hr	1,046	-	-	576	-	1,622
2150.500	Dump Fees Pavement	19.00 load	-	-	-	-	1,900	1,900
2200.700	Install and Maintain Silt Fence	195.00 lf	187	634	-	-	-	820
	** unassigned **		*6,501*	*634*		*3,050*	*1,900*	*12,084*
	50 Reach 3		**6,501**	**634**		**3,050**	**1,900**	**12,084**
100 EQR								
* unassigned *								
2150.050	Demo BarriersGuide Rails Misc	630.00 lf	8,835	-	-	3,766	-	12,601

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *								
2150.050	Demo AC Pavement	778.00 cy	15,270	-	-	7,589	-	22,859
2150.050	Excavate Road Base & Stock Pile on Site	583.00 cy	6,865	-	-	2,808	-	9,674
2150.500	Trucking Demo Materials Pavement	39.00 hr	4,081	-	-	2,245	-	6,326
2150.500	Dump Fees Pavement	78.00 load	-	-	-	-	7,800	7,800
2150.500	Dump Fees Barriers	16.00 load	-	-	-	-	1,600	1,600
2200.700	Install and Maintain Silt Fence	945.00 lf	904	3,071	-	-	-	3,975
	** unassigned **		*35,955*	*3,071*		*16,409*	*9,400*	*64,835*
	100 EQR		**35,955**	**3,071**		**16,409**	**9,400**	**64,835**
150 Rubble Reach 12+30 to 18+10								
* unassigned *								
2150.050	Demo BarriersGuide Rails Misc	580.00 lf	8,134	-	-	3,467	-	11,601
2150.050	Demo AC Pavement	889.00 cy	17,448	-	-	8,672	-	26,120
2150.050	Excavate Road Base & Stock Pile on Site	667.00 cy	7,855	-	-	3,213	-	11,067
2150.500	Trucking Demo Materials Pavement	45.00 hr	4,708	-	-	2,591	-	7,299
2150.500	Dump Fees Pavement	89.00 load	-	-	-	-	8,900	8,900
2150.500	Dump Fees Barriers	15.00 load	-	-	-	-	1,500	1,500
2200.700	Install and Maintain Silt Fence	870.00 lf	832	2,828	-	-	-	3,660
	** unassigned **		*38,977*	*2,828*		*17,943*	*10,400*	*70,148*
	150 Rubble Reach 12+30 to 18+10		**38,977**	**2,828**		**17,943**	**10,400**	**70,148**
155 Rubble Beach 18+10 to 20+55								
* unassigned *								
2150.050	Demo AC Pavement	370.00 cy	7,262	-	-	3,609	-	10,871
2150.050	Excavate Road Base & Stock Pile on Site	278.00 cy	3,274	-	-	1,339	-	4,613
2150.500	Trucking Demo Materials Pavement	19.00 hr	1,988	-	-	1,094	-	3,082
2150.500	Dump Fees Pavement	37.00 load	-	-	-	-	3,700	3,700
2200.700	Install and Maintain Silt Fence	368.00 lf	352	1,196	-	-	-	1,548
	** unassigned **		*12,876*	*1,196*		*6,042*	*3,700*	*23,814*
	155 Rubble Beach 18+10 to 20+55		**12,876**	**1,196**		**6,042**	**3,700**	**23,814**
200 Reach 2								
* unassigned *								
2150.050	Demo AC Pavement	519.00 cy	10,186	-	-	5,063	-	15,249
2150.050	Excavate Road Base & Stock Pile on Site	389.00 cy	4,581	-	-	1,874	-	6,455
2150.500	Trucking Demo Materials Pavement	26.00 hr	2,720	-	-	1,497	-	4,217
2150.500	Dump Fees Pavement	52.00 load	-	-	-	-	5,200	5,200
2200.700	Install and Maintain Silt Fence	473.00 lf	453	1,537	-	-	-	1,990
	** unassigned **		*17,940*	*1,537*		*8,434*	*5,200*	*33,111*
	200 Reach 2		**17,940**	**1,537**		**8,434**	**5,200**	**33,111**
250 Reach 1								
* unassigned *								
2150.050	Demo AC Pavement	1,148.00 cy	22,531	-	-	11,199	-	33,730
2150.050	Excavate Road Base & Stock Pile on Site	861.00 cy	10,139	-	-	4,147	-	14,286
2150.500	Trucking Demo Materials Pavement	58.00 hr	6,069	-	-	3,339	-	9,408
2150.500	Dump Fees Pavement	115.00 load	-	-	-	-	11,500	11,500
2200.700	Install and Maintain Silt Fence	900.00 lf	861	2,925	-	-	-	3,786
	** unassigned **		*39,600*	*2,925*		*18,685*	*11,500*	*72,711*
	250 Reach 1		**39,600**	**2,925**		**18,685**	**11,500**	**72,711**
	100 Great Highway Removal North Bound Lane		***181,412***	***14,970***		***84,428***	***50,700***	***331,510***

150 Parking Area Removal North Lot

01 North Lot Reach

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *									
2150.050	Demo BarriersGuide Rails Misc	570.00	lf	7,994	-	-	3,407	-	11,401
2150.050	Demo AC Pavement	741.00	cy	14,543	-	-	7,228	-	21,772
2150.050	Excavate Road Base & Stock Pile on Site	556.00	cy	6,547	-	-	2,678	-	9,226
2150.150	Demo and Dispose of Structure (Heavy Construction)	1,500.00	sf	21,138	-	-	12,085	6,000	39,223
2150.500	Trucking Demo Materials Pavement	37.00	hr	3,871	-	-	2,130	-	6,002
2150.500	Dump Fees Pavement	74.00	load	-	-	-	-	7,400	7,400
2150.500	Dump Fees Barriers	13.00	load	-	-	-	-	1,300	1,300
2200.700	Install and Maintain Silt Fence	570.00	lf	545	1,853	-	-	-	2,398
	** unassigned **			*54,639*	*1,853*		*27,529*	*14,700*	*98,721*
	01 North Lot Reach			**54,639**	**1,853**		**27,529**	**14,700**	**98,721**
	150 Parking Area Removal North Lot			***54,639***	***1,853***		***27,529***	***14,700***	***98,721***
200 Parking Area Removal South Lot									
150 Rubble Reach 12+30 to 18+10									
* unassigned *									
2150.050	Demo BarriersGuide Rails Misc	580.00	lf	8,134	-	-	3,467	-	11,601
2150.050	Demo AC Pavement	1,667.00	cy	32,718	-	-	16,262	-	48,979
2150.050	Excavate Road Base & Stock Pile on Site	1,250.00	cy	14,720	-	-	6,021	-	20,741
2150.500	Trucking Demo Materials Pavement	84.00	hr	8,789	-	-	4,836	-	13,625
2150.500	Dump Fees Pavement	167.00	load	-	-	-	-	16,700	16,700
2150.500	Dump Fees Barriers	15.00	load	-	-	-	-	1,500	1,500
2200.700	Install and Maintain Silt Fence	580.00	lf	555	1,885	-	-	-	2,440
	** unassigned **			*64,915*	*1,885*		*30,586*	*18,200*	*115,586*
	150 Rubble Reach 12+30 to 18+10			**64,915**	**1,885**		**30,586**	**18,200**	**115,586**
155 Rubble Beach 18+10 to 20+55									
* unassigned *									
2150.050	Demo BarriersGuide Rails Misc	245.00	lf	3,436	-	-	1,465	-	4,900
2150.500	Dump Fees Barriers	6.00	load	-	-	-	-	600	600
	** unassigned **			*3,436*			*1,465*	*600*	*5,500*
	155 Rubble Beach 18+10 to 20+55			**3,436**			**1,465**	**600**	**5,500**
	200 Parking Area Removal South Lot			***68,351***	***1,885***		***32,051***	***18,800***	***121,087***
250 Removal of Rock Rubble									
50 Reach 3									
* unassigned *									
2200.200	Structure Excavation, Load for Export, 250 CY/Day	650.00	cy	11,668	-	-	7,023	-	18,690
2200.450	Dispose of Excavated Material (Off Site)	650.00	cy	-	-	6,500	-	-	6,500
	** unassigned **			*11,668*		*6,500*	*7,023*		*25,190*
	50 Reach 3			**11,668**		**6,500**	**7,023**		**25,190**
100 EQR									
* unassigned *									
2200.200	Structure Excavation, Load for Export, 250 CY/Day	7,886.00	cy	141,557	-	-	85,202	-	226,758
2200.450	Dispose of Excavated Material (Off Site)	7,886.00	cy	-	-	78,860	-	-	78,860
	** unassigned **			*141,557*		*78,860*	*85,202*		*305,618*
	100 EQR			**141,557**		**78,860**	**85,202**		**305,618**
150 Rubble Reach 12+30 to 18+10									
* unassigned *									
2200.200	Structure Excavation, Load for Export, 250 CY/Day	6,994.00	cy	125,545	-	-	75,564	-	201,109
2200.450	Dispose of Excavated Material (Off Site)	6,699.00	cy	-	-	66,990	-	-	66,990
	** unassigned **			*125,545*		*66,990*	*75,564*		*268,099*

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	150 Rubble Reach 12+30 to 18+10		**125,545**		**66,990**	**75,564**		**268,099**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2200.200	Structure Excavation, Load for Export, 250 CY/Day	2,954.00 cy	53,025	-	-	31,915	-	84,941
2200.450	Dispose of Excavated Material (Off Site)	2,954.00 cy	-	-	29,540	-	-	29,540
	** unassigned **		*53,025*		*29,540*	*31,915*		*114,481*
	155 Rubble Beach 18+10 to 20+55		**53,025**		**29,540**	**31,915**		**114,481**
200 Reach 2								
** unassigned **								
2200.200	Structure Excavation, Load for Export, 250 CY/Day	1,468.00 cy	26,351	-	-	15,860	-	42,212
2200.450	Dispose of Excavated Material (Off Site)	1,468.00 cy	-	-	14,680	-	-	14,680
	** unassigned **		*26,351*		*14,680*	*15,860*		*56,892*
	200 Reach 2		**26,351**		**14,680**	**15,860**		**56,892**
250 Reach 1								
** unassigned **								
2200.200	Structure Excavation, Load for Export, 250 CY/Day	16,116.00 cy	289,289	-	-	174,120	-	463,408
2200.450	Dispose of Excavated Material (Off Site)	16,116.00 cy	-	-	161,160	-	-	161,160
	** unassigned **		*289,289*		*161,160*	*174,120*		*624,568*
	250 Reach 1		**289,289**		**161,160**	**174,120**		**624,568**
	250 Removal of Rock Rubble		***647,435***		***357,730***	***389,684***		***1,394,849***
300 Excavate for low profile wall and cap								
01 North Lot Reach								
** unassigned **								
2200.200	Structure Excavation, Haul to On-site Stockpile	20,288.00 cy	364,178	-	-	219,195	0	583,372
2200.800	Temporary Shoring	14,805.00 sf	-	0	0	-	370,125	370,125
	** unassigned **		*364,178*			*219,195*	*370,125*	*953,497*
	01 North Lot Reach		**364,178**			**219,195**	**370,125**	**953,497**
50 Reach 3								
** unassigned **								
2200.200	Structure Excavation, Haul to On-site Stockpile	5,612.00 cy	100,738	-	-	60,633		161,371
2200.800	Temporary Shoring	4,095.00 sf	-	0	0	-	102,375	102,375
	** unassigned **		*100,738*			*60,633*	*102,375*	*263,746*
	50 Reach 3		**100,738**			**60,633**	**102,375**	**263,746**
100 EQR								
** unassigned **								
2200.200	Structure Excavation, Haul to On-site Stockpile	25,667.00 cy	460,733	-	-	277,310		738,043
2200.800	Temporary Shoring	18,900.00 sf	-	0	0	-	472,500	472,500
	** unassigned **		*460,733*			*277,310*	*472,500*	*1,210,543*
	100 EQR		**460,733**			**277,310**	**472,500**	**1,210,543**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2200.200	Structure Excavation, Haul to On-site Stockpile	22,244.00 cy	399,289	-	-	240,327		639,616
2200.800	Temporary Shoring	16,530.00 sf	-	0	0	-	413,250	413,250
	** unassigned **		*399,289*			*240,327*	*413,250*	*1,052,866*
	150 Rubble Reach 12+30 to 18+10		**399,289**			**240,327**	**413,250**	**1,052,866**
	300 Excavate for low profile wall and cap		***1,324,937***			***797,465***	***1,358,250***	***3,480,652***
350 CIDH Piles								

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
01 North Lot Reach								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	8,740.00 lf	596,959	519,156	-	232,675	43,700	1,392,491
	** unassigned **		*596,959*	*519,156*		*232,675*	*43,700*	*1,392,491*
	01 North Lot Reach		**596,959**	**519,156**		**232,675**	**43,700**	**1,392,491**
50 Reach 3								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	1,993.00 lf	136,126	118,384	-	53,057	9,965	317,533
	** unassigned **		*136,126*	*118,384*		*53,057*	*9,965*	*317,533*
	50 Reach 3		**136,126**	**118,384**		**53,057**	**9,965**	**317,533**
100 EQR								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	9,660.00 lf	659,797	573,804	-	257,168	48,300	1,539,069
	** unassigned **		*659,797*	*573,804*		*257,168*	*48,300*	*1,539,069*
	100 EQR		**659,797**	**573,804**		**257,168**	**48,300**	**1,539,069**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	8,893.00 lf	607,410	528,244	-	236,749	44,465	1,416,867
	** unassigned **		*607,410*	*528,244*		*236,749*	*44,465*	*1,416,867*
	150 Rubble Reach 12+30 to 18+10		**607,410**	**528,244**		**236,749**	**44,465**	**1,416,867**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	4,410.00 lf	301,212	261,954	-	117,403	22,050	702,618
	** unassigned **		*301,212*	*261,954*		*117,403*	*22,050*	*702,618*
	155 Rubble Beach 18+10 to 20+55		**301,212**	**261,954**		**117,403**	**22,050**	**702,618**
200 Reach 2								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	5,670.00 lf	387,272	336,798	-	150,946	28,350	903,367
	** unassigned **		*387,272*	*336,798*		*150,946*	*28,350*	*903,367*
	200 Reach 2		**387,272**	**336,798**		**150,946**	**28,350**	**903,367**
250 Reach 1								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	10,800.00 lf	737,662	641,520	-	287,517	54,000	1,720,698
	** unassigned **		*737,662*	*641,520*		*287,517*	*54,000*	*1,720,698*
	250 Reach 1		**737,662**	**641,520**		**287,517**	**54,000**	**1,720,698**
	350 CIDH Piles		***3,426,438***	***2,979,860***		***1,335,514***	***250,830***	***7,992,643***
400 Jet Grouting								
01 North Lot Reach								
** unassigned **								
2350.350	Jet Grouting	2,299.00 cy	179,869	114,950	-	74,669	11,495	380,983
	** unassigned **		*179,869*	*114,950*		*74,669*	*11,495*	*380,983*
	01 North Lot Reach		**179,869**	**114,950**		**74,669**	**11,495**	**380,983**
50 Reach 3								
** unassigned **								
2350.350	Jet Grouting	524.00 cy	40,997	26,200	-	17,019	2,620	86,836
	** unassigned **		*40,997*	*26,200*		*17,019*	*2,620*	*86,836*
	50 Reach 3		**40,997**	**26,200**		**17,019**	**2,620**	**86,836**

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
100 EQR								
* *unassigned* *								
2350.350	Jet Grouting	2,541.00 cy	198,803	127,050	-	82,529	12,705	421,087
	* *unassigned* *		*198,803*	*127,050*		*82,529*	*12,705*	*421,087*
	100 EQR		**198,803**	**127,050**		**82,529**	**12,705**	**421,087**
150 Rubble Reach 12+30 to 18+10								
* *unassigned* *								
2350.350	Jet Grouting	2,340.00 cy	183,077	117,000	-	76,001	11,700	387,778
	* *unassigned* *		*183,077*	*117,000*		*76,001*	*11,700*	*387,778*
	150 Rubble Reach 12+30 to 18+10		**183,077**	**117,000**		**76,001**	**11,700**	**387,778**
155 Rubble Beach 18+10 to 20+55								
* *unassigned* *								
2350.350	Jet Grouting	1,292.00 cy	101,084	64,600	-	41,963	6,460	214,106
	* *unassigned* *		*101,084*	*64,600*		*41,963*	*6,460*	*214,106*
	155 Rubble Beach 18+10 to 20+55		**101,084**	**64,600**		**41,963**	**6,460**	**214,106**
200 Reach 2								
* *unassigned* *								
2350.350	Jet Grouting	1,662.00 cy	130,032	83,100	-	53,980	8,310	275,421
	* *unassigned* *		*130,032*	*83,100*		*53,980*	*8,310*	*275,421*
	200 Reach 2		**130,032**	**83,100**		**53,980**	**8,310**	**275,421**
250 Reach 1								
* *unassigned* *								
2350.350	Jet Grouting	3,165.00 cy	247,623	158,250	-	102,796	15,825	524,494
	* *unassigned* *		*247,623*	*158,250*		*102,796*	*15,825*	*524,494*
	250 Reach 1		**247,623**	**158,250**		**102,796**	**15,825**	**524,494**
	400 Jet Grouting		***1,081,484***	***691,150***		***448,956***	***69,115***	***2,290,705***
450 Horizontal Cap With Hold Downs								
01 North Lot Reach								
* *unassigned* *								
2350.250	Install 36" CIDH Pile Reinforced	1,081.00 lf	73,834	64,211	-	28,778	5,405	172,229
3100.150	Form Slab-on-Grade Perimeter Edge >1'	8,790.00 sf	107,293	10,988	-	15,791	-	134,072
3200.150	Purchase & Install Rebar, Slab-On-Grade (Average Production)	133.00 tn	107,870	146,300	-	13,858	-	268,029
3300.250	Pump-Place Concrete, Slab-On-Grade (Average Production)	2,663.00 cy	54,022	319,560	-	10,970	31,956	416,508
	* *unassigned* *		*343,020*	*541,059*		*69,398*	*37,361*	*990,838*
	01 North Lot Reach		**343,020**	**541,059**		**69,398**	**37,361**	**990,838**
50 Reach 3								
* *unassigned* *								
2350.250	Install 36" CIDH Pile Reinforced	299.00 lf	20,422	17,761	-	7,960	1,495	47,638
3100.150	Form Slab-on-Grade Perimeter Edge >1'	2,653.00 sf	32,383	3,316	-	4,766	-	40,466
3200.150	Purchase & Install Rebar, Slab-On-Grade (Average Production)	37.00 tn	30,009	40,700	-	3,855	-	74,564
3300.250	Pump-Place Concrete, Slab-On-Grade (Average Production)	737.00 cy	14,951	88,440	-	3,036	8,844	115,271
	* *unassigned* *		*97,766*	*150,217*		*19,617*	*10,339*	*277,939*
	50 Reach 3		**97,766**	**150,217**		**19,617**	**10,339**	**277,939**
100 EQR								

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *									
2350.250	Install 36" CIDH Pile Reinforced	1,449.00	lf	98,970	86,071	-	38,575	7,245	230,860
3100.150	Form Slab-on-Grade Perimeter Edge >1'	11,678.00	sf	142,545	14,598	-	20,980	-	178,122
3200.150	Purchase & Install Rebar, Slab-On-Grade (Average Production)	179.00	tn	145,179	196,900	-	18,651	-	360,730
3300.250	Pump-Place Concrete, Slab-On-Grade (Average Production)	3,570.00	cy	72,422	428,400	-	14,706	42,840	558,368
	** unassigned **			*459,115*	*725,968*		*92,913*	*50,085*	*1,328,081*
	100 EQR			**459,115**	**725,968**		**92,913**	**50,085**	**1,328,081**
150 Rubble Reach 12+30 to 18+10									
* unassigned *									
2350.250	Install 36" CIDH Pile Reinforced	1,334.00	lf	91,115	79,240	-	35,514	6,670	212,538
3100.150	Form Slab-on-Grade Perimeter Edge >1'	10,775.00	sf	131,523	13,469	-	19,358	-	164,349
3200.150	Purchase & Install Rebar, Slab-On-Grade (Average Production)	164.00	tn	133,013	180,400	-	17,089	-	330,502
3300.250	Pump-Place Concrete, Slab-On-Grade (Average Production)	3,287.00	cy	66,681	394,440	-	13,541	39,444	514,105
	** unassigned **			*422,332*	*667,548*		*85,500*	*46,114*	*1,221,494*
	150 Rubble Reach 12+30 to 18+10			**422,332**	**667,548**		**85,500**	**46,114**	**1,221,494**
	450 Horizontal Cap With Hold Downs			***1,322,233***	***2,084,792***		***267,428***	***143,899***	***3,818,352***
500 Backfill Over Tunnel									
01 North Lot Reach									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	15,729.00	CY	298,360	-	-	183,492	-	481,852
	** unassigned **			*298,360*			*183,492*		*481,852*
	01 North Lot Reach			**298,360**			**183,492**		**481,852**
50 Reach 3									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	4,421.00	CY	83,861	-	-	51,575	-	135,436
	** unassigned **			*83,861*			*51,575*		*135,436*
	50 Reach 3			**83,861**			**51,575**		**135,436**
100 EQR									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	19,976.00	CY	378,921	-	-	233,036	-	611,957
	** unassigned **			*378,921*			*233,036*		*611,957*
	100 EQR			**378,921**			**233,036**		**611,957**
150 Rubble Reach 12+30 to 18+10									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	16,692.00	CY	316,627	-	-	194,726	-	511,353
	** unassigned **			*316,627*			*194,726*		*511,353*
	150 Rubble Reach 12+30 to 18+10			**316,627**			**194,726**		**511,353**
	500 Backfill Over Tunnel			***1,077,769***			***662,828***		***1,740,597***
600 Re-Establish Great Highway North Bound									
01 North Lot Reach									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	475.00	cy	3,786	11,875	-	1,183	-	16,844
2750.050	AC Paving System 6"	1,900.00	sy	-	-	62,700	-	-	62,700
	** unassigned **			*3,786*	*11,875*	*62,700*	*1,183*		*79,544*
	01 North Lot Reach			**3,786**	**11,875**	**62,700**	**1,183**		**79,544**

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
50 Reach 3								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	108.00 cy	861	2,700	-	269	-	3,830
2750.050	AC Paving System 6"	433.00 sy	-	-	14,289	-	-	14,289
	* *unassigned* *		*861*	*2,700*	*14,289*	*269*		*18,119*
	50 Reach 3		**861**	**2,700**	**14,289**	**269**		**18,119**
100 EQR								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	525.00 cy	4,184	13,125	-	1,308	-	18,617
2750.050	AC Paving System 6"	2,100.00 sy	-	-	69,300	-	-	69,300
	* *unassigned* *		*4,184*	*13,125*	*69,300*	*1,308*		*87,917*
	100 EQR		**4,184**	**13,125**	**69,300**	**1,308**		**87,917**
150 Rubble Reach 12+30 to 18+10								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	483.00 cy	3,850	12,075	-	1,203	-	17,128
2750.050	AC Paving System 6"	1,933.00 sy	-	-	63,789	-	-	63,789
	* *unassigned* *		*3,850*	*12,075*	*63,789*	*1,203*		*80,917*
	150 Rubble Reach 12+30 to 18+10		**3,850**	**12,075**	**63,789**	**1,203**		**80,917**
155 Rubble Beach 18+10 to 20+55								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	204.00 cy	1,626	5,100	-	508	-	7,234
2750.050	AC Paving System 6"	817.00 sy	-	-	26,961	-	-	26,961
	* *unassigned* *		*1,626*	*5,100*	*26,961*	*508*		*34,195*
	155 Rubble Beach 18+10 to 20+55		**1,626**	**5,100**	**26,961**	**508**		**34,195**
200 Reach 2								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	263.00 cy	2,096	6,575	-	655	-	9,326
2750.050	AC Paving System 6"	1,050.00 sy	-	-	34,650	-	-	34,650
	* *unassigned* *		*2,096*	*6,575*	*34,650*	*655*		*43,976*
	200 Reach 2		**2,096**	**6,575**	**34,650**	**655**		**43,976**
250 Reach 1								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	500.00 cy	3,985	12,500	-	1,245	-	17,730
2750.050	AC Paving System 6"	2,000.00 sy	-	-	66,000	-	-	66,000
	* *unassigned* *		*3,985*	*12,500*	*66,000*	*1,245*		*83,730*
	250 Reach 1		**3,985**	**12,500**	**66,000**	**1,245**		**83,730**
	600 Re-Establish Great Highway North Bound		***20,387***	***63,950***	***337,689***	***6,372***		***428,398***
650 Re-Establish Equivalent Parking Area								
01 North Lot Reach								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	556.00 cy	4,431	13,900	-	1,385	-	19,716
2750.050	AC Paving System 6"	2,222.00 sy	-	-	73,326	-	-	73,326
	* *unassigned* *		*4,431*	*13,900*	*73,326*	*1,385*		*93,042*
	01 North Lot Reach		**4,431**	**13,900**	**73,326**	**1,385**		**93,042**
150 Rubble Reach 12+30 to 18+10								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	1,250.00 cy	9,963	31,250	-	3,114	-	44,326

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *								
2750.050	AC Paving System 6"	5,000.00 sy	-	-	165,000	-	-	165,000
	* unassigned *		*9,963*	*31,250*	*165,000*	*3,114*		*209,326*
	150 Rubble Reach 12+30 to 18+10		**9,963**	**31,250**	**165,000**	**3,114**		**209,326**
	650 Re-Establish Equivalent Parking Area		***14,394***	***45,150***	***238,326***	***4,499***		***302,368***
675 Re-Establish Markings/Signage/Barreirs/Misc Allowance								
01 North Lot Reach								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	37,100.00 sqft	-	-	-	-	371,000	371,000
	* unassigned *						*371,000*	*371,000*
	01 North Lot Reach						**371,000**	**371,000**
50 Reach 3								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	3,900.00 sqft	-	-	-	-	39,000	39,000
	* unassigned *						*39,000*	*39,000*
	50 Reach 3						**39,000**	**39,000**
100 EQR								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	18,900.00 sqft	-	-	-	-	189,000	189,000
	* unassigned *						*189,000*	*189,000*
	100 EQR						**189,000**	**189,000**
150 Rubble Reach 12+30 to 18+10								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	62,400.00 sqft	-	-	-	-	624,000	624,000
	* unassigned *						*624,000*	*624,000*
	150 Rubble Reach 12+30 to 18+10						**624,000**	**624,000**
155 Rubble Beach 18+10 to 20+55								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	7,350.00 sqft	-	-	-	-	73,500	73,500
	* unassigned *						*73,500*	*73,500*
	155 Rubble Beach 18+10 to 20+55						**73,500**	**73,500**
200 Reach 2								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	9,450.00 sqft	-	-	-	-	94,500	94,500
	* unassigned *						*94,500*	*94,500*
	200 Reach 2						**94,500**	**94,500**
250 Reach 1								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	18,000.00 sqft	-	-	-	-	180,000	180,000
	* unassigned *						*180,000*	*180,000*
	250 Reach 1						**180,000**	**180,000**
	675 Re-Establish Markings/Signage/Barreirs/Misc Allowance						***1,571,000***	***1,571,000***
700 Restoration Sand Only								
50 Reach 3								
* unassigned *								
2200.150	Restoration Sand Infill	4,634.00 cy	4,911	127,435	-	2,308	-	134,655

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	** unassigned **		*4,911*	*127,435*		*2,308*		*134,655*
	50 Reach 3		**4,911**	**127,435**		**2,308**		**134,655**
100 EQR								
** unassigned **								
2200.150	Restoration Sand Infill	29,727.00 cy	31,506	817,493	-	14,808	-	863,807
	** unassigned **		*31,506*	*817,493*		*14,808*		*863,807*
	100 EQR		**31,506**	**817,493**		**14,808**		**863,807**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2200.150	Restoration Sand Infill	32,996.00 cy	34,970	907,390	-	16,437	-	958,797
	** unassigned **		*34,970*	*907,390*		*16,437*		*958,797*
	150 Rubble Reach 12+30 to 18+10		**34,970**	**907,390**		**16,437**		**958,797**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2200.150	Restoration Sand Infill	13,938.00 cy	14,772	383,295	-	6,943	-	405,010
	** unassigned **		*14,772*	*383,295*		*6,943*		*405,010*
	155 Rubble Beach 18+10 to 20+55		**14,772**	**383,295**		**6,943**		**405,010**
200 Reach 2								
** unassigned **								
2200.150	Restoration Sand Infill	13,148.00 cy	13,935	361,570	-	6,550	-	382,054
	** unassigned **		*13,935*	*361,570*		*6,550*		*382,054*
	200 Reach 2		**13,935**	**361,570**		**6,550**		**382,054**
250 Reach 1								
** unassigned **								
2200.150	Restoration Sand Infill	40,056.00 cy	42,453	1,101,540	-	19,954	-	1,163,947
	** unassigned **		*42,453*	*1,101,540*		*19,954*		*1,163,947*
	250 Reach 1		**42,453**	**1,101,540**		**19,954**		**1,163,947**
	700 Restoration Sand Only		***142,547***	***3,698,723***		***67,000***		***3,908,270***
710 Restoration Allowance								
01 North Lot Reach								
** unassigned **								
2200.150	Restoration Allowance	45,320.00 sqft	0	0	-	0	158,620	158,620
	** unassigned **						*158,620*	*158,620*
	01 North Lot Reach						**158,620**	**158,620**
50 Reach 3								
** unassigned **								
2200.150	Restoration Allowance	9,790.00 sqft	0	0	-	0	34,265	34,265
	** unassigned **						*34,265*	*34,265*
	50 Reach 3						**34,265**	**34,265**
100 EQR								
** unassigned **								
2200.150	Restoration Sand Infill	60,060.00 sqft	0	0	-	0	210,210	210,210
	** unassigned **						*210,210*	*210,210*
	100 EQR						**210,210**	**210,210**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2200.150	Restoration Allowance	47,630.00 sqft	0	0	-	0	166,705	166,705

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	** unassigned **						*166,705*	*166,705*
	150 Rubble Reach 12+30 to 18+10						**166,705**	**166,705**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2200.150	Restoration Allowance	31,130.00 sqft	0	0	-	0	108,955	108,955
	** unassigned **						*108,955*	*108,955*
	155 Rubble Beach 18+10 to 20+55						**108,955**	**108,955**
200 Reach 2								
** unassigned **								
2200.150	Restoration Allowance	29,150.00 sqft	0	0	-	0	102,025	102,025
	** unassigned **						*102,025*	*102,025*
	200 Reach 2						**102,025**	**102,025**
250 Reach 1								
** unassigned **								
2200.150	Restoration Allowance	61,600.00 sqft	0	0	-	0	215,600	215,600
	** unassigned **						*215,600*	*215,600*
	250 Reach 1						**215,600**	**215,600**
	710 Restoration Allowance						***996,380***	***996,380***
720 Cobble Berm								
50 Reach 3								
** unassigned **								
2200.150	Cobble Berm Allowance	130.00 lft				-	91,000	91,000
	** unassigned **						*91,000*	*91,000*
	50 Reach 3						**91,000**	**91,000**
100 EQR								
** unassigned **								
2200.150	Cobble Berm Allowance	630.00 lft				-	441,000	441,000
	** unassigned **						*441,000*	*441,000*
	100 EQR						**441,000**	**441,000**
	720 Cobble Berm						***532,000***	***532,000***
750 Traffic Control/Dust Abatement								
01 North Lot Reach								
** unassigned **								
2200.950	Dust Abatement	5.00 mo	23,019	-	-	16,438	-	39,457
2750.400	Traffic Control Subcontactor	90.00 day	-	-	225,000	-	-	225,000
	** unassigned **		*23,019*		*225,000*	*16,438*		*264,457*
	01 North Lot Reach		**23,019**		**225,000**	**16,438**		**264,457**
50 Reach 3								
** unassigned **								
2200.950	Dust Abatement	1.00 mo	4,604	-	-	3,288	-	7,891
2750.400	Traffic Control Subcontactor	30.00 day	-	-	75,000	-	-	75,000
	** unassigned **		*4,604*		*75,000*	*3,288*		*82,891*
	50 Reach 3		**4,604**		**75,000**	**3,288**		**82,891**
100 EQR								
** unassigned **								
2200.950	Dust Abatement	6.00 mo	27,622	-	-	19,726	-	47,348
2750.400	Traffic Control Subcontactor	113.00 day	-	-	282,500	-	-	282,500

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	** unassigned **		*27,622*		*282,500*	*19,726*		*329,848*
	100 EQR		**27,622**		**282,500**	**19,726**		**329,848**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2200.950	Dust Abatement	5.00 mo	23,019	-	-	16,438	-	39,457
2750.400	Traffic Control Subcontactor	106.00 day	-	-	265,000	-	-	265,000
	** unassigned **		*23,019*		*265,000*	*16,438*		*304,457*
	150 Rubble Reach 12+30 to 18+10		**23,019**		**265,000**	**16,438**		**304,457**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2200.950	Dust Abatement	1.00 mo	4,604	-	-	3,288	-	7,891
2750.400	Traffic Control Subcontactor	30.00 day	-	-	75,000	-	-	75,000
	** unassigned **		*4,604*		*75,000*	*3,288*		*82,891*
	155 Rubble Beach 18+10 to 20+55		**4,604**		**75,000**	**3,288**		**82,891**
200 Reach 2								
** unassigned **								
2200.950	Dust Abatement	1.00 mo	4,604	-	-	3,288	-	7,891
2750.400	Traffic Control Subcontactor	30.00 day	-	-	75,000	-	-	75,000
	** unassigned **		*4,604*		*75,000*	*3,288*		*82,891*
	200 Reach 2		**4,604**		**75,000**	**3,288**		**82,891**
250 Reach 1								
** unassigned **								
2200.950	Dust Abatement	3.00 mo	13,811	-	-	9,863	-	23,674
2750.400	Traffic Control Subcontactor	60.00 day	-	-	150,000	-	-	150,000
	** unassigned **		*13,811*		*150,000*	*9,863*		*173,674*
	250 Reach 1		**13,811**		**150,000**	**9,863**		**173,674**
	750 Traffic Control/Dust Abatement		***101,282***		***1,147,500***	***72,327***		***1,321,109***
800 Dewatering								
01 North Lot Reach								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	200.00 vlf	501	20,000	-	598	-	21,099
2250.150	Header Lines & Fittings 8"	570.00 lf	2,182	28,500	-	7,980	-	38,662
2250.150	Maintenance of Deep Well System	3.00 mo	49,658	-	-	6,000	3,000	58,658
	** unassigned **		*52,340*	*48,500*		*14,578*	*3,000*	*118,418*
	01 North Lot Reach		**52,340**	**48,500**		**14,578**	**3,000**	**118,418**
50 Reach 3								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	50.00 vlf	125	5,000	-	149	-	5,275
2250.150	Header Lines & Fittings 8"	130.00 lf	498	6,500	-	1,820	-	8,818
2250.150	Maintenance of Deep Well System	1.00 mo	16,553	-	-	2,000	1,000	19,553
	** unassigned **		*17,175*	*11,500*		*3,969*	*1,000*	*33,645*
	50 Reach 3		**17,175**	**11,500**		**3,969**	**1,000**	**33,645**
100 EQR								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	200.00 vlf	501	20,000	-	598	-	21,099
2250.150	Header Lines & Fittings 8"	630.00 lf	2,411	31,500	-	8,820	-	42,731
2250.150	Maintenance of Deep Well System	4.00 mo	66,211	-	-	8,000	4,000	78,211
	** unassigned **		*69,122*	*51,500*		*17,418*	*4,000*	*142,040*

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	100 EQR		**69,122**	**51,500**		**17,418**	**4,000**	**142,040**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	200.00 vlf	501	20,000	-	598	-	21,099
2250.150	Header Lines & Fittings 8"	580.00 lf	2,220	29,000	-	8,120	-	39,340
2250.150	Maintenance of Deep Well System	4.00 mo	66,211	-	-	8,000	4,000	78,211
	** unassigned **		*68,931*	*49,000*		*16,718*	*4,000*	*138,649*
	150 Rubble Reach 12+30 to 18+10		**68,931**	**49,000**		**16,718**	**4,000**	**138,649**
	800 Dewatering		***207,569***	***160,500***		***52,683***	***12,000***	***432,752***

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Estimate Totals

Description	Amount	Totals	Hours	Rate	Cost Basis	Percent of Total	
Labor	9,961,272		93,037.493 hrs			10.87%	
Material	9,757,802					10.65%	
Subcontract	2,081,245					2.27%	
Equipment	4,381,186		43,101.014 hrs			4.78%	
Other	5,086,974					5.55%	
Subtotal	**31,268,479**	**31,268,479**				**34.12%**	**34.12%**
Sales Tax	829,413			8.500 %	C	0.90%	
8.5% of Materials					T		
Subtotal	**829,413**	**32,097,892**				**0.90%**	**35.02%**
Mob/Demob	2,888,810			9.000 %	T	3.15%	
9% of Previous Subtotal					T		
Subtotal	**2,888,810**	**34,986,702**				**3.15%**	**38.17%**
Field Office G&A (GC's)	9,460,360				L	10.32%	
12% of $78,836,333					T		
Subtotal	**9,460,360**	**44,447,062**				**10.32%**	**48.49%**
Home Office Overhead	2,759,272				L	3.01%	
3.5% of $78,836,333					T		
Fee	7,883,633				L	8.60%	
10% of $78,836,333					T		
Subtotal	**10,642,905**	**55,089,967**				**11.61%**	**60.11%**
Insurance /Bonds	1,576,727				L	1.72%	
2% of $78,836,333					T		
Subtotal	**1,576,727**	**56,666,694**				**1.72%**	**61.83%**
Escalation-Mid point of Const	11,225,672				L	12.25%	
Lump Sum Amount					T		
Subtotal	**11,225,672**	**67,892,366**				**12.25%**	**74.07%**
Contingency	23,762,327			35.000 %	T	25.93%	
35% Of Previous Subtotal					T		
Subtotal	**23,762,327**	**91,654,693**				**25.93%**	**100.00%**
Total		***91,654,693***					

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Project name	Alt B - South Ocean Beach
Labor rate table	South Ocean Beach
Equipment rate table	2012 Equip - CA 03
Bid date	12:00:00 AM
Report format	Sorted by 'WORK PKG/WORK AREA/Assembly' 'Detail' summary

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
50 Great Highway Removal South Bound Lane								
01 North Lot Reach								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	570.00 lf	7,994	-	-	3,407	-	11,401
2150.050	Demo AC Pavement	815.00 cy	15,996	-	-	7,950	-	23,946
2150.050	Excavate Road Base & Stock Pile on Site	611.00 cy	7,195	-	-	2,943	-	10,138
2150.500	Trucking Demo Materials Pavement	41.00 hr	4,290	-	-	2,361	-	6,650
2150.500	Dump Fees Pavement	82.00 load	-	-	-	-	8,200	8,200
2150.500	Dump Fees Barriers	14.00 load	-	-	-	-	1,400	1,400
2200.700	Install and Maintain Silt Fence	855.00 lf	818	2,779	-	-	-	3,597
	** unassigned **		*36,292*	*2,779*		*16,661*	*9,600*	*65,332*
	01 North Lot Reach		**36,292**	**2,779**		**16,661**	**9,600**	**65,332**
50 Reach 3								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	393.00 lf	5,511	-	-	2,349	-	7,861
2150.050	Demo AC Pavement	185.00 cy	3,631	-	-	1,805	-	5,436
2150.050	Excavate Road Base & Stock Pile on Site	139.00 cy	1,637	-	-	670	-	2,306
2150.500	Trucking Demo Materials Pavement	10.00 hr	1,046	-	-	576	-	1,622
2150.500	Dump Fees Pavement	19.00 load	-	-	-	-	1,900	1,900
2150.500	Dump Fees Barriers	7.00 load	-	-	-	-	700	700
2200.700	Install and Maintain Silt Fence	195.00 lf	187	634	-	-	-	820
	** unassigned **		*12,012*	*634*		*5,399*	*2,600*	*20,645*
	50 Reach 3		**12,012**	**634**		**5,399**	**2,600**	**20,645**
100 EQR								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	840.00 lf	11,780	-	-	5,021	-	16,801
2150.050	Demo AC Pavement	852.00 cy	16,722	-	-	8,311	-	25,033
2150.050	Excavate Road Base & Stock Pile on Site	639.00 cy	7,525	-	-	3,078	-	10,603
2150.500	Trucking Demo Materials Pavement	43.00 hr	4,499	-	-	2,476	-	6,975
2150.500	Dump Fees Pavement	86.00 load	-	-	-	-	8,600	8,600
2150.500	Dump Fees Barriers	5.00 load	-	-	-	-	500	500
2200.700	Install and Maintain Silt Fence	945.00 lf	904	3,071	-	-	-	3,975
	** unassigned **		*41,430*	*3,071*		*18,886*	*9,100*	*72,488*
	100 EQR		**41,430**	**3,071**		**18,886**	**9,100**	**72,488**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	1,740.00 lf	24,401	-	-	10,401	-	34,803
2150.050	Demo AC Pavement	963.00 cy	18,900	-	-	9,394	-	28,295
2150.050	Excavate Road Base & Stock Pile on Site	722.00 cy	8,502	-	-	3,478	-	11,980
2150.500	Trucking Demo Materials Pavement	49.00 hr	5,127	-	-	2,821	-	7,948
2150.500	Dump Fees Pavement	96.00 load	-	-	-	-	9,600	9,600
2150.500	Dump Fees Barriers	29.00 load	-	-	-	-	2,900	2,900
2200.700	Install and Maintain Silt Fence	870.00 lf	832	2,828	-	-	-	3,660
	** unassigned **		*57,763*	*2,828*		*26,094*	*12,500*	*99,185*
	150 Rubble Reach 12+30 to 18+10		**57,763**	**2,828**		**26,094**	**12,500**	**99,185**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2150.050	Demo BarriersGuide Rails Misc	735.00 lf	10,307	-	-	4,394	-	14,701
2150.050	Demo AC Pavement	407.00 cy	7,988	-	-	3,970	-	11,958
2150.050	Excavate Road Base & Stock Pile on Site	306.00 cy	3,603	-	-	1,474	-	5,077
2150.500	Trucking Demo Materials Pavement	20.00 hr	2,093	-	-	1,152	-	3,244
2150.500	Dump Fees Pavement	41.00 load	-	-	-	-	4,100	4,100

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *								
2150.500	Dump Fees Barriers	12.00 load	-	-	-	-	1,200	1,200
2200.700	Install and Maintain Silt Fence	368.00 lf	352	1,196	-	-	-	1,548
	** unassigned **		*24,344*	*1,196*		*10,989*	*5,300*	*41,829*
	155 Rubble Beach 18+10 to 20+55		**24,344**	**1,196**		**10,989**	**5,300**	**41,829**
200 Reach 2								
* unassigned *								
2150.050	Demo BarriersGuide Rails Misc	945.00 lf	13,252	-	-	5,649	-	18,901
2150.050	Demo AC Pavement	889.00 cy	17,448	-	-	8,672	-	26,120
2150.050	Excavate Road Base & Stock Pile on Site	667.00 cy	7,855	-	-	3,213	-	11,067
2150.500	Trucking Demo Materials Pavement	45.00 hr	4,708	-	-	2,591	-	7,299
2150.500	Dump Fees Pavement	89.00 load	-	-	-	-	8,900	8,900
2150.500	Dump Fees Barriers	24.00 load	-	-	-	-	2,400	2,400
2200.700	Install and Maintain Silt Fence	473.00 lf	453	1,537	-	-	-	1,990
	** unassigned **		*43,716*	*1,537*		*20,125*	*11,300*	*76,678*
	200 Reach 2		**43,716**	**1,537**		**20,125**	**11,300**	**76,678**
250 Reach 1								
* unassigned *								
2150.050	Demo BarriersGuide Rails Misc	1,800.00 lf	25,243	-	-	10,760	-	36,003
2150.050	Demo AC Pavement	1,444.00 cy	28,341	-	-	14,086	-	42,427
2150.050	Excavate Road Base & Stock Pile on Site	1,083.00 cy	12,753	-	-	5,217	-	17,970
2150.500	Trucking Demo Materials Pavement	73.00 hr	7,638	-	-	4,203	-	11,841
2150.500	Dump Fees Pavement	144.00 load	-	-	-	-	14,400	14,400
2150.500	Dump Fees Barriers	45.00 load	-	-	-	-	4,500	4,500
2200.700	Install and Maintain Silt Fence	900.00 lf	861	2,925	-	-	-	3,786
	** unassigned **		*74,836*	*2,925*		*34,266*	*18,900*	*130,927*
	250 Reach 1		**74,836**	**2,925**		**34,266**	**18,900**	**130,927**
	50 Great Highway Removal South Bound Lane		***290,394***	***14,970***		***132,421***	***69,300***	***507,084***
100 Great Highway Removal North Bound Lane								
01 North Lot Reach								
* unassigned *								
2150.050	Demo AC Pavement	852.00 cy	16,722	-	-	8,311	-	25,033
2150.050	Excavate Road Base & Stock Pile on Site	639.00 cy	7,525	-	-	3,078	-	10,603
2150.500	Trucking Demo Materials Pavement	43.00 hr	4,499	-	-	2,476	-	6,975
2150.500	Dump Fees Pavement	86.00 load	-	-	-	-	8,600	8,600
2200.700	Install and Maintain Silt Fence	855.00 lf	818	2,779	-	-	-	3,597
	** unassigned **		*29,564*	*2,779*		*13,865*	*8,600*	*54,808*
	01 North Lot Reach		**29,564**	**2,779**		**13,865**	**8,600**	**54,808**
50 Reach 3								
* unassigned *								
2150.050	Demo AC Pavement	185.00 cy	3,631	-	-	1,805	-	5,436
2150.050	Excavate Road Base & Stock Pile on Site	139.00 cy	1,637	-	-	670	-	2,306
2150.500	Trucking Demo Materials Pavement	10.00 hr	1,046	-	-	576	-	1,622
2150.500	Dump Fees Pavement	19.00 load	-	-	-	-	1,900	1,900
2200.700	Install and Maintain Silt Fence	195.00 lf	187	634	-	-	-	820
	** unassigned **		*6,501*	*634*		*3,050*	*1,900*	*12,084*
	50 Reach 3		**6,501**	**634**		**3,050**	**1,900**	**12,084**
100 EQR								
* unassigned *								
2150.050	Demo BarriersGuide Rails Misc	630.00 lf	8,835	-	-	3,766	-	12,601

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *								
2150.050	Demo AC Pavement	778.00 cy	15,270	-	-	7,589	-	22,859
2150.050	Excavate Road Base & Stock Pile on Site	583.00 cy	6,865	-	-	2,808	-	9,674
2150.500	Trucking Demo Materials Pavement	39.00 hr	4,081	-	-	2,245	-	6,326
2150.500	Dump Fees Pavement	78.00 load	-	-	-	-	7,800	7,800
2150.500	Dump Fees Barriers	16.00 load	-	-	-	-	1,600	1,600
2200.700	Install and Maintain Silt Fence	945.00 lf	904	3,071	-	-	-	3,975
	** unassigned **		*35,955*	*3,071*		*16,409*	*9,400*	*64,835*
	100 EQR		**35,955**	**3,071**		**16,409**	**9,400**	**64,835**
150 Rubble Reach 12+30 to 18+10								
* unassigned *								
2150.050	Demo BarriersGuide Rails Misc	580.00 lf	8,134	-	-	3,467	-	11,601
2150.050	Demo AC Pavement	889.00 cy	17,448	-	-	8,672	-	26,120
2150.050	Excavate Road Base & Stock Pile on Site	667.00 cy	7,855	-	-	3,213	-	11,067
2150.500	Trucking Demo Materials Pavement	45.00 hr	4,708	-	-	2,591	-	7,299
2150.500	Dump Fees Pavement	89.00 load	-	-	-	-	8,900	8,900
2150.500	Dump Fees Barriers	15.00 load	-	-	-	-	1,500	1,500
2200.700	Install and Maintain Silt Fence	870.00 lf	832	2,828	-	-	-	3,660
	** unassigned **		*38,977*	*2,828*		*17,943*	*10,400*	*70,148*
	150 Rubble Reach 12+30 to 18+10		**38,977**	**2,828**		**17,943**	**10,400**	**70,148**
155 Rubble Beach 18+10 to 20+55								
* unassigned *								
2150.050	Demo AC Pavement	370.00 cy	7,262	-	-	3,609	-	10,871
2150.050	Excavate Road Base & Stock Pile on Site	278.00 cy	3,274	-	-	1,339	-	4,613
2150.500	Trucking Demo Materials Pavement	19.00 hr	1,988	-	-	1,094	-	3,082
2150.500	Dump Fees Pavement	37.00 load	-	-	-	-	3,700	3,700
2200.700	Install and Maintain Silt Fence	368.00 lf	352	1,196	-	-	-	1,548
	** unassigned **		*12,876*	*1,196*		*6,042*	*3,700*	*23,814*
	155 Rubble Beach 18+10 to 20+55		**12,876**	**1,196**		**6,042**	**3,700**	**23,814**
200 Reach 2								
* unassigned *								
2150.050	Demo AC Pavement	519.00 cy	10,186	-	-	5,063	-	15,249
2150.050	Excavate Road Base & Stock Pile on Site	389.00 cy	4,581	-	-	1,874	-	6,455
2150.500	Trucking Demo Materials Pavement	26.00 hr	2,720	-	-	1,497	-	4,217
2150.500	Dump Fees Pavement	52.00 load	-	-	-	-	5,200	5,200
2200.700	Install and Maintain Silt Fence	473.00 lf	453	1,537	-	-	-	1,990
	** unassigned **		*17,940*	*1,537*		*8,434*	*5,200*	*33,111*
	200 Reach 2		**17,940**	**1,537**		**8,434**	**5,200**	**33,111**
250 Reach 1								
* unassigned *								
2150.050	Demo AC Pavement	1,148.00 cy	22,531	-	-	11,199	-	33,730
2150.050	Excavate Road Base & Stock Pile on Site	861.00 cy	10,139	-	-	4,147	-	14,286
2150.500	Trucking Demo Materials Pavement	58.00 hr	6,069	-	-	3,339	-	9,408
2150.500	Dump Fees Pavement	115.00 load	-	-	-	-	11,500	11,500
2200.700	Install and Maintain Silt Fence	900.00 lf	861	2,925	-	-	-	3,786
	** unassigned **		*39,600*	*2,925*		*18,685*	*11,500*	*72,711*
	250 Reach 1		**39,600**	**2,925**		**18,685**	**11,500**	**72,711**
	100 Great Highway Removal North Bound Lane		***181,412***	***14,970***		***84,428***	***50,700***	***331,510***

150 Parking Area Removal North Lot

01 North Lot Reach

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *									
2150.050	Demo BarriersGuide Rails Misc	570.00	lf	7,994	-	-	3,407	-	11,401
2150.050	Demo AC Pavement	741.00	cy	14,543	-	-	7,228	-	21,772
2150.050	Excavate Road Base & Stock Pile on Site	556.00	cy	6,547	-	-	2,678	-	9,226
2150.150	Demo and Dispose of Structure (Heavy Construction)	1,500.00	sf	21,138	-	-	12,085	6,000	39,223
2150.500	Trucking Demo Materials Pavement	37.00	hr	3,871	-	-	2,130	-	6,002
2150.500	Dump Fees Pavement	74.00	load	-	-	-	-	7,400	7,400
2150.500	Dump Fees Barriers	13.00	load	-	-	-	-	1,300	1,300
2200.700	Install and Maintain Silt Fence	570.00	lf	545	1,853	-	-	-	2,398
	** unassigned **			*54,639*	*1,853*		*27,529*	*14,700*	*98,721*
	01 North Lot Reach			**54,639**	**1,853**		**27,529**	**14,700**	**98,721**
	150 Parking Area Removal North Lot			***54,639***	***1,853***		***27,529***	***14,700***	***98,721***
200 Parking Area Removal South Lot									
150 Rubble Reach 12+30 to 18+10									
* unassigned *									
2150.050	Demo BarriersGuide Rails Misc	580.00	lf	8,134	-	-	3,467	-	11,601
2150.050	Demo AC Pavement	1,667.00	cy	32,718	-	-	16,262	-	48,979
2150.050	Excavate Road Base & Stock Pile on Site	1,250.00	cy	14,720	-	-	6,021	-	20,741
2150.500	Trucking Demo Materials Pavement	84.00	hr	8,789	-	-	4,836	-	13,625
2150.500	Dump Fees Pavement	167.00	load	-	-	-	-	16,700	16,700
2150.500	Dump Fees Barriers	15.00	load	-	-	-	-	1,500	1,500
2200.700	Install and Maintain Silt Fence	580.00	lf	555	1,885	-	-	-	2,440
	** unassigned **			*64,915*	*1,885*		*30,586*	*18,200*	*115,586*
	150 Rubble Reach 12+30 to 18+10			**64,915**	**1,885**		**30,586**	**18,200**	**115,586**
155 Rubble Beach 18+10 to 20+55									
* unassigned *									
2150.050	Demo BarriersGuide Rails Misc	245.00	lf	3,436	-	-	1,465	-	4,900
2150.500	Dump Fees Barriers	6.00	load	-	-	-	-	600	600
	** unassigned **			*3,436*			*1,465*	*600*	*5,500*
	155 Rubble Beach 18+10 to 20+55			**3,436**			**1,465**	**600**	**5,500**
	200 Parking Area Removal South Lot			***68,351***	***1,885***		***32,051***	***18,800***	***121,087***
250 Removal of Rock Rubble									
50 Reach 3									
* unassigned *									
2200.200	Structure Excavation, Load for Export, 250 CY/Day	650.00	cy	11,668	-	-	7,023	-	18,690
2200.450	Dispose of Excavated Material (Off Site)	650.00	cy	-	-	6,500	-	-	6,500
	** unassigned **			*11,668*		*6,500*	*7,023*		*25,190*
	50 Reach 3			**11,668**		**6,500**	**7,023**		**25,190**
100 EQR									
* unassigned *									
2200.200	Structure Excavation, Load for Export, 250 CY/Day	7,886.00	cy	141,557	-	-	85,202	-	226,758
2200.450	Dispose of Excavated Material (Off Site)	7,886.00	cy	-	-	78,860	-	-	78,860
	** unassigned **			*141,557*		*78,860*	*85,202*		*305,618*
	100 EQR			**141,557**		**78,860**	**85,202**		**305,618**
150 Rubble Reach 12+30 to 18+10									
* unassigned *									
2200.200	Structure Excavation, Load for Export, 250 CY/Day	6,994.00	cy	125,545	-	-	75,564	-	201,109
2200.450	Dispose of Excavated Material (Off Site)	6,699.00	cy	-	-	66,990	-	-	66,990
	** unassigned **			*125,545*		*66,990*	*75,564*		*268,099*

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	150 Rubble Reach 12+30 to 18+10		**125,545**		**66,990**	**75,564**		**268,099**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2200.200	Structure Excavation, Load for Export, 250 CY/Day	2,954.00 cy	53,025	-	-	31,915	-	84,941
2200.450	Dispose of Excavated Material (Off Site)	2,954.00 cy	-	-	29,540	-	-	29,540
	** unassigned **		*53,025*		*29,540*	*31,915*		*114,481*
	155 Rubble Beach 18+10 to 20+55		**53,025**		**29,540**	**31,915**		**114,481**
200 Reach 2								
** unassigned **								
2200.200	Structure Excavation, Load for Export, 250 CY/Day	1,468.00 cy	26,351	-	-	15,860	-	42,212
2200.450	Dispose of Excavated Material (Off Site)	1,468.00 cy	-	-	14,680	-	-	14,680
	** unassigned **		*26,351*		*14,680*	*15,860*		*56,892*
	200 Reach 2		**26,351**		**14,680**	**15,860**		**56,892**
250 Reach 1								
** unassigned **								
2200.200	Structure Excavation, Load for Export, 250 CY/Day	16,116.00 cy	289,289	-	-	174,120	-	463,408
2200.450	Dispose of Excavated Material (Off Site)	16,116.00 cy	-	-	161,160	-	-	161,160
	** unassigned **		*289,289*		*161,160*	*174,120*		*624,568*
	250 Reach 1		**289,289**		**161,160**	**174,120**		**624,568**
	250 Removal of Rock Rubble		***647,435***		***357,730***	***389,684***		***1,394,849***
300 Excavate for low profile wall and cap								
01 North Lot Reach								
** unassigned **								
2200.200	Structure Excavation, Haul to On-site Stockpile	20,288.00 cy	364,178	-	-	219,195		583,372
2200.800	Temporary Shoring	14,805.00 sf	-			-	370,125	370,125
	** unassigned **		*364,178*			*219,195*	*370,125*	*953,497*
	01 North Lot Reach		**364,178**			**219,195**	**370,125**	**953,497**
50 Reach 3								
** unassigned **								
2200.200	Structure Excavation, Haul to On-site Stockpile	5,612.00 cy	100,738	-	-	60,633		161,371
2200.800	Temporary Shoring	4,095.00 sf	-			-	102,375	102,375
	** unassigned **		*100,738*			*60,633*	*102,375*	*263,746*
	50 Reach 3		**100,738**			**60,633**	**102,375**	**263,746**
100 EQR								
** unassigned **								
2200.200	Structure Excavation, Haul to On-site Stockpile	25,667.00 cy	460,733	-	-	277,310		738,043
2200.800	Temporary Shoring	18,900.00 sf	-			-	472,500	472,500
	** unassigned **		*460,733*			*277,310*	*472,500*	*1,210,543*
	100 EQR		**460,733**			**277,310**	**472,500**	**1,210,543**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2200.200	Structure Excavation, Haul to On-site Stockpile	22,244.00 cy	399,289	-	-	240,327		639,616
2200.800	Temporary Shoring	16,530.00 sf	-			-	413,250	413,250
	** unassigned **		*399,289*			*240,327*	*413,250*	*1,052,866*
	150 Rubble Reach 12+30 to 18+10		**399,289**			**240,327**	**413,250**	**1,052,866**
	300 Excavate for low profile wall and cap		***1,324,937***			***797,465***	***1,358,250***	***3,480,652***
350 CIDH Piles								

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
01 North Lot Reach								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	8,740.00 lf	596,959	519,156	-	232,675	43,700	1,392,491
	** unassigned **		*596,959*	*519,156*		*232,675*	*43,700*	*1,392,491*
	01 North Lot Reach		**596,959**	**519,156**		**232,675**	**43,700**	**1,392,491**
50 Reach 3								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	1,993.00 lf	136,126	118,384	-	53,057	9,965	317,533
	** unassigned **		*136,126*	*118,384*		*53,057*	*9,965*	*317,533*
	50 Reach 3		**136,126**	**118,384**		**53,057**	**9,965**	**317,533**
100 EQR								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	9,660.00 lf	659,797	573,804	-	257,168	48,300	1,539,069
	** unassigned **		*659,797*	*573,804*		*257,168*	*48,300*	*1,539,069*
	100 EQR		**659,797**	**573,804**		**257,168**	**48,300**	**1,539,069**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	8,893.00 lf	607,410	528,244	-	236,749	44,465	1,416,867
	** unassigned **		*607,410*	*528,244*		*236,749*	*44,465*	*1,416,867*
	150 Rubble Reach 12+30 to 18+10		**607,410**	**528,244**		**236,749**	**44,465**	**1,416,867**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	4,410.00 lf	301,212	261,954	-	117,403	22,050	702,618
	** unassigned **		*301,212*	*261,954*		*117,403*	*22,050*	*702,618*
	155 Rubble Beach 18+10 to 20+55		**301,212**	**261,954**		**117,403**	**22,050**	**702,618**
200 Reach 2								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	5,670.00 lf	387,272	336,798	-	150,946	28,350	903,367
	** unassigned **		*387,272*	*336,798*		*150,946*	*28,350*	*903,367*
	200 Reach 2		**387,272**	**336,798**		**150,946**	**28,350**	**903,367**
250 Reach 1								
** unassigned **								
2350.250	Install 36" CIDH Pile Reinforced	10,800.00 lf	737,662	641,520	-	287,517	54,000	1,720,698
	** unassigned **		*737,662*	*641,520*		*287,517*	*54,000*	*1,720,698*
	250 Reach 1		**737,662**	**641,520**		**287,517**	**54,000**	**1,720,698**
	350 CIDH Piles		***3,426,438***	***2,979,860***		***1,335,514***	***250,830***	***7,992,643***
400 Jet Grouting								
01 North Lot Reach								
** unassigned **								
2350.350	Jet Grouting	2,299.00 cy	179,869	114,950	-	74,669	11,495	380,983
	** unassigned **		*179,869*	*114,950*		*74,669*	*11,495*	*380,983*
	01 North Lot Reach		**179,869**	**114,950**		**74,669**	**11,495**	**380,983**
50 Reach 3								
** unassigned **								
2350.350	Jet Grouting	524.00 cy	40,997	26,200	-	17,019	2,620	86,836
	** unassigned **		*40,997*	*26,200*		*17,019*	*2,620*	*86,836*
	50 Reach 3		**40,997**	**26,200**		**17,019**	**2,620**	**86,836**

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
100 EQR								
* *unassigned* *								
2350.350	Jet Grouting	2,541.00 cy	198,803	127,050	-	82,529	12,705	421,087
	* *unassigned* *		*198,803*	*127,050*		*82,529*	*12,705*	*421,087*
	100 EQR		**198,803**	**127,050**		**82,529**	**12,705**	**421,087**
150 Rubble Reach 12+30 to 18+10								
* *unassigned* *								
2350.350	Jet Grouting	2,340.00 cy	183,077	117,000	-	76,001	11,700	387,778
	* *unassigned* *		*183,077*	*117,000*		*76,001*	*11,700*	*387,778*
	150 Rubble Reach 12+30 to 18+10		**183,077**	**117,000**		**76,001**	**11,700**	**387,778**
155 Rubble Beach 18+10 to 20+55								
* *unassigned* *								
2350.350	Jet Grouting	1,292.00 cy	101,084	64,600	-	41,963	6,460	214,106
	* *unassigned* *		*101,084*	*64,600*		*41,963*	*6,460*	*214,106*
	155 Rubble Beach 18+10 to 20+55		**101,084**	**64,600**		**41,963**	**6,460**	**214,106**
200 Reach 2								
* *unassigned* *								
2350.350	Jet Grouting	1,662.00 cy	130,032	83,100	-	53,980	8,310	275,421
	* *unassigned* *		*130,032*	*83,100*		*53,980*	*8,310*	*275,421*
	200 Reach 2		**130,032**	**83,100**		**53,980**	**8,310**	**275,421**
250 Reach 1								
* *unassigned* *								
2350.350	Jet Grouting	3,165.00 cy	247,623	158,250	-	102,796	15,825	524,494
	* *unassigned* *		*247,623*	*158,250*		*102,796*	*15,825*	*524,494*
	250 Reach 1		**247,623**	**158,250**		**102,796**	**15,825**	**524,494**
	400 Jet Grouting		***1,081,484***	***691,150***		***448,956***	***69,115***	***2,290,705***
450 Horizontal Cap With Hold Downs								
01 North Lot Reach								
* *unassigned* *								
2350.250	Install 36" CIDH Pile Reinforced	1,081.00 lf	73,834	64,211	-	28,778	5,405	172,229
3100.150	Form Slab-on-Grade Perimeter Edge >1'	5,723.00 sf	69,857	7,154	-	10,281	-	87,292
3200.150	Purchase & Install Rebar, Slab-On-Grade (Average Production)	63.00 tn	51,096	69,300	-	6,564	-	126,961
3300.250	Pump-Place Concrete, Slab-On-Grade (Average Production)	1,253.00 cy	25,419	150,360	-	5,162	15,036	195,976
	* *unassigned* *		*220,206*	*291,025*		*50,786*	*20,441*	*582,458*
	01 North Lot Reach		**220,206**	**291,025**		**50,786**	**20,441**	**582,458**
50 Reach 3								
* *unassigned* *								
2350.250	Install 36" CIDH Pile Reinforced	299.00 lf	20,422	17,761	-	7,960	1,495	47,638
3100.150	Form Slab-on-Grade Perimeter Edge >1'	1,804.00 sf	22,020	2,255	-	3,241	-	27,516
3200.150	Purchase & Install Rebar, Slab-On-Grade (Average Production)	17.00 tn	13,788	18,700	-	1,771	-	34,259
3300.250	Pump-Place Concrete, Slab-On-Grade (Average Production)	347.00 cy	7,039	41,640	-	1,429	4,164	54,273
	* *unassigned* *		*63,270*	*80,356*		*14,402*	*5,659*	*163,686*
	50 Reach 3		**63,270**	**80,356**		**14,402**	**5,659**	**163,686**
100 EQR								

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *									
2350.250	Install 36" CIDH Pile Reinforced	1,449.00	lf	98,970	86,071	-	38,575	7,245	230,860
3100.150	Form Slab-on-Grade Perimeter Edge >1'	7,567.00	sf	92,365	9,459	-	13,594	-	115,418
3200.150	Purchase & Install Rebar, Slab-On-Grade (Average Production)	84.00	tn	68,129	92,400	-	8,753	-	169,281
3300.250	Pump-Place Concrete, Slab-On-Grade (Average Production)	1,680.00	cy	34,081	201,600	-	6,921	20,160	262,761
	** unassigned **			*293,544*	*389,529*		*67,843*	*27,405*	*778,321*
	100 EQR			**293,544**	**389,529**		**67,843**	**27,405**	**778,321**
150 Rubble Reach 12+30 to 18+10									
* unassigned *									
2350.250	Install 36" CIDH Pile Reinforced	1,334.00	lf	91,115	79,240	-	35,514	6,670	212,538
3100.150	Form Slab-on-Grade Perimeter Edge >1'	6,990.00	sf	85,322	8,738	-	12,558	-	106,617
3200.150	Purchase & Install Rebar, Slab-On-Grade (Average Production)	77.00	tn	62,451	84,700	-	8,023	-	155,175
3300.250	Pump-Place Concrete, Slab-On-Grade (Average Production)	1,547.00	cy	31,383	185,640	-	6,373	18,564	241,960
	** unassigned **			*270,271*	*358,317*		*62,467*	*25,234*	*716,289*
	150 Rubble Reach 12+30 to 18+10			**270,271**	**358,317**		**62,467**	**25,234**	**716,289**
	450 Horizontal Cap With Hold Downs			***847,291***	***1,119,227***		***195,498***	***78,739***	***2,240,755***
500 Backfill Over Tunnel									
01 North Lot Reach									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	15,729.00	CY	298,360	-	-	183,492	-	481,852
	** unassigned **			*298,360*			*183,492*		*481,852*
	01 North Lot Reach			**298,360**			**183,492**		**481,852**
50 Reach 3									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	4,421.00	CY	83,861	-	-	51,575	-	135,436
	** unassigned **			*83,861*			*51,575*		*135,436*
	50 Reach 3			**83,861**			**51,575**		**135,436**
100 EQR									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	19,976.00	CY	378,921	-	-	233,036	-	611,957
	** unassigned **			*378,921*			*233,036*		*611,957*
	100 EQR			**378,921**			**233,036**		**611,957**
150 Rubble Reach 12+30 to 18+10									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	16,692.00	CY	316,627	-	-	194,726	-	511,353
	** unassigned **			*316,627*			*194,726*		*511,353*
	150 Rubble Reach 12+30 to 18+10			**316,627**			**194,726**		**511,353**
	500 Backfill Over Tunnel			***1,077,769***			***662,828***		***1,740,597***
600 Re-Establish Great Highway North Bound									
01 North Lot Reach									
* unassigned *									
2200.250	Structural Backfill from On-Site Stockpile	475.00	cy	3,786	11,875	-	1,183	-	16,844
2750.050	AC Paving System 6"	1,900.00	sy	-	-	62,700	-	-	62,700
	** unassigned **			*3,786*	*11,875*	*62,700*	*1,183*		*79,544*
	01 North Lot Reach			**3,786**	**11,875**	**62,700**	**1,183**		**79,544**

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
50 Reach 3								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	108.00 cy	861	2,700	-	269	-	3,830
2750.050	AC Paving System 6"	433.00 sy	-	-	14,289	-	-	14,289
	* *unassigned* *		*861*	*2,700*	*14,289*	*269*		*18,119*
	50 Reach 3		**861**	**2,700**	**14,289**	**269**		**18,119**
100 EQR								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	525.00 cy	4,184	13,125	-	1,308	-	18,617
2750.050	AC Paving System 6"	2,100.00 sy	-	-	69,300	-	-	69,300
	* *unassigned* *		*4,184*	*13,125*	*69,300*	*1,308*		*87,917*
	100 EQR		**4,184**	**13,125**	**69,300**	**1,308**		**87,917**
150 Rubble Reach 12+30 to 18+10								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	483.00 cy	3,850	12,075	-	1,203	-	17,128
2750.050	AC Paving System 6"	1,933.00 sy	-	-	63,789	-	-	63,789
	* *unassigned* *		*3,850*	*12,075*	*63,789*	*1,203*		*80,917*
	150 Rubble Reach 12+30 to 18+10		**3,850**	**12,075**	**63,789**	**1,203**		**80,917**
155 Rubble Beach 18+10 to 20+55								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	204.00 cy	1,626	5,100	-	508	-	7,234
2750.050	AC Paving System 6"	817.00 sy	-	-	26,961	-	-	26,961
	* *unassigned* *		*1,626*	*5,100*	*26,961*	*508*		*34,195*
	155 Rubble Beach 18+10 to 20+55		**1,626**	**5,100**	**26,961**	**508**		**34,195**
200 Reach 2								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	263.00 cy	2,096	6,575	-	655	-	9,326
2750.050	AC Paving System 6"	1,050.00 sy	-	-	34,650	-	-	34,650
	* *unassigned* *		*2,096*	*6,575*	*34,650*	*655*		*43,976*
	200 Reach 2		**2,096**	**6,575**	**34,650**	**655**		**43,976**
250 Reach 1								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	500.00 cy	3,985	12,500	-	1,245	-	17,730
2750.050	AC Paving System 6"	2,000.00 sy	-	-	66,000	-	-	66,000
	* *unassigned* *		*3,985*	*12,500*	*66,000*	*1,245*		*83,730*
	250 Reach 1		**3,985**	**12,500**	**66,000**	**1,245**		**83,730**
	600 Re-Establish Great Highway North Bound		***20,387***	***63,950***	***337,689***	***6,372***		***428,398***
650 Re-Establish Equivalent Parking Area								
01 North Lot Reach								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	556.00 cy	4,431	13,900	-	1,385	-	19,716
2750.050	AC Paving System 6"	2,222.00 sy	-	-	73,326	-	-	73,326
	* *unassigned* *		*4,431*	*13,900*	*73,326*	*1,385*		*93,042*
	01 North Lot Reach		**4,431**	**13,900**	**73,326**	**1,385**		**93,042**
150 Rubble Reach 12+30 to 18+10								
* *unassigned* *								
2200.250	Structural Backfill from On-Site Stockpile	1,250.00 cy	9,963	31,250	-	3,114	-	44,326

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *								
2750.050	AC Paving System 6"	5,000.00 sy	-	-	165,000	-	-	165,000
	* unassigned *		*9,963*	*31,250*	*165,000*	*3,114*		*209,326*
	150 Rubble Reach 12+30 to 18+10		**9,963**	**31,250**	**165,000**	**3,114**		**209,326**
	650 Re-Establish Equivalent Parking Area		***14,394***	***45,150***	***238,326***	***4,499***		***302,368***
675 Re-Establish Markings/Signage/Barreirs/Misc Allowance								
01 North Lot Reach								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	37,100.00 sqft	-	-	-	-	371,000	371,000
	* unassigned *						*371,000*	*371,000*
	01 North Lot Reach						**371,000**	**371,000**
50 Reach 3								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	3,900.00 sqft	-	-	-	-	39,000	39,000
	* unassigned *						*39,000*	*39,000*
	50 Reach 3						**39,000**	**39,000**
100 EQR								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	18,900.00 sqft	-	-	-	-	189,000	189,000
	* unassigned *						*189,000*	*189,000*
	100 EQR						**189,000**	**189,000**
150 Rubble Reach 12+30 to 18+10								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	62,400.00 sqft	-	-	-	-	624,000	624,000
	* unassigned *						*624,000*	*624,000*
	150 Rubble Reach 12+30 to 18+10						**624,000**	**624,000**
155 Rubble Beach 18+10 to 20+55								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	7,350.00 sqft	-	-	-	-	73,500	73,500
	* unassigned *						*73,500*	*73,500*
	155 Rubble Beach 18+10 to 20+55						**73,500**	**73,500**
200 Reach 2								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	9,450.00 sqft	-	-	-	-	94,500	94,500
	* unassigned *						*94,500*	*94,500*
	200 Reach 2						**94,500**	**94,500**
250 Reach 1								
* unassigned *								
41000.100	Markings/Signage/Barreirs/Misc	18,000.00 sqft	-	-	-	-	180,000	180,000
	* unassigned *						*180,000*	*180,000*
	250 Reach 1						**180,000**	**180,000**
	675 Re-Establish Markings/Signage/Barreirs/Misc Allowance						***1,571,000***	***1,571,000***
700 Restoration Sand Only								
50 Reach 3								
* unassigned *								
2200.150	Restoration Sand Infill	4,634.00 cy	4,911	127,435	-	2,308	-	134,655

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	** unassigned **		*4,911*	*127,435*		*2,308*		*134,655*
	50 Reach 3		**4,911**	**127,435**		**2,308**		**134,655**
100 EQR								
	** unassigned **							
2200.150	Restoration Sand Infill	29,727.00 cy	31,506	817,493	-	14,808	-	863,807
	** unassigned **		*31,506*	*817,493*		*14,808*		*863,807*
	100 EQR		**31,506**	**817,493**		**14,808**		**863,807**
150 Rubble Reach 12+30 to 18+10								
	** unassigned **							
2200.150	Restoration Sand Infill	32,996.00 cy	34,970	907,390	-	16,437	-	958,797
	** unassigned **		*34,970*	*907,390*		*16,437*		*958,797*
	150 Rubble Reach 12+30 to 18+10		**34,970**	**907,390**		**16,437**		**958,797**
155 Rubble Beach 18+10 to 20+55								
	** unassigned **							
2200.150	Restoration Sand Infill	13,938.00 cy	14,772	383,295	-	6,943	-	405,010
	** unassigned **		*14,772*	*383,295*		*6,943*		*405,010*
	155 Rubble Beach 18+10 to 20+55		**14,772**	**383,295**		**6,943**		**405,010**
200 Reach 2								
	** unassigned **							
2200.150	Restoration Sand Infill	13,148.00 cy	13,935	361,570	-	6,550	-	382,054
	** unassigned **		*13,935*	*361,570*		*6,550*		*382,054*
	200 Reach 2		**13,935**	**361,570**		**6,550**		**382,054**
250 Reach 1								
	** unassigned **							
2200.150	Restoration Sand Infill	40,056.00 cy	42,453	1,101,540	-	19,954	-	1,163,947
	** unassigned **		*42,453*	*1,101,540*		*19,954*		*1,163,947*
	250 Reach 1		**42,453**	**1,101,540**		**19,954**		**1,163,947**
	700 Restoration Sand Only		***142,547***	***3,698,723***		***67,000***		***3,908,270***
710 Restoration Allowance								
01 North Lot Reach								
	** unassigned **							
2200.150	Restoration Allowance	22,660.00 sqft			-	79,310		79,310
	** unassigned **					*79,310*		*79,310*
	01 North Lot Reach					**79,310**		**79,310**
50 Reach 3								
	** unassigned **							
2200.150	Restoration Allowance	4,895.00 sqft			-	17,133		17,133
	** unassigned **					*17,133*		*17,133*
	50 Reach 3					**17,133**		**17,133**
100 EQR								
	** unassigned **							
2200.150	Restoration Sand Infill	30,030.00 sqft			-	105,105		105,105
	** unassigned **					*105,105*		*105,105*
	100 EQR					**105,105**		**105,105**
150 Rubble Reach 12+30 to 18+10								
	** unassigned **							
2200.150	Restoration Allowance	23,815.00 sqft			-	83,353		83,353

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	** unassigned **						*83,353*	*83,353*
	150 Rubble Reach 12+30 to 18+10						**83,353**	**83,353**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2200.150	Restoration Allowance	15,565.00 sqft				-	54,478	54,478
	** unassigned **						*54,478*	*54,478*
	155 Rubble Beach 18+10 to 20+55						**54,478**	**54,478**
200 Reach 2								
** unassigned **								
2200.150	Restoration Allowance	14,575.00 sqft				-	51,013	51,013
	** unassigned **						*51,013*	*51,013*
	200 Reach 2						**51,013**	**51,013**
250 Reach 1								
** unassigned **								
2200.150	Restoration Allowance	30,800.00 sqft				-	107,800	107,800
	** unassigned **						*107,800*	*107,800*
	250 Reach 1						**107,800**	**107,800**
	710 Restoration Allowance						***498,190***	***498,190***
720 Cobble Berm								
50 Reach 3								
** unassigned **								
2200.150	Cobble Berm Allowance	130.00 lft				-	91,000	91,000
	** unassigned **						*91,000*	*91,000*
	50 Reach 3						**91,000**	**91,000**
100 EQR								
** unassigned **								
2200.150	Cobble Berm Allowance	630.00 lft				-	441,000	441,000
	** unassigned **						*441,000*	*441,000*
	100 EQR						**441,000**	**441,000**
	720 Cobble Berm						***532,000***	***532,000***
750 Traffic Control/Dust Abatement								
01 North Lot Reach								
** unassigned **								
2200.950	Dust Abatement	5.00 mo	23,019	-	-	16,438	-	39,457
2750.400	Traffic Control Subcontactor	90.00 day	-	-	225,000	-	-	225,000
	** unassigned **		*23,019*		*225,000*	*16,438*		*264,457*
	01 North Lot Reach		**23,019**		**225,000**	**16,438**		**264,457**
50 Reach 3								
** unassigned **								
2200.950	Dust Abatement	1.00 mo	4,604	-	-	3,288	-	7,891
2750.400	Traffic Control Subcontactor	30.00 day	-	-	75,000	-	-	75,000
	** unassigned **		*4,604*		*75,000*	*3,288*		*82,891*
	50 Reach 3		**4,604**		**75,000**	**3,288**		**82,891**
100 EQR								
** unassigned **								
2200.950	Dust Abatement	6.00 mo	27,622	-	-	19,726	-	47,348
2750.400	Traffic Control Subcontactor	113.00 day	-	-	282,500	-	-	282,500

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	** unassigned **		*27,622*		*282,500*	*19,726*		*329,848*
	100 EQR		**27,622**		**282,500**	**19,726**		**329,848**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2200.950	Dust Abatement	5.00 mo	23,019	-	-	16,438	-	39,457
2750.400	Traffic Control Subcontactor	106.00 day	-	-	265,000	-	-	265,000
	** unassigned **		*23,019*		*265,000*	*16,438*		*304,457*
	150 Rubble Reach 12+30 to 18+10		**23,019**		**265,000**	**16,438**		**304,457**
155 Rubble Beach 18+10 to 20+55								
** unassigned **								
2200.950	Dust Abatement	1.00 mo	4,604	-	-	3,288	-	7,891
2750.400	Traffic Control Subcontactor	30.00 day	-	-	75,000	-	-	75,000
	** unassigned **		*4,604*		*75,000*	*3,288*		*82,891*
	155 Rubble Beach 18+10 to 20+55		**4,604**		**75,000**	**3,288**		**82,891**
200 Reach 2								
** unassigned **								
2200.950	Dust Abatement	1.00 mo	4,604	-	-	3,288	-	7,891
2750.400	Traffic Control Subcontactor	30.00 day	-	-	75,000	-	-	75,000
	** unassigned **		*4,604*		*75,000*	*3,288*		*82,891*
	200 Reach 2		**4,604**		**75,000**	**3,288**		**82,891**
250 Reach 1								
** unassigned **								
2200.950	Dust Abatement	3.00 mo	13,811	-	-	9,863	-	23,674
2750.400	Traffic Control Subcontactor	60.00 day	-	-	150,000	-	-	150,000
	** unassigned **		*13,811*		*150,000*	*9,863*		*173,674*
	250 Reach 1		**13,811**		**150,000**	**9,863**		**173,674**
	750 Traffic Control/Dust Abatement		***101,282***		***1,147,500***	***72,327***		***1,321,109***
800 Dewatering								
01 North Lot Reach								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	200.00 vlf	501	20,000	-	598	-	21,099
2250.150	Header Lines & Fittings 8"	570.00 lf	2,182	28,500	-	7,980	-	38,662
2250.150	Maintenance of Deep Well System	3.00 mo	49,658	-	-	6,000	3,000	58,658
	** unassigned **		*52,340*	*48,500*		*14,578*	*3,000*	*118,418*
	01 North Lot Reach		**52,340**	**48,500**		**14,578**	**3,000**	**118,418**
50 Reach 3								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	50.00 vlf	125	5,000	-	149	-	5,275
2250.150	Header Lines & Fittings 8"	130.00 lf	498	6,500	-	1,820	-	8,818
2250.150	Maintenance of Deep Well System	1.00 mo	16,553	-	-	2,000	1,000	19,553
	** unassigned **		*17,175*	*11,500*		*3,969*	*1,000*	*33,645*
	50 Reach 3		**17,175**	**11,500**		**3,969**	**1,000**	**33,645**
100 EQR								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	200.00 vlf	501	20,000	-	598	-	21,099
2250.150	Header Lines & Fittings 8"	630.00 lf	2,411	31,500	-	8,820	-	42,731
2250.150	Maintenance of Deep Well System	4.00 mo	66,211	-	-	8,000	4,000	78,211
	** unassigned **		*69,122*	*51,500*		*17,418*	*4,000*	*142,040*

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	100 EQR		**69,122**	**51,500**		**17,418**	**4,000**	**142,040**
150 Rubble Reach 12+30 to 18+10								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	200.00 vlf	501	20,000	-	598	-	21,099
2250.150	Header Lines & Fittings 8"	580.00 lf	2,220	29,000	-	8,120	-	39,340
2250.150	Maintenance of Deep Well System	4.00 mo	66,211	-	-	8,000	4,000	78,211
	** unassigned **		*68,931*	*49,000*		*16,718*	*4,000*	*138,649*
	150 Rubble Reach 12+30 to 18+10		**68,931**	**49,000**		**16,718**	**4,000**	**138,649**
300 Storage Reservoir 1.1 M Gallons								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	360.00 vlf	901	36,000	-	1,076	-	37,978
2250.150	Header Lines & Fittings 8"	404.00 lf	1,546	20,200	-	5,656	-	27,402
2250.150	Maintenance of Deep Well System	6.00 mo	99,316	-	-	12,000	6,000	117,316
	** unassigned **		*101,763*	*56,200*		*18,732*	*6,000*	*182,696*
	300 Storage Reservoir 1.1 M Gallons		**101,763**	**56,200**		**18,732**	**6,000**	**182,696**
310 Access Shaft - South								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	180.00 vlf	451	18,000	-	538	-	18,989
2250.150	Header Lines & Fittings 8"	200.00 lf	765	10,000	-	2,800	-	13,565
2250.150	Maintenance of Deep Well System	6.00 mo	99,316	-	-	12,000	6,000	117,316
	** unassigned **		*100,532*	*28,000*		*15,338*	*6,000*	*149,870*
	310 Access Shaft - South		**100,532**	**28,000**		**15,338**	**6,000**	**149,870**
325 Access Shaft Intermediate North								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	180.00 vlf	451	18,000	-	538	-	18,989
2250.150	Header Lines & Fittings 8"	200.00 lf	765	10,000	-	2,800	-	13,565
2250.150	Maintenance of Deep Well System	6.00 mo	99,316	-	-	12,000	6,000	117,316
	** unassigned **		*100,532*	*28,000*		*15,338*	*6,000*	*149,870*
	325 Access Shaft Intermediate North		**100,532**	**28,000**		**15,338**	**6,000**	**149,870**
340 Connection Tunnel to Storage Reservoir								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	180.00 vlf	451	18,000	-	538	-	18,989
2250.150	Header Lines & Fittings 8"	200.00 lf	765	10,000	-	2,800	-	13,565
2250.150	Maintenance of Deep Well System	3.00 mo	1,148	-	-	6,000	3,000	10,148
	** unassigned **		*2,364*	*28,000*		*9,338*	*3,000*	*42,702*
	340 Connection Tunnel to Storage Reservoir		**2,364**	**28,000**		**9,338**	**3,000**	**42,702**
350 Connection Storage Res to West Side Pump Station								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	180.00 vlf	451	18,000	-	538	-	18,989
2250.150	Header Lines & Fittings 8"	200.00 lf	765	10,000	-	2,800	-	13,565
2250.150	Maintenance of Deep Well System	3.00 mo	1,148	-	-	6,000	3,000	10,148
	** unassigned **		*2,364*	*28,000*		*9,338*	*3,000*	*42,702*
	350 Connection Storage Res to West Side Pump Station		**2,364**	**28,000**		**9,338**	**3,000**	**42,702**
	800 Dewatering		***515,125***	***328,700***		***120,768***	***36,000***	***1,000,593***
1000 Excavation and Support								
300 Storage Reservoir 1.1 M Gallons								
** unassigned **								
2150.050	Demo AC Pavement	342.00 cy	6,712	-	-	3,336	-	10,049

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *								
2150.500	Trucking Demo Materials Pavement	24.00 hr	2,511	-	-	1,382	-	3,893
2150.500	Dump Fees Pavement	35.00 load	-	-	-	-	3,500	3,500
2200.200	Structure Excavation	13,689.00 cy	58,033	-	-	91,839		149,871
2200.450	Haul Spoils to Off-Site Disposal	13,689.00 cy	57,291	-	-	31,526	27,378	116,195
2200.700	Install and Maintain Silt Fence	800.00 lf	765	2,600	-	-	-	3,365
2200.800	Temporary Shoring	24,240.00 sf	-			-	606,000	606,000
2200.900	Install W 18x50 walers along length of shoring	1,212.00 lf	63,459	60,600	-		-	124,059
2200.900	Drill, install, and grout tie backs, 20' long	61.00 ea	-	-	152,500	-	-	152,500
	** unassigned **		*188,771*	*63,200*	*152,500*	*128,082*	*636,878*	*1,169,431*
	300 Storage Reservoir 1.1 M Gallons		**188,771**	**63,200**	**152,500**	**128,082**	**636,878**	**1,169,431**
310 Access Shaft - South								
* unassigned *								
2150.050	Demo AC Pavement	185.00 cy	3,631	-	-	1,805	-	5,436
2150.500	Trucking Demo Materials Pavement	12.00 hr	1,256	-	-	691	-	1,946
2150.500	Dump Fees Pavement	19.00 load	-	-	-	-	1,900	1,900
2200.200	Structure Excavation	785.00 cy	122,764	-	-	75,063		197,827
2200.450	Haul Spoils to Off-Site Disposal	785.00 cy	3,285	-	-	1,808	1,570	6,663
2200.700	Install and Maintain Silt Fence	400.00 lf	383	1,300	-	-	-	1,683
2200.800	Temporary Shoring	4,241.00 sf	-			-	106,025	106,025
2200.900	Install W 18x50 walers along length of shoring	377.00 lf	20,471	18,850	-	22,531	-	61,853
2200.900	Drill, install, and grout tie backs, 20' long	19.00 ea	-	-	47,500	-	-	47,500
2300.700	Materials Misc	30.00 ft					15,000	15,000
	** unassigned **		*151,790*	*20,150*	*47,500*	*101,898*	*124,495*	*445,833*
	310 Access Shaft - South		**151,790**	**20,150**	**47,500**	**101,898**	**124,495**	**445,833**
320 Access Shafts Intemediate								
* unassigned *								
2150.050	Demo AC Pavement (2 Shafts)	14.00 cy	275	-	-	137	-	411
2150.500	Trucking Demo Materials Pavement	2.00 hr	209	-	-	115	-	324
2150.500	Dump Fees Pavement	2.00 load	-	-	-	-	200	200
2200.200	Structure Excavation	28.00 cy	4,379	-	-	2,677		7,056
2200.450	Haul Spoils to Off-Site Disposal	28.00 cy	117	-	-	64	56	238
2200.700	Install and Maintain Silt Fence	160.00 lf	153	520	-	-	-	673
2300.700	Intermediate Shafts (2 at 30 ft each)	60.00 lf	47,104	60,000		20,400		127,504
	** unassigned **		*52,237*	*60,520*		*23,393*	*256*	*136,407*
	320 Access Shafts Intemediate		**52,237**	**60,520**		**23,393**	**256**	**136,407**
325 Access Shaft Intermediate North								
* unassigned *								
2150.050	Demo AC Pavement	185.00 cy	3,631	-	-	1,805	-	5,436
2150.500	Trucking Demo Materials Pavement	12.00 hr	1,256	-	-	691	-	1,946
2150.500	Dump Fees Pavement	19.00 load	-	-	-	-	1,900	1,900
2200.200	Structure Excavation	545.00 cy	85,231	-	-	52,114		137,345
2200.450	Haul Spoils to Off-Site Disposal	545.00 cy	2,281	-	-	1,255	1,090	4,626
2200.700	Install and Maintain Silt Fence	400.00 lf	383	1,300	-	-	-	1,683
2200.800	Temporary Shoring	2,356.00 sf	-			-	58,900	58,900
2200.900	Install W 18x50 walers along length of shoring	314.00 lf	17,051	15,700	-	18,766	-	51,516
2200.900	Drill, install, and grout tie backs, 20' long	16.00 ea	-	-	40,000	-	-	40,000
2300.700	Materials Misc	30.00 ft					15,000	15,000
	** unassigned **		*109,832*	*17,000*	*40,000*	*74,630*	*76,890*	*318,352*
	325 Access Shaft Intermediate North		**109,832**	**17,000**	**40,000**	**74,630**	**76,890**	**318,352**
	1000 Excavation and Support		***502,630***	***160,870***	***240,000***	***328,004***	***838,519***	***2,070,023***

1005 Install Bulkhead

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
310 Access Shaft - South								
** unassigned **								
2300.700	Bulkhead	5.00 days	195,484			119,527		315,011
2300.700	Bulkhead Material	1.00 ls	-	50,000	-	-		50,000
	** unassigned **		*195,484*	*50,000*		*119,527*		*365,011*
	310 Access Shaft - South		**195,484**	**50,000**		**119,527**		**365,011**
325 Access Shaft Intermediate North								
** unassigned **								
2300.700	Bulkhead	5.00 days	195,484			119,527		315,011
2300.700	Bulkhead Material	1.00 ls	-	50,000	-	-		50,000
	** unassigned **		*195,484*	*50,000*		*119,527*		*365,011*
	325 Access Shaft Intermediate North		**195,484**	**50,000**		**119,527**		**365,011**
	1005 Install Bulkhead		***390,968***	***100,000***		***239,054***		***730,022***
1007 Remove Bulkhead								
310 Access Shaft - South								
** unassigned **								
2300.700	Bulkhead	5.00 days	195,484			119,527		315,011
	** unassigned **		*195,484*			*119,527*		*315,011*
	310 Access Shaft - South		**195,484**			**119,527**		**315,011**
	1007 Remove Bulkhead		***195,484***			***119,527***		***315,011***
1010 Concrete Slab on Grade								
300 Storage Reservoir 1.1 M Gallons								
03 C 01 Cast-in-Place Concrete - Rectangular Slab on Grade (Basic)								
2200.150	Fine Grade SOG	7,320.00 sf	3,556	-	-	509	-	4,065
3100.150	Form Slab-on-Grade Perimeter Edge	1,092.00 sf	13,329	1,638	-	1,962	-	16,929
3100.150	Form Slab-on-Grade Construction Joints	1,092.00 sf	13,329	1,747	-	1,962	-	17,038
3100.650	Strip & Oil Slab-on-Grade Construction Joint Forms	1,092.00 sf	3,309		-	50	-	3,360
3100.650	Strip & Oil Slab Edge Forms	1,092.00 sf	1,103	22	-	50	-	1,175
3100.850	Form Upset Keyway at Future Walls	364.00 lf	1,333	182	-	196	-	1,711
3200.150	Install Rebar, Slab-On-Grade (High Production)	81.33 tn	47,118		-	6,819	-	53,937
3200.150	Purchase Rebar, Slab-On-Grade	81.33 tn	-	81,333	-	-	-	81,333
3200.750	Place Rebar/Mesh Support - Bricks	740.00 ea	172	185	-	44	-	401
3300.050	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi	813.40 cy	-	101,675	-	-	-	101,675
3300.100	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi (Waste)	40.70 cy	-	5,088	-	-	-	5,088
3300.250	Pump-Place Concrete, Slab-On-Grade (High Production)	813.40 cy	12,376	-	-	2,023	8,134	22,533
3300.250	Screed Top Surface, Slab-On-Grade	7,320.00 sf	7,425	-	-	569	-	7,994
3300.250	Float Top Surface, Slab-On-Grade	7,320.00 sf	9,897	-	-	7,965	-	17,862
3300.250	Spray-On Liquid Curing Compound, Slab-on-Grade	7,320.00 sf	739	659	-	168	-	1,567
3350.050	Sealant At Construction Joint Grooves	364.00 lf	373	364	-		-	737
3350.100	Sealant At Control Joint Grooves	726.00 lf	871	363	-	148	-	1,382
3350.200	Waterstop, 6" Bulb	728.00 lf	9,342	4,550	-	1,537	-	15,430
3350.250	Zip Strips 3/4"	726.00 lf	6,966	116	-	99	-	7,181
3400.025	Sandblast Slab Construction Joints	1,092.00 sf	3,353		-		-	3,353
3400.050	Finish Flatwork - Broom	7,320.00 sf	8,910	73	-	569	-	9,552
	Cast-in-Place Concrete - Rectangular Slab on Grade (Basic)	*813.40 cy*	*143,501*	*197,995*		*24,672*	*8,134*	*374,302*
	300 Storage Reservoir 1.1 M Gallons		**143,501**	**197,995**		**24,672**	**8,134**	**374,302**
	1010 Concrete Slab on Grade		***143,501***	***197,995***		***24,672***	***8,134***	***374,302***
1020 Concrete Walls								

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
300 Storage Reservoir 1.1 M Gallons									
03 E 01 Cast-in-Place Concrete - Walls, Straight (Basic)									
3100.250	Erect Circular Wall Form System 16'-<	16,896.00	sf	257,797	27,878	-	23,016	-	308,692
3100.250	Construct Wall Bulkhead Forms	1,008.00	sf	36,912	2,016	-	2,746	-	41,674
3100.650	Strip & Oil Wall Forms	16,896.00	sf	17,068	338	-	778	-	18,184
3100.800	Install Edge Chamfer 1"	710.00	lf	1,291	142	-	967	-	2,400
3100.850	Form Vertical Wall Keyway 4"	336.00	lf	2,051	202	-	229	-	2,481
3100.950	Purchase Form Ties, Coil Tie, 36"x1/2", w/ Connecting Rods and Bolts	528.00	ea	-	2,640	-	-	-	2,640
3200.250	Install Rebar, Walls, Straight (High Production)	93.87	tn	79,779		-	8,527	-	88,307
3200.250	Purchase Rebar, Walls, Straight	93.87	tn	-	93,867	-	-	-	93,867
3300.050	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi	938.70	cy	-	117,338	-	-	-	117,338
3300.100	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi (Waste)	47.00	cy	-	5,875	-	-	-	5,875
3300.350	Pump-Place Concrete, Walls (High Production)	938.70	cy	9,966	-	-	1,350	9,387	20,702
3300.350	Screed Top Surface, Walls	1,056.00	sf	2,242	-	-	268	-	2,510
3300.350	Float Top Surface, Walls	1,056.00	sf	4,484	-	-	89	-	4,574
3300.350	Trowel Top Surface, Walls	1,056.00	sf	4,484	-	-	89	-	4,574
3300.350	Grind Fins and Patch Voids @ Formed Surfaces, Walls	16,896.00	sf	23,053	845	-		-	23,898
3350.200	Waterstop, 6" Bulb	336.00	lf	4,312	2,100	-	709	-	7,121
3400.025	Sandblast Vertical CJ @ Walls	1,008.00	sf	4,127	252	-		-	4,379
3400.025	Sandblast Horizontal Joints Before Placing Walls	1,056.00	sf	3,243	264	-		-	3,507
3400.400	Cure Concrete with Spray-On Liquid Curing Compounds	16,896.00	sf	6,827	591	-	389	-	7,807
	Cast-in-Place Concrete - Walls, Straight (Basic)	*938.70*	*cy*	*457,637*	*254,348*		*39,157*	*9,387*	*760,529*
	300 Storage Reservoir 1.1 M Gallons			**457,637**	**254,348**		**39,157**	**9,387**	**760,529**
	1020 Concrete Walls			***457,637***	***254,348***		***39,157***	***9,387***	***760,529***
1030 Concrete Suspened Slab									
300 Storage Reservoir 1.1 M Gallons									
03 G 01 Cast-In-Place Concrete - Elevated Slab, Rectangular									
3100.400	Construct Suspended Slab Construction Joint	1,692.00	sf	40,586	2,538	-	6,569	-	49,693
3100.400	Construct Suspended Slab Deck Form 15-up	7,320.00	sf	52,675	13,542	-	8,476	-	74,693
3100.400	Construct Suspended Slab Edge Form > 1'	1,152.00	sf	9,533	1,728	-	1,569	-	12,831
3100.650	Strip & Oil Non-Construction Joint Forms	1,152.00	sf	1,164	23	-	53	-	1,240
3100.650	Strip & Oil Suspended Slab Forms	1,692.00	sf	1,709	34	-	78	-	1,821
3150.050	Shore Suspended Slabs (High. Vol)	175,680.00	cf	28,094	19,325	-	11,966	-	59,384
3200.400	Install Rebar, Elevated Slabs (High Production)	87.43	tn	55,845		-	7,330	-	63,175
3200.400	Purchase Rebar, Elevated Slabs	87.43	tn	-	87,433	-	-	-	87,433
3300.050	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi	813.40	cy	-	101,675	-	-	-	101,675
3300.100	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi (Waste)	40.70	cy	-	5,088	-	-	-	5,088
3300.500	Pump-Place Concrete, Elevated Slabs (High Production)	813.40	cy	10,313	-	-	822	8,134	19,269
3350.050	Sealant At Construction Joint Grooves	564.00	lf	577	564	-		-	1,141
3350.200	Waterstop, 6" Bulb	564.00	lf	7,238	3,525	-	1,191	-	11,954
3350.250	Zip Strips 3/4"	564.00	lf	5,411	90	-	77	-	5,579
3400.025	Sandblast Slab Construction Joints	1,692.00	sf	5,196		-		-	5,196
3400.050	Finish Flatwork - Broom	7,920.00	sf	9,640	79	-	616	-	10,335
3400.050	Finish Flatwork - Hard Trowel	-600.00	sf	(907)	(24)	-	(93)	-	(1,024)
3400.400	Cure Concrete with Spray-On Liquid Curing Compounds	7,320.00	sf	2,958	256	-	168	-	3,382
	Cast-In-Place Concrete - Elevated Slab, Rectangular	*813.40*	*cy*	*230,032*	*235,876*		*38,821*	*8,134*	*512,863*
	300 Storage Reservoir 1.1 M Gallons			**230,032**	**235,876**		**38,821**	**8,134**	**512,863**
	1030 Concrete Suspened Slab			***230,032***	***235,876***		***38,821***	***8,134***	***512,863***
1040 Concrete Colums, 10 each									
300 Storage Reservoir 1.1 M Gallons									

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
03 F 01 Cast-In-Place Concrete - Columns, Rectangular								
3100.300	Erect Rectangular Column Forms & Accessories, Plyform Lined 20 -up	1,920.00 sf	41,848	3,360	-	3,923	-	49,131
3100.650	Strip & Oil Column Forms	1,920.00 sf	1,940	38	-	88	-	2,066
3100.800	Install Edge Chamfer 1"	960.00 lf	1,746	192	-	1,308	-	3,246
3200.300	Install Rebar, Columns (Low Production)	3.56 tn	4,242		-	533	-	4,775
3200.300	Purchase Rebar, Columns	3.56 tn	-	3,556	-	-	-	3,556
3300.050	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi	35.60 cy	-	4,450	-	-	-	4,450
3300.100	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi (Waste)	1.80 cy	-	225	-	-	-	225
3300.400	Pump-Place Concrete, Columns (Low Production)	35.60 cy	3,694	-	-	13,323	498	17,516
3300.400	Water Curing with Burlap & Spray Hoses, Columns	1,920.00 sf	388	384	-	44	-	816
3400.025	Sandblast Before Placing Columns	40.00 sf	123	10	-		-	133
3400.100	Grind and Patch Formed Surfaces - Columns	1,920.00 sf	2,928	38	-		-	2,967
3400.250	Sack-Rub Concrete Columns	1,920.00 sf	17,687	384	-		-	18,071
	Cast-In-Place Concrete - Columns, Rectangular	*35.60 cy*	*74,596*	*12,638*		*19,219*	*498*	*106,951*
	300 Storage Reservoir 1.1 M Gallons		**74,596**	**12,638**		**19,219**	**498**	**106,951**
	1040 Concrete Colums, 10 each		***74,596***	***12,638***		***19,219***	***498***	***106,951***
1050 Coatings								
300 Storage Reservoir 1.1 M Gallons								
** unassigned **								
9960.100	Coating @ Concrete Structures (Large Areas)	14,424.00 sf	-	-	360,600	-	-	360,600
	** unassigned **				*360,600*			*360,600*
	300 Storage Reservoir 1.1 M Gallons				**360,600**			**360,600**
	1050 Coatings				***360,600***			***360,600***
1060 Tunnel								
330 Reinforcement of Lake Merced Tunnel								
** unassigned **								
2250.050	6" Dewatering Pump & Hoses, 24-hr Operation	2.00 day	4,593	-	-	1,045	-	5,637
2300.700	Setup for Reinforcing Tunnel	2,970.00 lf	190,485			48,372	742,500	981,358
2300.700	Install Reinforced Liner	2,970.00 lf	1,015,922			257,985		1,273,908
2300.700	Tunnel Concrete	8,294.00 cy	-	1,036,750	-	-	-	1,036,750
2300.700	Tunnel Rebar	493,020.00 lb	-	246,510	-	-	-	246,510
2300.700	Tunnel Forms and Carrier	4,712.00 sqft	-		-	-	353,400	353,400
2300.700	Cleanup and Tear Down Tunnel	2,970.00 lf	152,388			38,698	297,000	488,086
	** unassigned **		*1,363,389*	*1,283,260*		*346,100*	*1,392,900*	*4,385,649*
	330 Reinforcement of Lake Merced Tunnel		**1,363,389**	**1,283,260**		**346,100**	**1,392,900**	**4,385,649**
360 By Pass Pumping								
** unassigned **								
2250.050	6" Dewatering Pump & Hoses, 24-hr Operation	180.00 day	413,338	-	-	94,008	-	507,345
	** unassigned **		*413,338*			*94,008*		*507,345*
	360 By Pass Pumping		**413,338**			**94,008**		**507,345**
	1060 Tunnel		***1,776,726***	***1,283,260***		***440,108***	***1,392,900***	***4,892,994***
1080 Backfill								
300 Storage Reservoir 1.1 M Gallons								
02 B 05 Earthwork - Structural Base & Backfill								
2200.150	Fine Grade Structural Base Material	1,026.00 sy	2,658	-	-	453	-	3,111
2200.250	Structural Backfill, Staged or Delivered	5,308.00 CY	81,934	95,544	-	42,940	-	220,418
	Earthwork - Structural Base & Backfill	*5,240.00 cy*	*84,592*	*95,544*		*43,393*		*223,529*
	300 Storage Reservoir 1.1 M Gallons		**84,592**	**95,544**		**43,393**		**223,529**

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
310 Access Shaft - South								
* *unassigned* *								
2300.525	Shaft Cleanup and Teardown	10.00 days	67,595			45,618		113,213
2300.800	Concrete	785.00 cy	-	98,125	-	-		98,125
	* *unassigned* *		*67,595*	*98,125*		*45,618*		*211,338*
	310 Access Shaft - South		**67,595**	**98,125**		**45,618**		**211,338**
320 Access Shafts Intemediate								
* *unassigned* *								
2200.150	Fine Grade Structural Base Material	3.00 sy	8	-	-	1	-	9
2200.250	Structural Backfill, Staged or Delivered	28.00 CY	432	504	-	227	-	1,163
	* *unassigned* *		*440*	*504*		*228*		*1,172*
	320 Access Shafts Intemediate		**440**	**504**		**228**		**1,172**
325 Access Shaft Intermediate North								
* *unassigned* *								
2200.150	Fine Grade Structural Base Material	55.00 sy	142	-	-	24	-	167
2200.250	Structural Backfill, Staged or Delivered (2 ft thick)	37.00 CY	571	666	-	299	-	1,536
	* *unassigned* *		*714*	*666*		*324*		*1,703*
	325 Access Shaft Intermediate North		**714**	**666**		**324**		**1,703**
340 Connection Tunnel to Storage Reservoir								
* *unassigned* *								
2200.150	Fine Grade Structural Base Material	222.00 sy	575	-	-	98	-	673
2200.250	Structural Backfill, Staged or Delivered	3,072.00 CY	47,419	55,296	-	24,852	-	127,567
	* *unassigned* *		*47,995*	*55,296*		*24,950*		*128,240*
	340 Connection Tunnel to Storage Reservoir		**47,995**	**55,296**		**24,950**		**128,240**
350 Connection Storage Res to West Side Pump Station								
* *unassigned* *								
2200.150	Fine Grade Structural Base Material	133.00 sy	345	-	-	59	-	403
2200.250	Structural Backfill, Staged or Delivered	1,843.00 CY	28,449	33,174	-	14,909	-	76,532
	* *unassigned* *		*28,793*	*33,174*		*14,968*		*76,935*
	350 Connection Storage Res to West Side Pump Station		**28,793**	**33,174**		**14,968**		**76,935**
	1080 Backfill		***230,129***	***283,309***		***129,480***		***642,917***
1090 Restore Pavement								
300 Storage Reservoir 1.1 M Gallons								
* *unassigned* *								
2750.050	AC Paving System 6"	2,053.00 sy	-	-	67,749	-	-	67,749
	* *unassigned* *				*67,749*			*67,749*
	300 Storage Reservoir 1.1 M Gallons				**67,749**			**67,749**
310 Access Shaft - South								
* *unassigned* *								
2750.050	AC Paving System 6"	1,111.00 sy	-	-	36,663	-	-	36,663
	* *unassigned* *				*36,663*			*36,663*
	310 Access Shaft - South				**36,663**			**36,663**
320 Access Shafts Intemediate								
* *unassigned* *								
2750.050	AC Paving System 6"	10.00 sy	-	-	330	-	-	330
	* *unassigned* *				*330*			*330*

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	320 Access Shafts Intemediate					**330**			**330**
325 Access Shaft Intermediate North									
** unassigned **									
2750.050	AC Paving System 6"	1,111.00	sy	-	-	36,663	-	-	36,663
	** unassigned **					*36,663*			*36,663*
	325 Access Shaft Intermediate North					**36,663**			**36,663**
340 Connection Tunnel to Storage Reservoir									
** unassigned **									
2750.050	AC Paving System 6"	111.00	sy	-	-	3,663	-	-	3,663
	** unassigned **					*3,663*			*3,663*
	340 Connection Tunnel to Storage Reservoir					**3,663**			**3,663**
	1090 Restore Pavement					***145,068***			***145,068***
1100 Connection Tunnel to Storage									
340 Connection Tunnel to Storage Reservoir									
** unassigned **									
2150.050	Demo AC Pavement	19.00	cy	373	-	-	185	-	558
2150.500	Trucking Demo Materials Pavement	1.00	hr	105	-	-	58	-	162
2150.500	Dump Fees Pavement	2.00	load	-	-	-	-	200	200
2200.200	Structure Excavation	3,333.00	cy	14,130	-	-	22,361	0	36,491
2200.450	Haul Spoils to Off-Site Disposal	3,333.00	cy	13,949	-	-	7,676	6,666	28,291
2200.700	Install and Maintain Silt Fence	500.00	lf	478	1,625	-	-	-	2,103
2200.800	Temporary Shoring	22,500.00	sf	-	0	0	-	562,500	562,500
2200.900	Install W 18x50 walers along length of shoring	1,000.00	lf	52,359	50,000	-	0	-	102,359
2300.700	Setup for Shaft Concrete	5.00	days	39,097	0	0	23,905	0	63,002
2300.700	Shaft Concrete	20.00	days	156,387	0	0	95,622	0	252,009
2300.700	Shaft Concrete Materials	269.00	cy	-	33,625	-	-	-	33,625
2300.700	Shaft Rebar Materials	53,800.00	lb	-	26,900	-	-	-	26,900
2300.700	Shaft Forms	2,785.00	sqft	-	0	-	-	208,875	208,875
2300.700	Cleanup TearDown Shaft	5.00	days	39,097	0	0	23,905	0	63,002
2300.700	Gate Installation 2 ea (op elect to open/close)	10.00	days	66,586					66,586
2300.700	Gates Materials	2.00	ea	-	60,000	-	-	-	60,000
2300.700	Electrical Installation Allowance	2.00	ls			50,000			50,000
2300.700	Pipe Install	250.00	lft	97,742	125,000		59,764	125,000	407,506
	** unassigned **			*480,302*	*297,150*	*50,000*	*233,476*	*903,241*	*1,964,169*
	340 Connection Tunnel to Storage Reservoir			**480,302**	**297,150**	**50,000**	**233,476**	**903,241**	**1,964,169**
	1100 Connection Tunnel to Storage			***480,302***	***297,150***	***50,000***	***233,476***	***903,241***	***1,964,169***
1120 Connection Storage to West Side Pump									
350 Connection Storage Res to West Side Pump Station									
** unassigned **									
2200.150	Fine Grade Structural Base Material	133.00	sy	345	-	-	59	-	403
2200.200	Structure Excavation	2,000.00	cy	8,479	-	-	13,418		21,897
2200.450	Haul Spoils to Off-Site Disposal	2,000.00	cy	8,370	-	-	4,606	4,000	16,976
2200.700	Install and Maintain Silt Fence	632.00	lf	605	2,054	-	-	-	2,659
2200.800	Temporary Shoring	13,500.00	sf	-				337,500	337,500
2200.900	Install W 18x50 walers along length of shoring	600.00	lf	31,415	30,000	-		-	61,415
2300.700	Gate Installation 1 ea (op elect to open/close)	5.00	days	33,293					33,293
2300.700	Gates Materials	1.00	ea	-	30,000	-	-	-	30,000
2300.700	Electrical Installation Allowance	1.00	ls			***25,000***			25,000
2300.700	Pipe Install	150.00	lft	58,645	75,000		35,858	75,000	244,503
	** unassigned **			*141,151*	*137,054*	*25,000*	*53,941*	*416,500*	*773,646*

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	350 Connection Storage Res to West Side Pump Station		141,151	137,054	25,000	53,941	416,500	773,646
	1120 Connection Storage to West Side Pump		***141,151***	***137,054***	***25,000***	***53,941***	***416,500***	***773,646***

Estimate Totals

Description	Amount	Totals	Hours	Rate	Cost Basis	Percent of Total	
Labor	14,417,042		132,375.152 hrs			10.90%	
Material	11,922,936					9.01%	
Subcontract	2,901,913					2.19%	
Equipment	6,042,798		72,933.812 hrs			4.57%	
Other	8,124,937					6.14%	
Subtotal	**43,409,626**	**43,409,626**				**32.81%**	**32.81%**
Sales Tax	1,013,450			8.500 %	C	0.77%	
8.5 % of Materials					L		
Subtotal	**1,013,450**	**44,423,076**				**0.77%**	**33.58%**
Mob/Demob	3,998,077			9.000 %	T	3.02%	
9% of Previous Subtotal					L		
Subtotal	**3,998,077**	**48,421,153**				**3.02%**	**36.60%**
Field Office G&A (GC's)	13,101,440				L	9.90%	
12% of $190,178,666					L		
Subtotal	**13,101,440**	**61,522,593**				**9.90%**	**46.50%**
Home Office Overhead	3,821,253				L	2.89%	
3.5% of $109,178,666					L		
Fee	10,917,867				L	8.25%	
10% of $109,178,666					L		
Subtotal	**14,739,120**	**76,261,713**				**11.14%**	**57.64%**
Insurance /Bonds	2,183,573				L	1.65%	
2% of $109,178,666					L		
Subtotal	**2,183,573**	**78,445,286**				**1.65%**	**59.29%**
Escalation-Mid point of Const	19,552,650				L	14.78%	
Lump Sum Amount					L		
Subtotal	**19,552,650**	**97,997,936**				**14.78%**	**74.07%**
Contingency	34,299,277			35.000 %	T	25.93%	
35% of Previous Subtotal					L		
Subtotal	**34,299,277**	**132,297,213**				**25.93%**	**100.00%**
Total		***132,297,213***					

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Project name	Alt C2 - South Ocean Beach
Labor rate table	South Ocean Beach
Equipment rate table	2012 Equip - CA 03
Bid date	12:00:00 AM
Report format	Sorted by 'WORK PKG/WORK AREA/Assembly' 'Detail' summary

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
350 CIDH Piles									
2050 Secant Wall 0+00 to 29+03									
** unassigned **									
2050.050	Sub - Secant Wall	75,810.00	SF	-	-	9,931,110	-	-	9,931,110
2200.200	Structure Excavation Spoils from Drilled Piers	7,714.00	CY	211,967	-	-	20,101	-	232,068
2200.450	Dispose of Excavated Material (Off Site)	7,714.00	CY	-	-	964,250	-	-	964,250
	** unassigned **			*211,967*		*10,895,360*	*20,101*		*11,127,428*
	2050 Secant Wall 0+00 to 29+03			**211,967**		**10,895,360**	**20,101**		**11,127,428**
	350 CIDH Piles			***211,967***		***10,895,360***	***20,101***		***11,127,428***
800 Dewatering									
1050 Launch Shaft									
** unassigned **									
2250.150	Develop Deep Dewatering Wells	400.00	vlf	1,002	40,000	-	1,196	-	42,197
2250.150	Header Lines & Fittings 8"	100.00	lf	383	5,000	-	1,400	-	6,783
2250.150	Maintenance of Deep Well System	6.00	mo	99,316	-	-	12,000	6,000	117,316
	** unassigned **			*100,700*	*45,000*		*14,596*	*6,000*	*166,296*
	1050 Launch Shaft			**100,700**	**45,000**		**14,596**	**6,000**	**166,296**
1100 Receiving Shaft									
** unassigned **									
2250.150	Develop Deep Dewatering Wells	600.00	vlf	1,502	60,000	-	1,794	-	63,296
2250.150	Header Lines & Fittings 8"	100.00	lf	383	5,000	-	1,400	-	6,783
2250.150	Maintenance of Deep Well System	6.00	mo	99,316	-	-	12,000	6,000	117,316
	** unassigned **			*101,201*	*65,000*		*15,194*	*6,000*	*187,395*
	1100 Receiving Shaft			**101,201**	**65,000**		**15,194**	**6,000**	**187,395**
1400 Tunnel									
** unassigned **									
2250.150	Develop Deep Dewatering Wells	5,800.00	vlf	14,522	580,000	-	17,339	-	611,861
2250.150	Header Lines & Fittings 8"	5,800.00	lf	22,198	290,000	-	81,200	-	393,398
2250.150	Maintenance of Deep Well System	6.00	mo	99,316	-	-	12,000	6,000	117,316
	** unassigned **			*136,036*	*870,000*		*110,539*	*6,000*	*1,122,575*
	1400 Tunnel			**136,036**	**870,000**		**110,539**	**6,000**	**1,122,575**
	800 Dewatering			***337,937***	***980,000***		***140,328***	***18,000***	***1,476,265***
1090 Restore Pavement									
1050 Launch Shaft									
** unassigned **									
2750.050	AC Paving System 6"	1,111.00	sy	-	-	36,663	-	-	36,663
	** unassigned **					*36,663*			*36,663*
	1050 Launch Shaft					**36,663**			**36,663**
1100 Receiving Shaft									
** unassigned **									
2750.050	AC Paving System 6"	278.00	sy	-	-	9,174	-	-	9,174
	** unassigned **					*9,174*			*9,174*
	1100 Receiving Shaft					**9,174**			**9,174**
1200 Intermediate Shaft A									
** unassigned **									
2750.050	AC Paving System 6"	44.00	sy	-	-	1,452	-	-	1,452
	** unassigned **					*1,452*			*1,452*
	1200 Intermediate Shaft A					**1,452**			**1,452**

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
1300 Intermediate Shaft B								
* *unassigned* *								
2750.050	AC Paving System 6"	44.00 sy	-	-	1,452	-	-	1,452
	* *unassigned* *				*1,452*			*1,452*
	1300 Intermediate Shaft B				**1,452**			**1,452**
	1090 Restore Pavement				***48,741***			***48,741***
2000 Surface								
1000 Surface								
* *unassigned* *								
2300.400	Surface Setup	10.00 days	113,482	10,000		39,985	10,000	173,466
2300.600	Surface Teardown	10.00 days	113,482			39,985		153,466
	* *unassigned* *		*226,963*	*10,000*		*79,970*	*10,000*	*326,933*
	1000 Surface		**226,963**	**10,000**		**79,970**	**10,000**	**326,933**
	2000 Surface		***226,963***	***10,000***		***79,970***	***10,000***	***326,933***
2050 Shafts								
1050 Launch Shaft								
* *unassigned* *								
2150.050	Demo AC Pavement	185.00 cy	3,631	-	-	1,805	-	5,436
2150.500	Trucking Demo Materials Pavement	12.00 hr	1,256	-	-	691	-	1,946
2200.450	Haul Spoils to Off-Site Disposal	5,236.00 cy	21,914	-	-	17,041	52,360	91,315
2300.500	Setup	10.00 days	113,482	10,000		39,985	10,000	173,466
2300.510	Shaft Initial Support & Excavation	50.00 vft	943,473			489,009		1,432,482
2300.520	Shaft Bottom Slab Permanent	3.00 vft	141,521			79,444		220,965
2300.520	Shaft Walls Permanent	44.00 vft	124,538			69,911		194,450
2300.520	Shaft Top Slab Permanent	3.00 vft	283,042			158,889		441,931
2300.525	Shaft Cleanup and Teardown	10.00 days	113,217			58,681		171,898
2300.800	Shoring	14,137.00 sqft	-	353,425	-	-		353,425
2300.800	Steel Structural Members	113,097.00 lb	-	141,371	-	-		141,371
2300.800	Concrete	1,222.00 cy	-	146,640	-	-		146,640
2300.800	Rebar	244,439.00 lb	-	122,220	-	-		122,220
2300.800	Forming	14,137.00 sqft	-		-	-	141,370	141,370
2300.800	Utilities/Misc	50.00 lft	-		-	-	12,500	12,500
	* *unassigned* *		*1,746,073*	*773,656*		*915,455*	*216,230*	*3,651,414*
	1050 Launch Shaft		**1,746,073**	**773,656**		**915,455**	**216,230**	**3,651,414**
1100 Receiving Shaft								
* *unassigned* *								
2150.050	Demo AC Pavement	46.00 cy	903	-	-	449	-	1,352
2150.500	Trucking Demo Materials Pavement	2.00 hr	209	-	-	115	-	324
2200.450	Haul Spoils to Off-Site Disposal	3,563.00 cy	14,912	-	-	11,596	35,630	62,138
2300.500	Setup	10.00 days	113,482			39,985		153,466
2300.510	Shaft Initial Support & Excavation	100.00 vft	1,886,947			978,017		2,864,964
2300.520	Shaft Bottom Slab Permanent	3.00 vft	141,521			79,444		220,965
2300.520	Shaft Walls Permanent	94.00 vft	266,059			149,355		415,415
2300.520	Shaft Top Slab Permanent	3.00 vft	283,042			158,889		441,931
2300.525	Shaft Cleanup and Teardown	10.00 days	113,217			58,681		171,898
2300.800	Shoring	16,493.00 sqft	-	412,325	-	-		412,325
2300.800	Steel Structural Members	65,973.00 lb	-	82,466	-	-		82,466
2300.800	Concrete	936.00 cy	-	112,320	-	-		112,320
2300.800	Rebar	187,134.00 lb	-	93,567	-	-		93,567
2300.800	Forming	16,493.00 sqft	-		-	-	164,930	164,930
2300.800	Utilities/Misc	100.00 lft	-		-	-	25,000	25,000

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	** unassigned **			*2,820,292*	*700,678*		*1,476,531*	*225,560*	*5,223,061*
	1100 Receiving Shaft			**2,820,292**	**700,678**		**1,476,531**	**225,560**	**5,223,061**
1200 Intermediate Shaft A									
** unassigned **									
2150.050	Demo AC Pavement	7.00	cy	137	-	-	68	-	206
2150.500	Trucking Demo Materials Pavement	1.00	hr	105	-	-	58	-	162
2200.450	Haul Spoils to Off-Site Disposal	116.00	cy	485	-	-	378	1,160	2,023
2300.500	Setup	5.00	days	33,798			22,809		56,607
2300.510	Shaft Initial Support & Excavation	40.00	vft	27,038			18,247		45,285
2300.520	Shaft Bottom Slab Permanent	1.00	vft	13,519	0	0	10,098	0	23,618
2300.520	Shaft Walls Permanent	40.00	vft	27,038			20,197		47,235
2300.520	Shaft Top Slab Permanent	2.00	vft	54,076			40,394		94,470
2300.525	Shaft Cleanup and Teardown	5.00	days	33,798			22,809		56,607
2300.800	Concrete	47.00	cy	-	5,640	-	-		5,640
2300.800	Rebar	9,495.00	lb	-	4,748	-	-		4,748
2300.800	Forming	1,005.00	sqft	-		-	-	10,050	10,050
2300.800	Casing	50,265.00	lb	-	62,831	-	-		62,831
2300.800	Utilities/Misc	40.00	lft	-		-	-	10,000	10,000
	** unassigned **			*189,994*	*73,219*		*135,058*	*21,210*	*419,481*
	1200 Intermediate Shaft A			**189,994**	**73,219**		**135,058**	**21,210**	**419,481**
1300 Intermediate Shaft B									
** unassigned **									
2150.050	Demo AC Pavement	7.00	cy	137	-	-	68	-	206
2150.500	Trucking Demo Materials Pavement	1.00	hr	105	-	-	58	-	162
2200.450	Haul Spoils to Off-Site Disposal	116.00	cy	485	-	-	378	1,160	2,023
2300.500	Setup	5.00	days	33,798			22,809		56,607
2300.510	Shaft Initial Support & Excavation	40.00	vft	27,038			18,247		45,285
2300.520	Shaft Bottom Slab Permanent	1.00	vft	13,519			10,098		23,618
2300.520	Shaft Walls Permanent	40.00	vft	27,038			20,197		47,235
2300.520	Shaft Top Slab Permanent	2.00	vft	54,076			40,394		94,470
2300.525	Shaft Cleanup and Teardown	5.00	days	33,798			22,809		56,607
2300.800	Concrete	47.00	cy	-	5,640	-	-		5,640
2300.800	Rebar	9,495.00	lb	-	4,748	-	-		4,748
2300.800	Forming	1,005.00	sqft	-		-	-	10,050	10,050
2300.800	Casing	50,265.00	lb	-	62,831	-	-		62,831
2300.800	Utilities/Misc	40.00	lft	-		-	-	10,000	10,000
	** unassigned **			*189,994*	*73,219*		*135,058*	*21,210*	*419,481*
	1300 Intermediate Shaft B			**189,994**	**73,219**		**135,058**	**21,210**	**419,481**
	2050 Shafts			***4,946,353***	***1,620,772***		***2,662,102***	***484,210***	***9,713,436***
2100 Tunnel									
360 By Pass Pumping									
** unassigned **									
2250.050	6" Dewatering Pump & Hoses, 24-hr Operation	30.00	day	68,890	-	-	15,668	-	84,558
	** unassigned **			*68,890*			*15,668*		*84,558*
	360 By Pass Pumping			**68,890**			**15,668**		**84,558**
1400 Tunnel									
** unassigned **									
2200.450	Haul Spoils to Off-Site Disposal	43,191.00	cy	180,763	-	-	140,568	431,910	753,241
2300.530	Tunnel Setup	30.00	days	1,182,312			415,123		1,597,435
2300.535	Starter Tunnel	300.00	lft	1,021,350			575,063		1,596,413
2300.540	Tunnel Excavate and Line	5,500.00	lft	3,744,950			2,658,563		6,403,513
2300.545	Tunnel Cleanup	5,800.00	lft	457,161			160,514		617,675

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *								
2300.560	Tunnel Teardown	20.00 day	788,208			276,749		1,064,957
2300.800	Precast Segments	10,123.00 cy	-	6,073,800	-	-		6,073,800
2300.800	Starter Tunnel Supplies	300.00 lft	-		-	-	150,000	150,000
2300.800	Utilities/Misc	5,800.00 lft	-		-	-	1,450,000	1,450,000
2300.900	TBM New	1.00 ls	-	-	-	10,000,000		10,000,000
	** unassigned **		*7,374,744*	*6,073,800*		*14,226,579*	*2,031,910*	*29,707,032*
	1400 Tunnel		**7,374,744**	**6,073,800**		**14,226,579**	**2,031,910**	**29,707,032**
2000 Demo 72" Westside PS to Transition Structure								
* unassigned *								
1350.100	Provide Temporary 6' Chain Link Fencing Top of Shoring	260.00 LF	-	-	2,600	-	-	2,600
1700.150	CT 202 Gradation	1.00 ea	-	-	165	-	-	165
1700.150	ASTM D1557 (CT 216) In place Density Testing	48.00 hr	-	-	3,360	-	-	3,360
1700.150	ASTM D4318 - Plasticity Index (Atterberg Limits)	1.00 ea	-	-	195	-	-	195
1700.350	Engineering Review - 1% of Tech Hours	0.48 hr	-	-	36	-	-	36
1700.350	Admin - 10% of Tech Hours	4.80 hr	-	-	360	-	-	360
1700.350	Laboratory Services - 1% of Tech Hours	0.48 hr	-	-	36	-	-	36
2050.050	Sub - Sitework Shoring Sheet Piles (Install)	17,760.00 SF	-	-	351,648	-	-	351,648
2050.050	Sub - Sitework Shoring Sheet Piles (Remove)	17,760.00 SF	-	-	351,648	-	-	351,648
2050.050	Sub - Sitework Shoring Sheet Piles (Purchase)	17,760.00 SF	-	-	421,978	-	-	421,978
2050.050	Excavations over 20'	1.00 EA	-	-	1,500	-	-	1,500
2050.050	Traffic Control	1.25 Mo	-	-	13,284	-	-	13,284
2050.050	Water for Backfill	60,667.00 gal	-	-	607	-	-	607
2150.150	Structure Concrete Demo Excavation 330/BRKR	49.00 CY	1,353	-	-	489		1,841
2150.500	Haul Off Site W/Dump Fees	49.00 CY		-	7,105		-	7,105
2200.200	Structure Excavation 330/Long Reach	1,684.00 CY	25,913	-	-	8,517	-	34,430
2200.250	Structural Backfill from On-Site Stockpile, From Pump Station Cut	49.00 CY	639	-	-	111	-	750
2200.250	Structural Backfill from On-Site Stockpile,	1,684.00 CY	21,944	-	-	3,816	-	25,760
2200.450	Load, Haul and Stockpile Material On Site	1,684.00 CY	43,795	-	-	12,098		55,894
2200.450	Load, On Site/Haul	49.00 CY	287	-	681	79	-	1,047
2200.450	Load, On Site	49.00 CY	717	-	-	198		915
2200.450	Load, On Site/Rebar	2.70 TN	16	-	-	4	-	20
2250.100	Install Deep Wells	6.00 EA	-	-	33,600	-	-	33,600
2250.100	Remove Deep Well System	6.00 EA	-	-	84,000	-	-	84,000
2250.200	Settlement Tank 20k gal.	1.25 Mo	-	-	2,188	-	-	2,188
2250.200	Monitor Wells	1.00 EA	-	-	2,500	-	-	2,500
2250.200	Power Drops	6.00 EA	-	-	3,000	-	-	3,000
2250.200	Diconnect Switches	6.00 EA	-	-	3,000	-	-	3,000
2250.200	Maintain System	1.25 Mo	-	-	2,188	-	-	2,188
2250.200	Temp Power	1.25 Mo	-	-	4,000	-	-	4,000
2250.200	Monthly Deep Well Rental	1.25 Mo	-	-	1,000	-	-	1,000
	** unassigned **		*94,663*		*1,290,677*	*25,313*		*1,410,653*
	2000 Demo 72" Westside PS to Transition Structure		**94,663**		**1,290,677**	**25,313**		**1,410,653**
2010 Demo Transition Structure								
* unassigned *								
1350.100	Provide Temporary 6' Chain Link Fencing Top of Shoring	100.00 LF	-	-	1,000	-	-	1,000
1700.150	CT 202 Gradation	1.00 ea	-	-	165	-	-	165
1700.150	ASTM D1557 (CT 216) In place Density Testing	34.00 hr	-	-	2,380	-	-	2,380
1700.150	ASTM D4318 - Plasticity Index (Atterberg Limits)	1.00 ea	-	-	195	-	-	195
1700.350	Engineering Review - 1% of Tech Hours	0.34 hr	-	-	26	-	-	26
1700.350	Admin - 10% of Tech Hours	3.40 hr	-	-	255	-	-	255
1700.350	Laboratory Services - 1% of Tech Hours	0.34 hr	-	-	26	-	-	26
2050.050	Sub - Sitework Shoring Sheet Piles (Install)	8,160.00 SF	-	-	161,568	-	-	161,568

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
** unassigned **									
2050.050	Sub - Sitework Shoring Sheet Piles (Remove)	8,160.00	SF	-	-	161,568	-	-	161,568
2050.050	Sub - Sitework Shoring Sheet Piles (Purchase)	8,160.00	SF	-	-	193,882	-	-	193,882
2050.050	Excavations over 20'	1.00	EA	-	-	1,500	-	-	1,500
2050.050	Traffic Control	1.25	Mo	-	-	13,284	-	-	13,284
2050.050	Water for Backfill	49,259.00	gal	-	-	493	-	-	493
2150.150	Structure Concrete Demo Excavation 330/BRKR	76.00	CY	2,098	-	-	758		2,856
2150.500	Haul Off Site W/Dump Fees	76.00	CY		-	9,500		-	9,500
2200.200	Structure Excavation 330/Long Reach	1,190.00	CY	18,312	-	-	6,019	-	24,330
2200.250	Structural Backfill from On-Site Stockpile, From Pump Station Cut	217.00	CY	2,828	-	-	492	-	3,319
2200.250	Structural Backfill from On-Site Stockpile,	1,190.00	CY	15,507	-	-	2,697	-	18,204
2200.450	Load, Haul and Stockpile Material On Site	1,190.00	CY	6,963	-	-	1,924		8,887
2200.450	Load, On Site/Haul	217.00	CY	1,270	-	3,014	351	-	4,635
2200.450	Load, On Site	76.00	CY	1,112	-	-	307		1,419
2200.450	Load, On Site/Rebar	4.20	TN	25	-	-	7	-	31
2250.100	Install Deep Wells	2.00	EA	-	-	11,200	-	-	11,200
2250.100	Remove Deep Well System	2.00	EA	-	-	28,000	-	-	28,000
2250.200	Settlement Tank 20k gal.	1.25	Mo	-	-	2,188	-	-	2,188
2250.200	Monitor Wells	1.00	EA	-	-	2,500	-	-	2,500
2250.200	Power Drops	2.00	EA	-	-	1,000	-	-	1,000
2250.200	Disconnect Switches	2.00	EA	-	-	1,000	-	-	1,000
2250.200	Maintain System	1.25	Mo	-	-	2,188	-	-	2,188
2250.200	Temp Power	1.25	Mo	-	-	4,000	-	-	4,000
2250.200	Monthly Deep Well Rental	1.25	Mo	-	-	1,000	-	-	1,000
	** unassigned **			*48,114*		*601,930*	*12,553*		*662,597*
	2010 Demo Transition Structure			**48,114**		**601,930**	**12,553**		**662,597**
2020 Demo Tunnel 0+00 to 29+03									
** unassigned **									
1200.100	SWPPP Permit	1.00	LS	-	-	3,000	-	-	3,000
1350.100	Provide Temporary 6' Chain Link Fencing Top of Shoring	400.00	LF	-	-	4,000	-	-	4,000
1700.150	CT 202 Gradation	4.00	ea	-	-	660	-	-	660
1700.150	ASTM D1557 (CT 216) In place Density Testing	1,810.00	hr	-	-	126,700	-	-	126,700
1700.150	ASTM D4318 - Plasticity Index (Atterberg Limits)	4.00	ea	-	-	780	-	-	780
1700.350	Engineering Review - 1% of Tech Hours	18.00	hr	-	-	1,350	-	-	1,350
1700.350	Admin - 10% of Tech Hours	181.00	hr	-	-	13,575	-	-	13,575
1700.350	Laboratory Services - 1% of Tech Hours	18.00	hr	-	-	1,350	-	-	1,350
2050.050	Sub - Sitework Shoring Sheet Piles (Install)	350,580.00	SF	-	-	6,941,484	-	-	6,941,484
2050.050	Sub - Sitework Shoring Sheet Piles (Remove)	350,580.00	SF	-	-	6,941,484	-	-	6,941,484
2050.050	Sub - Sitework Shoring Sheet Piles (Purchase)	26,160.00	SF	-	-	621,562	-	-	621,562
2050.050	Excavations over 20'	1.00	EA	-	-	1,500	-	-	1,500
2050.050	Water Connection Cost	1.00	EA	-	-	750	-	-	750
2050.050	Traffic Control	9.00	Mo	-	-	95,648	-	-	95,648
2050.050	Water for Backfill	2,639,656.00	gal	-	-	26,397	-	-	26,397
2150.150	Structure Concrete Demo Excavation 330/BRKR	6,963.00	CY	192,217	-	-	69,439		261,657
2150.150	Structure Demo AC Paving	33,683.00	SY	114,316	-	-	31,580		145,895
2150.500	Haul Off Site W/Dump Fees (AC Demo)	9,319.00	CY		-	1,164,875		-	1,164,875
2150.500	Haul Off Site W/Dump Fees	6,963.00	CY		-	870,375		-	870,375
2200.100	Purchase Type G: Aggregate Base (Temp Paving 6")	2,350.00	TN	-	26,438	18,800	-	-	45,238
2200.100	Purchase Type G: Aggregate Base (Replace Road 6")	10,218.00	TN	-	114,953	81,744	-	-	196,697
2200.150	Earthwork Prep SG (Temp Paving)	7,741.00	SY	21,015	-	-	3,684	-	24,699
2200.150	Earthwork Prep SG (Replace Road)	33,683.00	SY	91,443	-	-	16,029	-	107,472
2200.200	Structure Excavation 330/Long Reach	68,532.00	CY	1,054,558	-	-	346,608	-	1,401,166
2200.250	Structural Backfill from On-Site Stockpile, From Pump Station Cut	6,886.00	CY	89,733	-	-	15,604	-	105,336

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
** unassigned **								
2200.250	Structural Backfill from On-Site Stockpile,	68,532.00 CY	372,105	-	-	64,706	-	436,811
2200.250	Spread, Grade, and Compact Imported Structure Base	56.00 CY	608	-	-	106	-	714
2200.250	Spread, Grade, and Compact Imported Structure Base (Temp Paving 6")	1,290.00 CY	14,009	-	-	2,436	-	16,444
2200.250	Spread, Grade, and Compact Imported Structure Base (Replace Road 6")	5,614.00 CY	60,964	-	-	10,601	-	71,565
2200.450	Load, Haul and Stockpile Material On Site	68,532.00 CY	401,015	-	-	110,780		511,795
2200.450	Load, On Site (AC Demo)	9,319.00 CY	34,232	-	-	25,022		59,254
2200.450	Load, On Site/Haul	6,886.00 CY	40,293	-	95,647	11,131	-	147,071
2200.450	Load, On Site	6,963.00 CY	101,860	-	-	28,139		129,999
2200.450	Load, On Site/Rebar	752.00 TN	4,400	-	-	1,216	-	5,616
2200.550	Purchase Rip Rap 3"-6	102.00 TN	-	1,530	816	-	-	2,346
2200.700	F&I Filter Fabric	222.00 SY	634	183	-	60	-	878
2200.700	Install Silt Fence	4,000.00 LF	10,991	12,000	-	1,038	-	24,030
2200.700	Maintain Silt Fence	4,000.00 LF	54,957	6,000	-	5,216	-	66,173
2200.700	Remove Silt Fence	4,000.00 LF	10,991		-	1,038	-	12,030
2200.700	Inlet Protection	16.00 EA	1,055	2,400	-	100	-	3,555
2250.100	Mob Dewatering System	1.00 EA	-	-	22,500	-	-	22,500
2250.100	Install Deep Wells	116.00 EA	-	-	649,600	-	-	649,600
2250.100	Remove Deep Well System	116.00 EA	-	-	1,624,000	-	-	1,624,000
2250.200	Settlement Tank 20k gal.	9.00 Mo	-	-	15,750	-	-	15,750
2250.200	Monitor Wells	6.00 EA	-	-	15,000	-	-	15,000
2250.200	Power Drops	116.00 EA	-	-	58,000	-	-	58,000
2250.200	Disconnect Switches	116.00 EA	-	-	58,000	-	-	58,000
2250.200	Maintain System	9.00 Mo	-	-	15,750	-	-	15,750
2250.200	Temp Power	9.00 Mo	-	-	28,800	-	-	28,800
2250.200	Monthly Deep Well Rental	9.00 Mo	-	-	7,200	-	-	7,200
2750.050	Subcontractor AC Paving (Temp Paving 4")	30,965.00 SYIN	-	-	173,714	-	-	173,714
2750.050	Subcontractor AC Paving (Replace Road)	134,732.00 SYIN	-	-	755,847	-	-	755,847
	** unassigned **		*2,671,397*	*163,503*	*20,436,655*	*744,533*		*24,016,088*
	2020 Demo Tunnel 0+00 to 29+03		**2,671,397**	**163,503**	**20,436,655**	**744,533**		**24,016,088**
	2100 Tunnel		***10,257,807***	***6,237,303***	***22,329,262***	***15,024,645***	***2,031,910***	***55,880,928***
2120 Connection Tunnel to Westside Pump Station								
1400 Tunnel								
** unassigned **								
2200.150	Fine Grade Structural Base Material	133.00 sy	345	-	-	59	-	403
2200.200	Structure Excavation	2,000.00 cy	8,479	-	-	13,418		21,897
2200.450	Haul Spoils to Off-Site Disposal	2,000.00 cy	8,370	-	-	4,606	4,000	16,976
2200.700	Install and Maintain Silt Fence	632.00 lf	605	2,054	-	-	-	2,659
2200.800	Temporary Shoring	13,500.00 sf	-			-	337,500	337,500
2200.900	Install W 18x50 walers along length of shoring	600.00 lf	31,415	30,000	-		-	61,415
2300.700	Bulkhead	10.00 days	390,968			239,054		630,022
2300.700	Bulkhead Material	1.00 ls	-	50,000	-	-		50,000
2300.700	Gate Installation 1 ea (op elect to open/close)	5.00 days	33,293					33,293
2300.700	Gates Materials	1.00 ea	-	30,000	-	-	-	30,000
2300.700	Electrical Installation Allowance	1.00 ls			***25,000***			25,000
2300.700	Pipe Install	150.00 lft	58,645	75,000		35,858	75,000	244,503
	** unassigned **		*532,119*	*187,054*	*25,000*	*292,995*	*416,500*	*1,453,669*
	1400 Tunnel		**532,119**	**187,054**	**25,000**	**292,995**	**416,500**	**1,453,669**
	2120 Connection Tunnel to Westside Pump Station		***532,119***	***187,054***	***25,000***	***292,995***	***416,500***	***1,453,669***

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
2130 Connection New Tunnel to LM Tunnel								
1400 Tunnel								
** unassigned **								
2300.700	Bulkhead	10.00 days	390,968			239,054		630,022
2300.700	Bulkhead Material	1.00 ls	-	50,000	-	-		50,000
2300.700	Gate Installation 1 ea (op elect to open/close)	5.00 days	33,293					33,293
2300.700	Gates Materials	1.00 ea	-	30,000	-	-	-	30,000
2300.700	Electrical Installation Allowance	1.00 ls			***25,000***			25,000
2300.700	Pipe Install	150.00 lft	58,645	75,000		35,858	75,000	244,503
	** unassigned **		*482,906*	*155,000*	*25,000*	*274,913*	*75,000*	*1,012,819*
	1400 Tunnel		**482,906**	**155,000**	**25,000**	**274,913**	**75,000**	**1,012,819**
	2130 Connection New Tunnel to LM Tunnel		***482,906***	***155,000***	***25,000***	***274,913***	***75,000***	***1,012,819***
2200 Lake Merced Tunnel								
1500 Lake Merced Tunnel Decommission								
** unassigned **								
2300.530	Tunnel Setup	10.00 days	340,450			138,888		479,338
2300.545	Tunnel Cleanup	1,097.00 lft	74,695			30,472		105,167
2300.550	Tunnel Decommissioning	1,097.00 lft	155,249			93,835		249,083
2300.560	Tunnel Teardown	5.00 day	170,225			69,444		239,669
2300.800	Concrete - Low Strength	6,255.00 cy	-	500,400	-	-		500,400
2300.800	Utilities/Misc	1,097.00 lft	-		-	-	54,850	54,850
	** unassigned **		*740,618*	*500,400*		*332,638*	*54,850*	*1,628,506*
	1500 Lake Merced Tunnel Decommission		**740,618**	**500,400**		**332,638**	**54,850**	**1,628,506**
	2200 Lake Merced Tunnel		***740,618***	***500,400***		***332,638***	***54,850***	***1,628,506***

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Estimate Totals

Description	Amount	Totals	Hours	Rate	Cost Basis	Percent of Total	
Labor	17,736,672		156,161.165 hrs			6.61%	
Material	9,690,529					3.61%	
Subcontract	33,323,363					12.42%	
Equipment	18,827,691		162,987.494 hrs			7.02%	
Other	3,090,470					1.15%	
Subtotal	**82,668,725**	**82,668,725**				**30.80%**	**30.80%**
Sales Tax	823,695			8.500 %	C	0.31%	
8.5% of Materials					L		
Subtotal	**823,695**	**83,492,420**				**0.31%**	**31.11%**
Mob/Demob	14,193,711			17.000 %	T	5.29%	
17% of Previous Subtotal					L		
Subtotal	**14,193,711**	**97,686,131**				**5.29%**	**36.40%**
Field Office G&A (GC's)	26,123,832				L	9.73%	
12% of $217,698,598					L		
Subtotal	**26,123,832**	**123,809,963**				**9.73%**	**46.13%**
Home Office Overhead	7,619,451				L	2.84%	
3.5% of $217,698,598					L		
Fee	21,769,860				L	8.11%	
10% of $217,698,598					L		
Subtotal	**29,389,311**	**153,199,274**				**10.95%**	**57.08%**
Insurance /Bonds	4,353,972				L	1.62%	
2% of $217,698,598					L		
Subtotal	**4,353,972**	**157,553,246**				**1.62%**	**58.70%**
Escalation-Mid point of Const	41,255,294				L	15.37%	
Lump Sum Amount					L		
Subtotal	**41,255,294**	**198,808,540**				**15.37%**	**74.07%**
Contingency	69,582,989			35.000 %	T	25.93%	
35% of Previous Subtotal					L		
Subtotal	**69,582,989**	**268,391,529**				**25.93%**	**100.00%**
Total		***268,391,529***					

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Project name	Alt D2 - South Ocean Beach
Labor rate table	South Ocean Beach
Equipment rate table	2012 Equip - CA 03
Bid date	12:00:00 AM
Report format	Sorted by 'WORK PKG/WORK AREA/Assembly' 'Detail' summary

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
800 Dewatering								
325 Access Shaft Intermediate North								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	180.00 vlf	451	18,000	-	538	-	18,989
2250.150	Header Lines & Fittings 8"	200.00 lf	765	10,000	-	2,800	-	13,565
2250.150	Maintenance of Deep Well System	6.00 mo	99,316	-	-	12,000	6,000	117,316
	** unassigned **		*100,532*	*28,000*		*15,338*	*6,000*	*149,870*
	325 Access Shaft Intermediate North		**100,532**	**28,000**		**15,338**	**6,000**	**149,870**
350 Connection Storage Res to West Side Pump Station								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	180.00 vlf	451	18,000	-	538	-	18,989
2250.150	Header Lines & Fittings 8"	200.00 lf	765	10,000	-	2,800	-	13,565
2250.150	Maintenance of Deep Well System	3.00 mo	1,148	-	-	6,000	3,000	10,148
	** unassigned **		*2,364*	*28,000*		*9,338*	*3,000*	*42,702*
	350 Connection Storage Res to West Side Pump Station		**2,364**	**28,000**		**9,338**	**3,000**	**42,702**
500 Storage Reservoir 3.7 M Gallons								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	600.00 vlf	1,502	60,000	-	1,794	-	63,296
2250.150	Header Lines & Fittings 8"	600.00 lf	2,296	30,000	-	8,400	-	40,696
2250.150	Maintenance of Deep Well System	6.00 mo	99,316	-	-	12,000	6,000	117,316
	** unassigned **		*103,114*	*90,000*		*22,194*	*6,000*	*221,308*
	500 Storage Reservoir 3.7 M Gallons		**103,114**	**90,000**		**22,194**	**6,000**	**221,308**
600 Pipeline								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	1,680.00 vlf	4,207	168,000	-	5,022	-	177,229
2250.150	Header Lines & Fittings 8"	4,200.00 lf	16,074	210,000	-	58,800	-	284,874
2250.150	Maintenance of Deep Well System	6.00 mo	2,296	-	-	12,000	6,000	20,296
	** unassigned **		*22,577*	*378,000*		*75,822*	*6,000*	*482,399*
	600 Pipeline		**22,577**	**378,000**		**75,822**	**6,000**	**482,399**
1600 Connection Shaft/ 100 MGD Pump Station Shaft								
** unassigned **								
2250.150	Develop Deep Dewatering Wells	600.00 vlf	1,502	60,000	-	1,794	-	63,296
2250.150	Header Lines & Fittings 8"	600.00 lf	2,296	30,000	-	8,400	-	40,696
2250.150	Maintenance of Deep Well System	6.00 mo	2,296	-	-	12,000	6,000	20,296
	** unassigned **		*6,095*	*90,000*		*22,194*	*6,000*	*124,289*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft		**6,095**	**90,000**		**22,194**	**6,000**	**124,289**
	800 Dewatering		***234,683***	***614,000***		***144,886***	***27,000***	***1,020,569***
1000 Excavation and Support								
325 Access Shaft Intermediate North								
** unassigned **								
2150.050	Demo AC Pavement	185.00 cy	3,631	-	-	1,805	-	5,436
2150.500	Trucking Demo Materials Pavement	12.00 hr	1,256	-	-	691	-	1,946
2150.500	Dump Fees Pavement	19.00 load	-	-	-	-	1,900	1,900
2200.200	Structure Excavation	785.00 cy	122,764	-	-	75,063		197,827
2200.450	Haul Spoils to Off-Site Disposal	785.00 cy	3,285	-	-	1,808	1,570	6,663
2200.700	Install and Maintain Silt Fence	400.00 lf	383	1,300	-	-	-	1,683
2200.800	Temporary Shoring	2,827.00 sf	-			-	70,675	70,675
2200.900	Install W 18x50 walers along length of shoring	377.00 lf	20,471	18,850	-	22,531	-	61,853
2200.900	Drill, install, and grout tie backs, 20' long	19.00 ea	-	-	47,500	-	-	47,500
2300.700	Materials Misc	30.00 ft					15,000	15,000

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
	** unassigned **			*151,790*	*20,150*	*47,500*	*101,898*	*89,145*	*410,483*
	325 Access Shaft Intermediate North			**151,790**	**20,150**	**47,500**	**101,898**	**89,145**	**410,483**
500 Storage Reservoir 3.7 M Gallons									
** unassigned **									
2150.050	Demo AC Pavement	1,037.00	cy	20,353	-	-	10,116	-	30,469
2150.500	Trucking Demo Materials Pavement	70.00	hr	7,324	-	-	4,030	-	11,354
2150.500	Dump Fees Pavement	104.00	load	-	-	-	-	10,400	10,400
2200.200	Structure Excavation	41,481.00	cy	175,853	-	-	278,293		454,146
2200.450	Haul Spoils to Off-Site Disposal	41,481.00	cy	173,606	-	-	95,531	82,962	352,099
2200.700	Install and Maintain Silt Fence	1,880.00	lf	1,799	6,110	-	-	-	7,909
2200.800	Temporary Shoring	56,400.00	sf	-			-	1,410,000	1,410,000
2200.900	Install W 18x50 walers along length of shoring	2,820.00	lf	147,651	141,000	-		-	288,651
2200.900	Drill, install, and grout tie backs, 20' long	141.00	ea	-	-	352,500	-	-	352,500
	** unassigned **			*526,586*	*147,110*	*352,500*	*387,970*	*1,503,362*	*2,917,528*
	500 Storage Reservoir 3.7 M Gallons			**526,586**	**147,110**	**352,500**	**387,970**	**1,503,362**	**2,917,528**
	1000 Excavation and Support			***678,376***	***167,260***	***400,000***	***489,868***	***1,592,507***	***3,328,010***
1002 Excavation/Pipe Install/Backfill									
600 Pipeline									
** unassigned **									
2150.050	Demo AC Pavement	3,111.00	cy	61,059	-	-	30,348	-	91,406
2150.500	Trucking Demo Materials Pavement	206.00	hr	21,554	-	-	11,860	-	33,414
2150.500	Dump Fees Pavement	311.00	load	-	-	-	-	31,100	31,100
2200.100	Purchase Type E: Pea Gravel	11,780.00	CY	-	259,160	-	-	-	259,160
2200.300	Trench Excavation & Backfill Incl Pipe Install & Mtl	4,200.00	lf	1,001,018	2,520,000	-	385,904	-	3,906,921
2200.450	Haul Spoils to Off-Site Disposal	13,109.00	cy	54,864	-	-	42,664	26,218	123,746
2200.750	Trench Sheet Piling	16,000.00	sf	33,161	400,000	-	30,412	-	463,573
	** unassigned **			*1,171,655*	*3,179,160*		*501,188*	*57,318*	*4,909,321*
	600 Pipeline			**1,171,655**	**3,179,160**		**501,188**	**57,318**	**4,909,321**
	1002 Excavation/Pipe Install/Backfill			***1,171,655***	***3,179,160***		***501,188***	***57,318***	***4,909,321***
1003 Manholes									
600 Pipeline									
02 C 30 Buried Pipe Appurtenances - Pre-Cast Manholes, Catch Basins, & Vaults									
2700.050	Pre-Cast Concrete Manhole, AASHTO HS-20, 4' Dia., 16-20' Tall	4.00	ea	41,829		-	8,246	-	50,075
	Buried Pipe Appurtenances - Pre-Cast Manholes, Catch Basins, & Vaults	*1.00*	*ls*	*41,829*			*8,246*		*50,075*
	600 Pipeline			**41,829**			**8,246**		**50,075**
	1003 Manholes			***41,829***			***8,246***		***50,075***
1005 Install Bulkhead									
325 Access Shaft Intermediate North									
** unassigned **									
2300.700	Bulkhead	5.00	days	195,484			119,527		315,011
2300.700	Bulkhead Material	1.00	ls	-	50,000	-	-		50,000
	** unassigned **			*195,484*	*50,000*		*119,527*		*365,011*
	325 Access Shaft Intermediate North			**195,484**	**50,000**		**119,527**		**365,011**
	1005 Install Bulkhead			***195,484***	***50,000***		***119,527***		***365,011***
1010 Concrete Slab on Grade									
500 Storage Reservoir 3.7 M Gallons									
** unassigned **									

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
** unassigned **								
2200.150	Fine Grade SOG	23,400.00 sf	11,367	-	-	1,627	-	12,995
3100.150	Form Slab-on-Grade Perimeter Edge	2,700.00 sf	32,957	4,050	-	4,851	-	41,858
3100.150	Form Slab-on-Grade Construction Joints	3,960.00 sf	48,337	6,336	-	7,114	-	61,787
3100.650	Strip & Oil Slab-on-Grade Construction Joint Forms	3,960.00 sf	12,001		-	182	-	12,183
3100.650	Strip & Oil Slab Edge Forms	2,700.00 sf	2,727	54	-	124	-	2,906
3100.850	Form Upset Keyway at Future Walls	900.00 lf	3,296	450	-	485	-	4,231
3200.150	Install Rebar, Slab-On-Grade (High Production)	260.00 tn	150,625		-	21,798	-	172,422
3200.150	Purchase Rebar, Slab-On-Grade	260.00 tn	-	260,000	-	-	-	260,000
3200.750	Place Rebar/Mesh Support - Bricks	2,340.00 ea	543	585	-	140	-	1,269
3300.050	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi	2,600.00 cy	-	325,000	-	-	-	325,000
3300.100	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi (Waste)	130.00 cy	-	16,250	-	-	-	16,250
3300.250	Pump-Place Concrete, Slab-On-Grade (High Production)	2,600.00 cy	39,558	-	-	6,467	26,000	72,025
3300.250	Screed Top Surface, Slab-On-Grade	23,400.00 sf	23,735	-	-	1,819	-	25,554
3300.250	Float Top Surface, Slab-On-Grade	23,400.00 sf	31,639	-	-	25,463	-	57,101
3300.250	Spray-On Liquid Curing Compound, Slab-on-Grade	23,400.00 sf	2,364	2,106	-	539	-	5,008
3350.050	Sealant At Construction Joint Grooves	1,320.00 lf	1,351	1,320	-		-	2,671
3350.100	Sealant At Control Joint Grooves	2,370.00 lf	2,842	1,185	-	484	-	4,512
3350.200	Waterstop, 6" Bulb	2,220.00 lf	28,489	13,875	-	4,687	-	47,052
3350.250	Zip Strips 3/4"	2,370.00 lf	22,740	379	-	323	-	23,442
3400.025	Sandblast Slab Construction Joints	3,960.00 sf	12,160		-		-	12,160
3400.050	Finish Flatwork - Broom	23,400.00 sf	28,482	234	-	1,819	-	30,535
	** unassigned **		*455,213*	*631,824*		*77,922*	*26,000*	*1,190,959*
	500 Storage Reservoir 3.7 M Gallons		**455,213**	**631,824**		**77,922**	**26,000**	**1,190,959**
	1010 Concrete Slab on Grade		***455,213***	***631,824***		***77,922***	***26,000***	***1,190,959***
1020 Concrete Walls								
500 Storage Reservoir 3.7 M Gallons								
03 E 01 Cast-in-Place Concrete - Walls, Straight (Basic)								
3100.250	Erect Circular Wall Form System 16'-<	42,624.00 sf	650,352	70,330	-	58,063	-	778,745
3100.250	Construct Wall Bulkhead Forms	2,520.00 sf	92,280	5,040	-	6,866	-	104,185
3100.650	Strip & Oil Wall Forms	42,624.00 sf	43,058	852	-	1,962	-	45,872
3100.800	Install Edge Chamfer 1"	1,782.00 lf	3,241	356	-	2,427	-	6,025
3100.850	Form Vertical Wall Keyway 4"	840.00 lf	5,127	504	-	572	-	6,203
3100.950	Purchase Form Ties, Coil Tie, 36"x1/2", w/ Connecting Rods and Bolts	1,332.00 ea	-	6,660	-	-	-	6,660
3200.250	Install Rebar, Walls, Straight (High Production)	236.80 tn	201,261		-	21,512	-	222,773
3200.250	Purchase Rebar, Walls, Straight	236.80 tn	-	236,800	-	-	-	236,800
3300.050	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi	2,368.00 cy	-	296,000	-	-	-	296,000
3300.100	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi (Waste)	118.40 cy	-	14,800	-	-	-	14,800
3300.350	Pump-Place Concrete, Walls (High Production)	2,368.00 cy	25,140	-	-	3,404	23,680	52,225
3300.350	Screed Top Surface, Walls	2,664.00 sf	5,657	-	-	676	-	6,332
3300.350	Float Top Surface, Walls	2,664.00 sf	11,313	-	-	225	-	11,538
3300.350	Trowel Top Surface, Walls	2,664.00 sf	11,313	-	-	225	-	11,538
3300.350	Grind Fins and Patch Voids @ Formed Surfaces, Walls	42,624.00 sf	58,156	2,131	-		-	60,287
3350.200	Waterstop, 6" Bulb	840.00 lf	10,780	5,250	-	1,774	-	17,803
3400.025	Sandblast Vertical CJ @ Walls	2,520.00 sf	10,317	630	-		-	10,947
3400.025	Sandblast Horizontal Joints Before Placing Walls	2,664.00 sf	8,180	666	-		-	8,846
3400.400	Cure Concrete with Spray-On Liquid Curing Compounds	42,624.00 sf	17,223	1,492	-	981	-	19,696
	Cast-in-Place Concrete - Walls, Straight (Basic)	*2,368.00 cy*	*1,153,397*	*641,512*		*98,687*	*23,680*	*1,917,276*
	500 Storage Reservoir 3.7 M Gallons		**1,153,397**	**641,512**		**98,687**	**23,680**	**1,917,276**
	1020 Concrete Walls		***1,153,397***	***641,512***		***98,687***	***23,680***	***1,917,276***

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
1030 Concrete Suspened Slab								
500 Storage Reservoir 3.7 M Gallons								
03 G 01 Cast-In-Place Concrete - Elevated Slab, Rectangular								
3100.400	Construct Suspended Slab Construction Joint	3,960.00 sf	94,989	5,940	-	15,374	-	116,303
3100.400	Construct Suspended Slab Deck Form 15-up	23,400.00 sf	168,389	43,290	-	27,095	-	238,773
3100.400	Construct Suspended Slab Edge Form > 1'	2,700.00 sf	22,344	4,050	-	3,678	-	30,072
3100.650	Strip & Oil Non-Construction Joint Forms	2,700.00 sf	2,727	54	-	124	-	2,906
3100.650	Strip & Oil Suspended Slab Forms	3,960.00 sf	4,000	79	-	182	-	4,262
3150.050	Shore Suspended Slabs (High. Vol)	561,600.00 cf	89,807	61,776	-	38,251	-	189,834
3200.400	Install Rebar, Elevated Slabs (High Production)	279.50 tn	178,521		-	23,433	-	201,953
3200.400	Purchase Rebar, Elevated Slabs	279.50 tn	-	279,500	-	-	-	279,500
3300.050	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi	2,600.00 cy	-	325,000	-	-	-	325,000
3300.100	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi (Waste)	130.00 cy	-	16,250	-	-	-	16,250
3300.500	Pump-Place Concrete, Elevated Slabs (High Production)	2,600.00 cy	32,965	-	-	2,627	26,000	61,592
3350.050	Sealant At Construction Joint Grooves	1,320.00 lf	1,351	1,320	-		-	2,671
3350.200	Waterstop, 6" Bulb	1,320.00 lf	16,940	8,250	-	2,787	-	27,977
3350.250	Zip Strips 3/4"	1,320.00 lf	12,665	211	-	180	-	13,056
3400.025	Sandblast Slab Construction Joints	3,960.00 sf	12,160		-		-	12,160
3400.050	Finish Flatwork - Broom	23,400.00 sf	28,482	234	-	1,819	-	30,535
3400.400	Cure Concrete with Spray-On Liquid Curing Compounds	23,400.00 sf	9,455	819	-	539	-	10,813
	Cast-In-Place Concrete - Elevated Slab, Rectangular	*2,600.00 cy*	*674,795*	*746,773*		*116,088*	*26,000*	*1,563,656*
	500 Storage Reservoir 3.7 M Gallons		**674,795**	**746,773**		**116,088**	**26,000**	**1,563,656**
	1030 Concrete Suspened Slab		***674,795***	***746,773***		***116,088***	***26,000***	***1,563,656***
1040 Concrete Columns, 36 each								
500 Storage Reservoir 3.7 M Gallons								
03 F 01 Cast-In-Place Concrete - Columns, Rectangular								
3100.300	Erect Rectangular Column Forms & Accessories, Plyform Lined 20 -up	6,912.00 sf	150,653	12,096	-	14,124	-	176,872
3100.650	Strip & Oil Column Forms	6,912.00 sf	6,982	138	-	318	-	7,439
3100.800	Install Edge Chamfer 1"	3,456.00 lf	6,286	691	-	4,708	-	11,685
3200.300	Install Rebar, Columns (Low Production)	12.80 tn	15,268		-	1,918	-	17,186
3200.300	Purchase Rebar, Columns	12.80 tn	-	12,800	-	-	-	12,800
3300.050	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi	128.00 cy	-	16,000	-	-	-	16,000
3300.100	Purchase Ready-Mix Concrete (Pump Mix) - 4,500 psi (Waste)	6.40 cy	-	800	-	-	-	800
3300.400	Pump-Place Concrete, Columns (Low Production)	128.00 cy	13,283	-	-	47,902	1,792	62,977
3300.400	Water Curing with Burlap & Spray Hoses, Columns	6,912.00 sf	1,396	1,382	-	159	-	2,938
3400.025	Sandblast Before Placing Columns	144.00 sf	442	36	-		-	478
3400.100	Grind and Patch Formed Surfaces - Columns	6,912.00 sf	10,541	138	-		-	10,680
3400.250	Sack-Rub Concrete Columns	6,912.00 sf	63,673	1,382	-		-	65,055
	Cast-In-Place Concrete - Columns, Rectangular	*128.00 cy*	*268,525*	*45,464*		*69,129*	*1,792*	*384,911*
	500 Storage Reservoir 3.7 M Gallons		**268,525**	**45,464**		**69,129**	**1,792**	**384,911**
	1040 Concrete Columns, 36 each		***268,525***	***45,464***		***69,129***	***1,792***	***384,911***
1050 Coatings								
500 Storage Reservoir 3.7 M Gallons								
** unassigned **								
9960.100	Coating @ Concrete Structures (Large Areas)	41,760.00 sf	-	-	1,044,000	-	-	1,044,000
	** unassigned **				*1,044,000*			*1,044,000*
	500 Storage Reservoir 3.7 M Gallons				**1,044,000**			**1,044,000**
	1050 Coatings				***1,044,000***			***1,044,000***

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
1080 Backfill								
325 Access Shaft Intermediate North								
* *unassigned* *								
2300.525	Shaft Cleanup and Teardown	10.00 days	67,595			45,618		113,213
2300.800	Concrete	785.00 cy	-	98,125	-	-		98,125
	* *unassigned* *		*67,595*	*98,125*		*45,618*		*211,338*
	325 Access Shaft Intermediate North		**67,595**	**98,125**		**45,618**		**211,338**
350 Connection Storage Res to West Side Pump Station								
* *unassigned* *								
2200.150	Fine Grade Structural Base Material	133.00 sy	345	-	-	59	-	403
2200.250	Structural Backfill, Staged or Delivered	1,843.00 CY	28,449	33,174	-	14,909	-	76,532
	* *unassigned* *		*28,793*	*33,174*		*14,968*		*76,935*
	350 Connection Storage Res to West Side Pump Station		**28,793**	**33,174**		**14,968**		**76,935**
500 Storage Reservoir 3.7 M Gallons								
* *unassigned* *								
2200.150	Fine Grade Structural Base Material	3,111.00 sy	8,060	-	-	1,373	-	9,432
2200.250	Structural Backfill, Staged or Delivered	12,585.00 CY	194,262	226,530	-	101,809	-	522,601
2200.250	Spread, Grade, and Compact Imported Structure Base	1,037.00 CY	16,007	18,666	-	8,389	-	43,062
	* *unassigned* *		*218,329*	*245,196*		*111,571*		*575,095*
	500 Storage Reservoir 3.7 M Gallons		**218,329**	**245,196**		**111,571**		**575,095**
	1080 Backfill		***314,717***	***376,495***		***172,156***		***863,369***
1090 Restore Pavement								
325 Access Shaft Intermediate North								
* *unassigned* *								
2750.050	AC Paving System 6"	1,111.00 sy	-	-	36,663	-	-	36,663
	* *unassigned* *				*36,663*			*36,663*
	325 Access Shaft Intermediate North				**36,663**			**36,663**
500 Storage Reservoir 3.7 M Gallons								
* *unassigned* *								
2750.050	AC Paving System 6"	6,222.00 sy	-	-	205,326	-	-	205,326
	* *unassigned* *				*205,326*			*205,326*
	500 Storage Reservoir 3.7 M Gallons				**205,326**			**205,326**
600 Pipeline								
* *unassigned* *								
2750.050	AC Paving System 6"	18,667.00 sy	-	-	616,011	-	-	616,011
	* *unassigned* *				*616,011*			*616,011*
	600 Pipeline				**616,011**			**616,011**
1600 Connection Shaft/ 100 MGD Pump Station Shaft								
* *unassigned* *								
2750.050	AC Paving System 6"	2,827.00 sy	-	-	93,291	-	-	93,291
	* *unassigned* *				*93,291*			*93,291*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft				**93,291**			**93,291**
	1090 Restore Pavement				***951,291***			***951,291***
1120 Connection Storage to West Side Pump								
350 Connection Storage Res to West Side Pump Station								
* *unassigned* *								
2200.150	Fine Grade Structural Base Material	133.00 sy	345	-	-	59	-	403

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
** unassigned **								
2200.200	Structure Excavation	2,000.00 cy	8,479	-	-	13,418		21,897
2200.450	Haul Spoils to Off-Site Disposal	2,000.00 cy	8,370	-	-	4,606	4,000	16,976
2200.700	Install and Maintain Silt Fence	632.00 lf	605	2,054	-	-	-	2,659
2200.800	Temporary Shoring	13,500.00 sf	-			-	337,500	337,500
2200.900	Install W 18x50 walers along length of shoring	600.00 lf	31,415	30,000	-		-	61,415
2300.700	Gate Installation 1 ea (op elect to open/close)	5.00 days	33,293					33,293
2300.700	Gates Materials	1.00 ea	-	30,000	-	-	-	30,000
2300.700	Electrical Installation Allowance	1.00 ls			***25,000***			25,000
2300.700	Pipe Install	150.00 lft	58,645	75,000		35,858	75,000	244,503
	** unassigned **		*141,151*	*137,054*	*25,000*	*53,941*	*416,500*	*773,646*
	350 Connection Storage Res to West Side Pump Station		**141,151**	**137,054**	**25,000**	**53,941**	**416,500**	**773,646**
	1120 Connection Storage to West Side Pump		***141,151***	***137,054***	***25,000***	***53,941***	***416,500***	***773,646***
2200 Lake Merced Tunnel								
1500 Lake Merced Tunnel Decommission								
** unassigned **								
2300.530	Tunnel Setup	10.00 days	340,450			138,888		479,338
2300.545	Tunnel Cleanup	1,097.00 lft	74,695			30,472		105,167
2300.550	Tunnel Decommissioning	1,097.00 lft	155,249			93,835		249,083
2300.560	Tunnel Teardown	5.00 day	170,225			69,444		239,669
2300.800	Concrete - Low Strength	6,255.00 cy	-	500,400	-	-		500,400
2300.800	Utilities/Misc	1,097.00 lft	-		-	-	54,850	54,850
	** unassigned **		*740,618*	*500,400*		*332,638*	*54,850*	*1,628,506*
	1500 Lake Merced Tunnel Decommission		**740,618**	**500,400**		**332,638**	**54,850**	**1,628,506**
	2200 Lake Merced Tunnel		***740,618***	***500,400***		***332,638***	***54,850***	***1,628,506***
2300 100 MGD Pump Station Civil								
1600 Connection Shaft/ 100 MGD Pump Station Shaft								
** unassigned **								
2150.050	Demo AC Pavement	52.00 cy	1,021	-	-	507	-	1,528
2150.500	Trucking Demo Materials Pavement	4.00 hr	419	-	-	230	-	649
2150.500	Dump Fees Pavement	6.00 load	-	-	-	-	600	600
2200.450	Haul Spoils to Off-Site Disposal	10,472.00 cy	43,827	-	-	34,082	104,720	182,629
2300.500	Setup	10.00 days	113,482	10,000		39,985	10,000	173,466
2300.510	Shaft Initial Support & Excavation	100.00 vft	1,886,947			978,017		2,864,964
2300.520	Shaft Bottom Slab Permanent	3.00 vft	141,521			79,444		220,965
2300.520	Shaft Walls Permanent	94.00 vft	266,059			149,355		415,415
2300.520	Shaft Top Slab Permanent	3.00 vft	283,042			158,889		441,931
2300.520	Shaft Pump Level	3.00 vft	113,217			63,555		176,772
2300.525	Shaft Cleanup and Teardown	10.00 days	113,217			58,681		171,898
2300.800	Shoring	28,274.00 sqft	-	706,850	-	-		706,850
2300.800	Steel Structural Members	113,097.00 lb	-	141,371	-	-		141,371
2300.800	Concrete	2,211.00 cy	-	265,320	-	-		265,320
2300.800	Rebar	457,950.00 lb	-	228,975	-	-		228,975
2300.800	Forming	24,504.00 sqft	-		-	-	245,040	245,040
2300.800	Utilities/Misc	100.00 lft	-		-	-	25,000	25,000
	** unassigned **		*2,962,751*	*1,352,516*		*1,562,746*	*385,360*	*6,263,373*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft		**2,962,751**	**1,352,516**		**1,562,746**	**385,360**	**6,263,373**
	2300 100 MGD Pump Station Civil		***2,962,751***	***1,352,516***		***1,562,746***	***385,360***	***6,263,373***
2302 100 MGD Pump Station Sitework								

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
1600 Connection Shaft/ 100 MGD Pump Station Shaft								
02 B 00 100 MGD PS Site Work								
2050.050	Common Site Work	1.00 ls	58,283	75,034		-	-	133,317
2050.050	Specialty Site Work	1.00 ls	137,479	156,441		-	-	293,920
	100 MGD PS Site Work		*195,763*	*231,475*				*427,238*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft		**195,763**	**231,475**				**427,238**
	2302 100 MGD Pump Station Sitework		***195,763***	***231,475***				***427,238***
2303 100 MGD Pump Station Concrete								
1600 Connection Shaft/ 100 MGD Pump Station Shaft								
03 A 00 100 MGD PS Concrete								
3050.050	Concrete	1.00 ls	305,434	144,816		-	-	450,250
	100 MGD PS Concrete		*305,434*	*144,816*				*450,250*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft		**305,434**	**144,816**				**450,250**
	2303 100 MGD Pump Station Concrete		***305,434***	***144,816***				***450,250***
2304 100 MGD Pump Station Masonry								
1600 Connection Shaft/ 100 MGD Pump Station Shaft								
0401- Block Basic Takeoff for all Sizes								
4050.200	Masonry	1.00 ls	24,766	15,572	0	-	-	40,338
	Block Basic Takeoff for all Sizes		*24,766*	*15,572*				*40,338*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft		**24,766**	**15,572**				**40,338**
	2304 100 MGD Pump Station Masonry		***24,766***	***15,572***				***40,338***
2305 100 MGD Pump Station Div 5-8								
1600 Connection Shaft/ 100 MGD Pump Station Shaft								
0500- 100 MGD PS Metals								
5590.100	EQ: Misc Metals	1.00 ls		362,304	-	-	-	362,304
5590.100	Misc Metals Install	1.00 ls	113,973	23,848	-	-	-	137,821
5590.100	Buildings & Components	1.00 ls	181,262	320,116	-	-	-	501,378
	100 MGD PS Metals		*295,234*	*706,268*				*1,001,502*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft		**295,234**	**706,268**				**1,001,502**
	2305 100 MGD Pump Station Div 5-8		***295,234***	***706,268***				***1,001,502***
2309 100 MGD Pump Station Finishes								
1600 Connection Shaft/ 100 MGD Pump Station Shaft								
091 0- 100 MGD PS Finishes								
9912.500	Finishes	1.00 ls	102,053	41,175		-	-	143,228
	100 MGD PS Finishes		*102,053*	*41,175*				*143,228*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft		**102,053**	**41,175**				**143,228**
	2309 100 MGD Pump Station Finishes		***102,053***	***41,175***				***143,228***
2320 100 MGD Pump Station Mechanical								
1600 Connection Shaft/ 100 MGD Pump Station Shaft								
** unassigned **								
2300.950	EQ: Process Mechanical	1.00 ls		7,535,800				7,535,800
2300.950	Process Mechanical Installation	1.00 ls	116,643			828,393		945,036
	** unassigned **		*116,643*	*7,535,800*		*828,393*		*8,480,836*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft		**116,643**	**7,535,800**		**828,393**		**8,480,836**
	2320 100 MGD Pump Station Mechanical		***116,643***	***7,535,800***		***828,393***		***8,480,836***
2330 100 MGD Pump Station Electrical								
1600 Connection Shaft/ 100 MGD Pump Station Shaft								

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
* unassigned *								
2300.960	EQ: Electrical & I&C	1.00 ls		1,887,617				1,887,617
2300.960	Elect & I&C Installation	1.00 ls	887,991			2,105,843		2,993,834
	* unassigned *		*887,991*	*1,887,617*		*2,105,843*		*4,881,451*
	1600 Connection Shaft/ 100 MGD Pump Station Shaft		**887,991**	**1,887,617**		**2,105,843**		**4,881,451**
	2330 100 MGD Pump Station Electrical		***887,991***	***1,887,617***		***2,105,843***		***4,881,451***
2335 Pipeline								
360 By Pass Pumping								
* unassigned *								
2250.050	6" Dewatering Pump & Hoses, 24-hr Operation	30.00 day	68,890	-	-	15,668	-	84,558
	* unassigned *		*68,890*			*15,668*		*84,558*
	360 By Pass Pumping		**68,890**			**15,668**		**84,558**
	2335 Pipeline		***68,890***			***15,668***		***84,558***
2200 Lake Merced Tun								
2000 Demo 72" Westside PS to Transition Structure								
* unassigned *								
1350.100	Provide Temporary 6' Chain Link Fencing Top of Shoring	260.00 LF	-	-	2,600	-	-	2,600
1700.150	CT 202 Gradation	1.00 ea	-	-	165	-	-	165
1700.150	ASTM D1557 (CT 216) In place Density Testing	48.00 hr	-	-	3,360	-	-	3,360
1700.150	ASTM D4318 - Plasticity Index (Atterberg Limits)	1.00 ea	-	-	195	-	-	195
1700.350	Engineering Review - 1% of Tech Hours	0.48 hr	-	-	36	-	-	36
1700.350	Admin - 10% of Tech Hours	4.80 hr	-	-	360	-	-	360
1700.350	Laboratory Services - 1% of Tech Hours	0.48 hr	-	-	36	-	-	36
2050.050	Sub - Sitework Shoring Sheet Piles (Install)	17,760.00 SF	-	-	351,648	-	-	351,648
2050.050	Sub - Sitework Shoring Sheet Piles (Remove)	17,760.00 SF	-	-	351,648	-	-	351,648
2050.050	Sub - Sitework Shoring Sheet Piles (Purchase)	17,760.00 SF	-	-	421,978	-	-	421,978
2050.050	Excavations over 20'	1.00 EA	-	-	1,500	-	-	1,500
2050.050	Traffic Control	1.25 Mo	-	-	13,284	-	-	13,284
2050.050	Water for Backfill	60,667.00 gal	-	-	607	-	-	607
2150.150	Structure Concrete Demo Excavation 330/BRKR	49.00 CY	1,353	-	-	489		1,841
2150.500	Haul Off Site W/Dump Fees	49.00 CY		-	7,105		-	7,105
2200.200	Structure Excavation 330/Long Reach	1,684.00 CY	25,913	-	-	8,517	-	34,430
2200.250	Structural Backfill from On-Site Stockpile, From Pump Station Cut	49.00 CY	639	-	-	111	-	750
2200.250	Structural Backfill from On-Site Stockpile,	1,684.00 CY	21,944	-	-	3,816	-	25,760
2200.450	Load, Haul and Stockpile Material On Site	1,684.00 CY	43,795	-	-	12,098		55,894
2200.450	Load, On Site/Haul	49.00 CY	287	-	681	79	-	1,047
2200.450	Load, On Site	49.00 CY	717	-	-	198		915
2200.450	Load, On Site/Rebar	2.70 TN	16	-	-	4	-	20
2250.100	Install Deep Wells	6.00 EA	-	-	33,600	-	-	33,600
2250.100	Remove Deep Well System	6.00 EA	-	-	84,000	-	-	84,000
2250.200	Settlement Tank 20k gal.	1.25 Mo	-	-	2,188	-	-	2,188
2250.200	Monitor Wells	1.00 EA	-	-	2,500	-	-	2,500
2250.200	Power Drops	6.00 EA	-	-	3,000	-	-	3,000
2250.200	Diconnect Switches	6.00 EA	-	-	3,000	-	-	3,000
2250.200	Maintain System	1.25 Mo	-	-	2,188	-	-	2,188
2250.200	Temp Power	1.25 Mo	-	-	4,000	-	-	4,000
2250.200	Monthly Deep Well Rental	1.25 Mo	-	-	1,000	-	-	1,000
	* unassigned *		*94,663*		*1,290,677*	*25,313*		*1,410,653*
	2000 Demo 72" Westside PS to Transition Structure		**94,663**		**1,290,677**	**25,313**		**1,410,653**
2010 Demo Transition Structure								
* unassigned *								

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
** unassigned **									
1350.100	Provide Temporary 6' Chain Link Fencing Top of Shoring	100.00	LF	-	-	1,000	-	-	1,000
1700.150	CT 202 Gradation	1.00	ea	-	-	165	-	-	165
1700.150	ASTM D1557 (CT 216) In place Density Testing	34.00	hr	-	-	2,380	-	-	2,380
1700.150	ASTM D4318 - Plasticity Index (Atterberg Limits)	1.00	ea	-	-	195	-	-	195
1700.350	Engineering Review - 1% of Tech Hours	0.34	hr	-	-	26	-	-	26
1700.350	Admin - 10% of Tech Hours	3.40	hr	-	-	255	-	-	255
1700.350	Laboratory Services - 1% of Tech Hours	0.34	hr	-	-	26	-	-	26
2050.050	Sub - Sitework Shoring Sheet Piles (Install)	8,160.00	SF	-	-	161,568	-	-	161,568
2050.050	Sub - Sitework Shoring Sheet Piles (Remove)	8,160.00	SF	-	-	161,568	-	-	161,568
2050.050	Sub - Sitework Shoring Sheet Piles (Purchase)	8,160.00	SF	-	-	193,882	-	-	193,882
2050.050	Excavations over 20'	1.00	EA	-	-	1,500	-	-	1,500
2050.050	Traffic Control	1.25	Mo	-	-	13,284	-	-	13,284
2050.050	Water for Backfill	49,259.00	gal	-	-	493	-	-	493
2150.150	Structure Concrete Demo Excavation 330/BRKR	76.00	CY	2,098	-	-	758		2,856
2150.500	Haul Off Site W/Dump Fees	76.00	CY		-	9,500		-	9,500
2200.200	Structure Excavation 330/Long Reach	1,190.00	CY	18,312	-	-	6,019	-	24,330
2200.250	Structural Backfill from On-Site Stockpile, From Pump Station Cut	217.00	CY	2,828	-	-	492	-	3,319
2200.250	Structural Backfill from On-Site Stockpile,	1,190.00	CY	15,507	-	-	2,697	-	18,204
2200.450	Load, Haul and Stockpile Material On Site	1,190.00	CY	6,963	-	-	1,924		8,887
2200.450	Load, On Site/Haul	217.00	CY	1,270	-	3,014	351	-	4,635
2200.450	Load, On Site	76.00	CY	1,112	-	-	307		1,419
2200.450	Load, On Site/Rebar	4.20	TN	25	-	-	7	-	31
2250.100	Install Deep Wells	2.00	EA	-	-	11,200	-	-	11,200
2250.100	Remove Deep Well System	2.00	EA	-	-	28,000	-	-	28,000
2250.200	Settlement Tank 20k gal.	1.25	Mo	-	-	2,188	-	-	2,188
2250.200	Monitor Wells	1.00	EA	-	-	2,500	-	-	2,500
2250.200	Power Drops	2.00	EA	-	-	1,000	-	-	1,000
2250.200	Disconnect Switches	2.00	EA	-	-	1,000	-	-	1,000
2250.200	Maintain System	1.25	Mo	-	-	2,188	-	-	2,188
2250.200	Temp Power	1.25	Mo	-	-	4,000	-	-	4,000
2250.200	Monthly Deep Well Rental	1.25	Mo	-	-	1,000	-	-	1,000
	** unassigned **			*48,114*		*601,930*	*12,553*		*662,597*
	2010 Demo Transition Structure			**48,114**		**601,930**	**12,553**		**662,597**
2020 Demo Tunnel 0+00 to 29+03									
** unassigned **									
1200.100	SWPPP Permit	1.00	LS	-	-	3,000	-	-	3,000
1350.100	Provide Temporary 6' Chain Link Fencing Top of Shoring	400.00	LF	-	-	4,000	-	-	4,000
1700.150	CT 202 Gradation	4.00	ea	-	-	660	-	-	660
1700.150	ASTM D1557 (CT 216) In place Density Testing	1,810.00	hr	-	-	126,700	-	-	126,700
1700.150	ASTM D4318 - Plasticity Index (Atterberg Limits)	4.00	ea	-	-	780	-	-	780
1700.350	Engineering Review - 1% of Tech Hours	18.00	hr	-	-	1,350	-	-	1,350
1700.350	Admin - 10% of Tech Hours	181.00	hr	-	-	13,575	-	-	13,575
1700.350	Laboratory Services - 1% of Tech Hours	18.00	hr	-	-	1,350	-	-	1,350
2050.050	Sub - Sitework Shoring Sheet Piles (Install)	350,580.00	SF	-	-	6,941,484	-	-	6,941,484
2050.050	Sub - Sitework Shoring Sheet Piles (Remove)	350,580.00	SF	-	-	6,941,484	-	-	6,941,484
2050.050	Sub - Sitework Shoring Sheet Piles (Purchase)	26,160.00	SF	-	-	621,562	-	-	621,562
2050.050	Excavations over 20'	1.00	EA	-	-	1,500	-	-	1,500
2050.050	Water Connection Cost	1.00	EA	-	-	750	-	-	750
2050.050	Traffic Control	9.00	Mo	-	-	95,648	-	-	95,648
2050.050	Water for Backfill	2,639,656.00	gal	-	-	26,397	-	-	26,397
2150.150	Structure Concrete Demo Excavation 330/BRKR	6,963.00	CY	192,217	-	-	69,439		261,657
2150.150	Structure Demo AC Paving	33,683.00	SY	114,316	-	-	31,580		145,895
2150.500	Haul Off Site W/Dump Fees (AC Demo)	9,319.00	CY		-	1,164,875		-	1,164,875

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
** unassigned **								
2150.500	Haul Off Site W/Dump Fees	6,963.00 CY		-	870,375		-	870,375
2200.100	Purchase Type G: Aggregate Base (Temp Paving 6")	2,350.00 TN	-	26,438	18,800	-	-	45,238
2200.100	Purchase Type G: Aggregate Base (Replace Road 6")	10,218.00 TN	-	114,953	81,744	-	-	196,697
2200.150	Earthwork Prep SG (Temp Paving)	7,741.00 SY	21,015	-	-	3,684	-	24,699
2200.150	Earthwork Prep SG (Replace Road)	33,683.00 SY	91,443	-	-	16,029	-	107,472
2200.200	Structure Excavation 330/Long Reach	68,532.00 CY	1,054,558	-	-	346,608	-	1,401,166
2200.250	Structural Backfill from On-Site Stockpile, From Pump Station Cut	6,886.00 CY	89,733	-	-	15,604	-	105,336
2200.250	Structural Backfill from On-Site Stockpile,	68,532.00 CY	372,105	-	-	64,706	-	436,811
2200.250	Spread, Grade, and Compact Imported Structure Base	56.00 CY	608	-	-	106	-	714
2200.250	Spread, Grade, and Compact Imported Structure Base (Temp Paving 6")	1,290.00 CY	14,009	-	-	2,436	-	16,444
2200.250	Spread, Grade, and Compact Imported Structure Base (Replace Road 6")	5,614.00 CY	60,964	-	-	10,601	-	71,565
2200.450	Load, Haul and Stockpile Material On Site	68,532.00 CY	401,015	-	-	110,780		511,795
2200.450	Load, On Site (AC Demo)	9,319.00 CY	34,232	-	-	25,022		59,254
2200.450	Load, On Site/Haul	6,886.00 CY	40,293	-	95,647	11,131	-	147,071
2200.450	Load, On Site	6,963.00 CY	101,860	-	-	28,139		129,999
2200.450	Load, On Site/Rebar	752.00 TN	4,400	-	-	1,216	-	5,616
2200.550	Purchase Rip Rap 3"-6	102.00 TN	-	1,530	816	-	-	2,346
2200.700	F&I Filter Fabric	222.00 SY	634	183	-	60	-	878
2200.700	Install Silt Fence	4,000.00 LF	10,991	12,000	-	1,038	-	24,030
2200.700	Maintain Silt Fence	4,000.00 LF	54,957	6,000	-	5,216	-	66,173
2200.700	Remove Silt Fence	4,000.00 LF	10,991		-	1,038	-	12,030
2200.700	Inlet Protection	16.00 EA	1,055	2,400	-	100	-	3,555
2250.100	Mob Dewatering System	1.00 EA	-	-	22,500	-	-	22,500
2250.100	Install Deep Wells	116.00 EA	-	-	649,600	-	-	649,600
2250.100	Remove Deep Well System	116.00 EA	-	-	1,624,000	-	-	1,624,000
2250.200	Settlement Tank 20k gal.	9.00 Mo	-	-	15,750	-	-	15,750
2250.200	Monitor Wells	6.00 EA	-	-	15,000	-	-	15,000
2250.200	Power Drops	116.00 EA	-	-	58,000	-	-	58,000
2250.200	Disconnect Switches	116.00 EA	-	-	58,000	-	-	58,000
2250.200	Maintain System	9.00 Mo	-	-	15,750	-	-	15,750
2250.200	Temp Power	9.00 Mo	-	-	28,800	-	-	28,800
2250.200	Monthly Deep Well Rental	9.00 Mo	-	-	7,200	-	-	7,200
2750.050	Subcontractor AC Paving (Temp Paving 4")	30,965.00 SYIN	-	-	173,714	-	-	173,714
2750.050	Subcontractor AC Paving (Replace Road)	134,732.00 SYIN	-	-	755,847	-	-	755,847
	** unassigned **		*2,671,397*	*163,503*	*20,436,655*	*744,533*		*24,016,088*
	2020 Demo Tunnel 0+00 to 29+03		**2,671,397**	**163,503**	**20,436,655**	**744,533**		**24,016,088**
2050 Secant Wall 0+00 to 29+03								
** unassigned **								
2050.050	Sub - Secant Wall	75,810.00 SF	-	-	9,931,110	-	-	9,931,110
2200.200	Structure Excavation Spoils from Drilled Piers	7,714.00 CY	211,967	-	-	20,101	-	232,068
2200.450	Dispose of Excavated Material (Off Site)	7,714.00 CY	-	-	964,250	-	-	964,250
	** unassigned **		*211,967*		*10,895,360*	*20,101*		*11,127,428*
	2050 Secant Wall 0+00 to 29+03		**211,967**		**10,895,360**	**20,101**		**11,127,428**
2060 Earthwork For Pump Station Abv Grade								
** unassigned **								
1350.100	Provide Temporary 6' Chain Link Fencing Top of Shoring	800.00 LF	-	-	8,000	-	-	8,000
2050.050	Excavations over 20'	1.00 EA	-	-	1,500	-	-	1,500
2200.200	Structure Excavation 330	14,932.00 CY	57,443	-	-	75,520	-	132,963
2200.450	Load, Haul and Stockpile Material On Site (Backfill for Tunnel)	7,152.00 CY	41,850	-	-	11,561		53,411

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Phase	Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
** unassigned **								
2200.450	Dispose of Excavated Material (Off Site)	7,780.00 CY	-	-	972,500	-	-	972,500
2200.700	Erosion Control Mats-Slopes	2,217.00 SY	4,874	8,535	-	465	-	13,873
2200.700	Temp Seeding	1.20 ac	-	-	3,222	-	-	3,222
2200.700	Install Silt Fence	1,200.00 LF	3,297	3,600	-	311	-	7,209
2200.700	Maintain Silt Fence	1,200.00 LF	16,487	1,800	-	1,565	-	19,852
2200.700	Remove Silt Fence	1,200.00 LF	3,297		-	311	-	3,609
	** unassigned **		*127,248*	*13,935*	*985,222*	*89,733*		*1,216,139*
	2060 Earthwork For Pump Station Abv Grade		**127,248**	**13,935**	**985,222**	**89,733**		**1,216,139**
	2200 Lake Merced Tun		***3,153,389***	***177,439***	***34,209,844***	***892,233***		***38,432,905***

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

Estimate Totals

Description	Amount	Totals	Hours	Rate	Cost Basis	Percent of Total	
Labor	14,183,357		136,894.357 hrs			5.80%	
Material	19,182,620					7.85%	
Subcontract	36,630,135					14.99%	
Equipment	7,589,159		101,798.656 hrs			3.11%	
Other	2,611,007					1.07%	
Subtotal	**80,196,278**	**80,196,278**				**32.81%**	**32.81%**
Sales Tax	1,630,523			8.500 %	C	0.67%	
8.5% of Materials					L		
Subtotal	**1,630,523**	**81,826,801**				**0.67%**	**33.48%**
Mob/Demob	8,182,680			10.000 %	T	3.35%	
10% of Previous Subtotal					L		
Subtotal	**8,182,680**	**90,009,481**				**3.35%**	**36.83%**
Field Office G&A (GC's)	24,322,952				L	9.95%	
12% of $202,691,268					L		
Subtotal	**24,322,952**	**114,332,433**				**9.95%**	**46.78%**
Home Office Overhead	7,094,194				L	2.90%	
3.5% of $202,691,268					L		
Fee	20,269,126				L	8.29%	
10% of $202'619,268					L		
Subtotal	**27,363,320**	**141,695,753**				**11.20%**	**57.98%**
Insurance /Bonds	4,053,825				L	1.66%	
2% of $202,691,268					L		
Subtotal	**4,053,825**	**145,749,578**				**1.66%**	**59.64%**
Escalation-Mid point of Const	35,287,419				L	14.44%	
Lump Sum Amount					L		
Subtotal	**35,287,419**	**181,036,997**				**14.44%**	**74.07%**
Contingency	63,362,949			35.000 %	T	25.93%	
35% of Previous Subtotal					L		
Subtotal	**63,362,949**	**244,399,946**				**25.93%**	**100.00%**
Total		***244,399,946***					

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spend preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards)

APPENDIX B
TECHNICAL MEMORANDUM: EVALUATION CRITERION – BEACH WIDTH AS A SURROGATE FOR ECOLOGICAL AND RECREATIONAL VALUE

South Ocean Beach AAR: Technical Memorandum

Evaluation Criterion – Beach Width as a Surrogate for Ecological and Recreational Value

Louis White, PE and James Jackson, PE
Environmental Science Associates (ESA)

Prepared for the San Francisco Public Utilities Commission

February 15, 2018

Introduction

This memorandum presents an overview of the technical analyses conducted by ESA to assess impacts of Lake Merced Tunnel (LMT) treatment alternatives on ecology and recreation, using beach width as a proxy. Beach width modeling showed that over the long-term, with sea level rise and annual beach nourishment, the average beach width would gradually narrow at a similar rate for all alternatives. Sea level rise amounts used are based on the March 2011 resolution of the Ocean Protection Council (OPC 2011)[1], and are consistent with those of the OBMP and the CCSF guidance (CCSF 2015). Noticeable distinctions in annual average beach width across the alternatives did not become apparent until after 2050, and become considerably more pronounced around 2080 when the rate of sea level rise accelerates and interaction between waves and the hardened back beach of Alternatives A & B occurs more frequently. In the short term, there would likely be some slight variation among the alternatives due to storm-induced episodic erosion events involving extreme wave interactions with a hardened back beach and resulting scour. But those events are expected to be recoverable over one or two seasons.

Beach Width as a Proxy for Recreational and Ecological Value at South Ocean Beach

Ecological function and recreation at South Ocean Beach (SOB) are directly related to the beach width; the wider the beach, the greater the area for invertebrates, shorebirds and public recreation. Thus, beach width was used as a surrogate for ecological and recreational value. The potential change in beach width was modeled through time for the various LMT treatment alternatives, assuming a constant frequency and volume of sand placement for each alternative. The results of the modeling allowed the team to compare the impacts of each alternative on the beach width over time, allowing for an indirect assessment of the post-construction environmental effects of the alternatives (e.g., effects on beach ecology, recreation).

[1] Note: the model was used to compare the relative effects of the alternatives on beach width over time, rather than to identify sites for the placement of infrastructure. The sea level rise amounts used in the model (OPC estimates) are: 0.6 feet by 2030, 1.2 feet by 2050, and 4.6 feet by 2100. The CCSF sea level rise guidance recommends using projections of 6 in. by 2030, 11 in. by 2050, and 36 in. by 2100; with adaptive capacity to accommodate upper end ranges of 12 in., 24 in., and 66 in. for these years, respectively. While not identical, the OPC and CCSF estimates are sufficiently similar to inform an analysis of the relative differences between alternatives.

Criteria Definition and Analysis

Beach width is used as a measure of ecological and recreational value for each alternative. Beach width is defined as the distance between the backshore (e.g., toe of bluff, dune or armor structure) and the mean high water shoreline (MHW = 5.3 ft NAVD88).

Beach widths over time at SOB were analyzed for each alternative using a model developed by ESA in 2013 and reviewed by the U.S. Army Corps of Engineers (USACE) for its the Regional Sediment Management Plan. The erosive nature of SOB results in landward transgression of the shore over time, and narrowing of beaches for fixed backshores. The overall impact of the alternatives on beach width consider the long-term beach evolution as a function of ongoing erosion, nourishment, sea level rise, and the short-term, episodic erosion impacts from storms (also referred to as scour).

The beach width modeling was performed on a representative beach profile that traverses the shore, Great Highway, and location of the former Fleishhacker Building. Backshore erosion parameters were modified for each alternative to reflect the different geometries associated with each:

- **Alternative A. Protect LMT with low-profile wall** – Under this alternative, a wall would be constructed approximately 10 feet seaward of the existing LMT springline (outer edge). The top of cap would be approximately 5.5 feet above the top of LMT, providing vertical cover above the tunnel. Thus, the wall (and cap) would rise to approximately 14 to 18 feet North American Vertical Datum (NAVD); the LMT's top elevation ranges from approximately 8.5 feet NAVD in the north to 12.3 feet NAVD in the south.2 Bluff erosion would ultimately intersect the wall, fixing the backshore and limiting the amount of sand and other bluff material from being eroded onto the beach. Limitations on the landward extent and elevation of erosion were applied to the model to reflect the constructed wall geometry for this alternative.

- **Alternatives B. Fortify LMT in place via structural modification** – For this alternative, the LMT would remain in its current location and undergo structural modification. No exterior wall is included in this alternative. Bluff erosion would intersect the LMT later in time relative to the wall option (Alternative A). Because the LMT is round and lower in elevation relative to the wall in Alternative A, Alternative B would be less effective at limiting erosion of the material above the LMT. The extent and elevation limits of backshore erosion were set to reflect the current LMT geometry.

- **Alternative C& D. Remove LMT** – With these alternatives, the LMT would be completely removed and bluff erosion would proceed naturally. No additional limitations or constraints on backshore erosion were applied to the beach width model.

Modeling of Average Long-Term Beach Width Impacts

Beach nourishment actions are outlined in the Ocean Beach Master Plan (SPUR et al. 2012) and were investigated as part of the Regional Sediment Management Plan (RSMP) prepared for the USACE. The RSMP study includes beach width modeling performed by ESA for different beach nourishment scenarios, including volumes, nourishment frequency, and backshore conditions. The beach width model is a profile-based 2-line model that tracks the erosion of the backshore line and the mean high water (MHW) line over time, so that the annual average beach width can be tracked. This model uses the historic erosion rate published by the USGS, and accelerates the erosion due to sea level rise using a

2 Mean sea level at Ocean Beach is approximately 3.2 feet NAVD (NOAA/Co-ops station 9414290).

geometric calculation of the shore profile. The backshore erosion is computed as a function of the shore erosion rate and the beach width, where a wider beach results in lower relative backshore erosion rates. This method is useful in that the effectiveness of beach nourishment can be simulated by augmenting the beach width at set times.

ESA modified the model for the AAR analysis. The model's backshore erosion parameters were originally established based upon the existing shoreline condition. ESA modified the model's erosion parameters to represent backshore conditions under the various alternatives considered in the AAR: a low profile wall seaward of the LMT (Alternative A), structural modification of LMT (Alternative B), and remove LMT (Alternatives C and D). The model assumes 75,000 cubic yards of sand are placed every 3 years. This rate of sand placement was selected because it represents a volume of sand that is reasonably expected to be available at regular intervals, either from routine USACE dredging of the San Francisco Bay Bar, or backpassing from North Ocean Beach. This nourishment rate is smaller in volume and higher in frequency than the nourishment program envisioned in the Ocean Beach Master Plan (OBMP), which calls for beach nourishment of 0.5 million cubic yards (MCY) to be placed at SOB every 10 to 30 years.

The *Coastal Protection Measures & Management Strategy for South Ocean Beach* (SPUR et al. 2015) recommended increasing the nourishment rate to 0.5 to 1 MCY every 10 to 20 years, based on input from the Technical Advisory Committee. On an annual average basis, this placement volume equates to approximately 25,000 to 100,000 cubic yards per year. The larger OBMP nourishment volumes were selected to minimize environmental impacts by reducing the frequency of sand placement events, but the feasibility and consistency with efforts by the USACE and others has not yet been evaluated.

Figure 1 presents the beach width model results for the alternatives considered in the AAR. The results indicate that there would be no detectible distinction in beach width across the alternatives within the planning horizon (i.e., through 2060). Rather, as the figure indicates, differences between the alternatives would not be expected to occur until late in the century, between the years 2080 and 2090. By end of century, the model indicates the beach could be up to 15 feet wider for alternatives that involve LMT removal; for the structural protection alternatives, the beach would narrow due to the higher elevation and seaward position of the backshore structures. However, given the timing of these distinctions (well beyond the planning horizon) and the uncertainty associated with SLR estimates late in the century, the differences are considered negligible.

For the sake of comparison, **Figure 2** shows the beach width over time under the various alternatives with no nourishment. The figure indicates that the beach would be non-existent by sometime between the years 2060 and 2070. This modeling does not account for seasonal fluctuations and short-term deviations associated with storm-induced beach scour in front of a structure.

The decrease in beach width later in the century could be mitigated by modifying the nourishment strategy over time, where a large volume of sand could be placed. To illustrate the effectiveness of sand nourishment, **Figure 3** presents beach width response for various nourishment scenarios, including ranges in volumes and placement frequencies, for the low-profile protection alternative (Alternative A). The results presented are based on a transect that bisects the Sloat Parking lot. While specific beach widths at other locations along SOB may vary, based upon bluff geometries and geologic conditions, the results are representative of the relative effects on SOB beach widths associated with placing different volumes of sand.

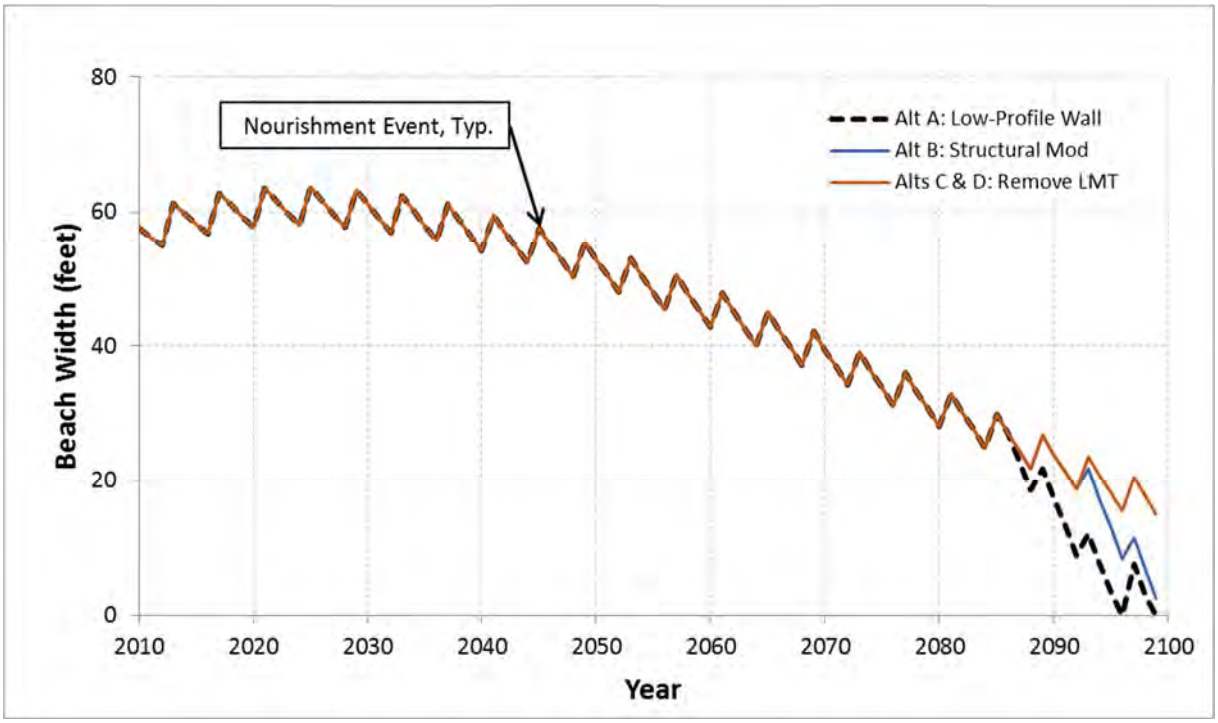


Figure 1
Beach width modeling for each LMT treatment
Assumes beach nourishment of 75k CY per 3 years

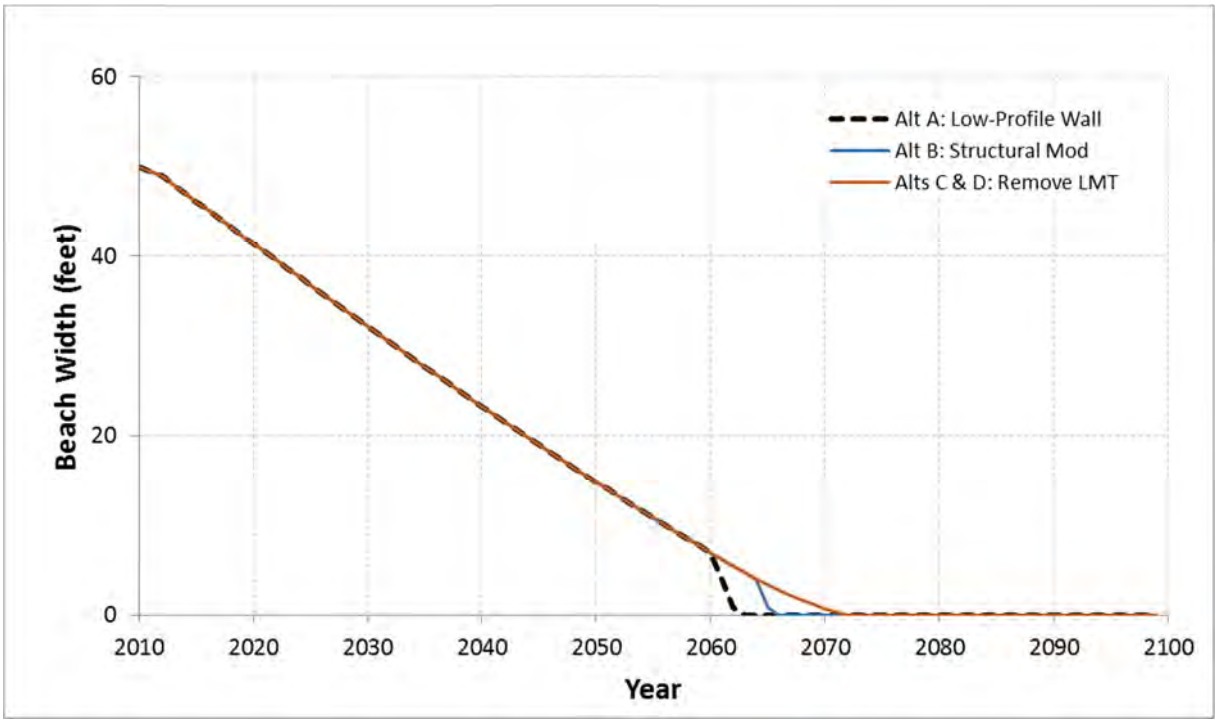


Figure 2
Beach width modeling for each LMT treatment,
assumes no beach nourishment

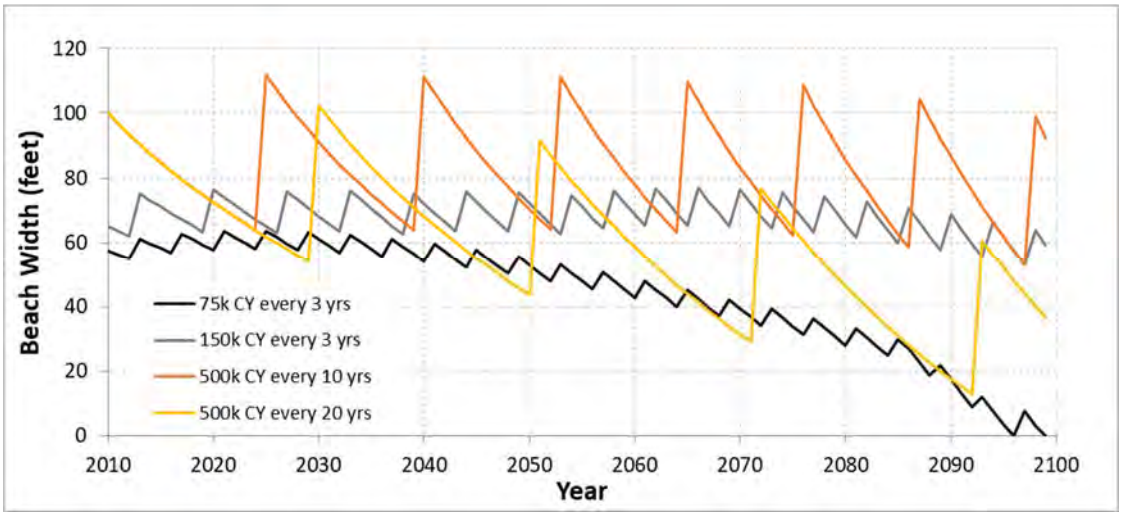


Figure 3
Beach width modeling for various nourishment scenarios
Assumes Low Profile Wall alternative

Because of the uncertainty associated with the future nourishment strategy, ESA developed a beach width index as the metric to represent the effects of each LMT treatment alternative on beach width. The beach width index is presented on a scale of 1 to 4, where 4 is the greatest benefit to beach width and 1 is the least. Results of several nourishment scenarios were used to assign the values of beach width index for the alternatives in **Table 1**, below. As the table indicates, given the alternatives would have the same effect on beach width over the planning horizon, and that the distinctions later in the century are negligible, each was assigned the same score of 4.

TABLE 1
LONG-TERM BEACH WIDTH (AVERAGE) INDICES FOR LMT TREATMENT ALTERNATIVES

Alternative	LMT Treatment Alternative	Long-Term Beach Width (Average)
A	Protect LMT with exterior low-profile wall	4
B	Protect LMT with interior reinforcement + new storage	4
C	Remove LMT + new tunnel alignment	4
D	Remove LMT + new pump station, pipeline & storage	4

Assessment of Short-term Beach Width Impacts

The analysis and results presented above focus on long-term changes of the average beach width over time for the different alternatives. Although the results show there is not much difference in the average beach width for the alternatives until the beach width narrows substantially, some other factors need to be considered. These factors include short-term seasonal and storm effects. While these effects occur for beaches of all widths, as the beach width approaches 0 ft, impacts by scour during storms becomes much greater. This means that as a beach narrows toward a hard structure, the potential for wave-induced scour during a storm is much greater. This would be similar to the scour observed in front of the Taraval Seawall and its recovered condition (see **Figure 4** below, from the *Coastal Protection Measures & Management Strategy for South Ocean Beach*, SPUR et al. 2015).

Figure 4
Taraval seawall in fall 2011 (left, © E. Vandebroek)
and winter 1998 (right, © B. Battalio)

The scour potential is greater for alternatives that involve structures located relatively further seaward and extend higher in elevation. The scour potential at the structure increases as the shoreline erodes. **Figure 5** below shows a graph of the scour potential for the two structural alternatives developed for the LMT (Alt A: Low profile wall and Alt B: structural modification). The graph shows that for every foot of elevation decrease of the beach at the structure, the depth limited wave height increases by a foot, and the scour relative to the top of the structure increases by 2 feet. The lower and further landward structural modification alternative would have less scour potential than the low profile wall that is further seaward and higher in elevation. Removal of the LMT would not induce this type of scour response because of the lack of a hard barrier that induces wave reflection and scour. Instead the unarmored bluff would erode as the fronting beach drops, supplying material to the beach.

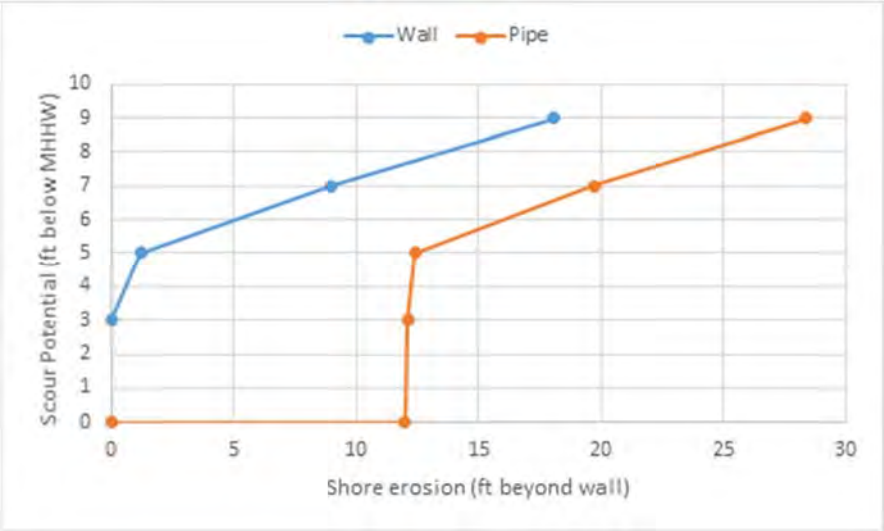


Figure 5
Scour potential at structure-beach interface for alternatives
Protect in place (Wall) and fortify (Pipe)

Similar to that for average beach width changes over the long-term, we also assigned scores for the short-term effects of the alternatives on beach widths due to episodic erosion events. **Table 2** presents the scores for each of the alternatives considered. As the table indicates, the structural protection alternatives (i.e., Alts A & B) scored lower because they would result in greater short-term impacts to the beach width due to scour during storm events. However, because the scour would be temporary and recoverable, especially if beach nourishment activities are ongoing, the structural protection alternatives were assigned scores only slightly lower (score of 3) than the non-structural alternatives (score of 4). The extent of erosion and scour would be similar for Alternatives A and B, and therefore these alternatives were assigned the same score.

TABLE 2
SHORT-TERM BEACH WIDTH (EPISODIC) INDICES FOR LMT TREATMENT ALTERNATIVES

Alternative	LMT Treatment Alternative	Short-Term Beach Width (Episodic)
A	Protect LMT with exterior low-profile wall	3
B	Protect LMT with interior reinforcement + new storage	3
C	Remove LMT + new tunnel alignment	4
D	Remove LMT + new pump station, pipeline & storage	4

Additional Beach Width Modeling Considerations

Shoreline proximity to LMT

As part of the OBMP analysis, it was conservatively assumed that an initial landward adjustment of the shore would occur after removal of the existing armoring. In reality, the bluff cover remaining between the existing beach and the LMT would provide some temporary protection to the LMT. There are erosion-resistant hardpan and concrete rubble buried in the bluff which will slow erosion. The exact location and extent of these buried components are not defined and hence ignored in erosion projections. The erosion projections are extrapolations of observed erosion, which was measured primarily at the bluff top rather than at the bluff base, whereas the bluff base has self-armored as erosion released rubble from the fill, protecting the LMT. Thus, the graphs presented in Figures 1, 2 and 3 do not include the additional bluff material and armoring between the backshore and the LMT, and therefore a greater degree of protection exists for the LMT than may be implied by the figures. While the assumption of an initial landward adjustment following armoring removal may seem conservative, they are appropriate, given the consequences of LMT damage are high indicating a high risk (probability x consequence) that needs to be mitigated.

Beach Nourishment

Compared to the nourishment scenario used in the beach width analysis, the OBMP assumes a beach nourishment program with a much greater volume of sand that is placed less frequently (approx. 0.5 MCY placed every 10 to 20 years). Although this approach was described and recommended in the OBMP because it would have much less frequent impacts on the beach environment, the details on how it would be implemented are not yet determined. The nourishment program used in this analysis (i.e., 75,000 CY every 3 years) is within the range of sediment volumes dredged under the existing USACE San Francisco

Bay Bar dredging program, which typically results in a volume of about 300k CY per year (average fluctuating dredge volume accomplished every one to two years).[3] The modeled volume of sand is also within the range of historic and recent sand backpassing from North Ocean Beach, typically between 25,000 and 75,000 cubic yards.

Conclusions

The alternatives were evaluated based upon their short- and long-term impacts on beach width. An index was established for short- and long-term beach width impacts, and each of the alternatives was evaluated under this index. A score from 1 to 4 was assigned to each alternative, where 1 is the worst performing and 4 is the best performing. The relative performance is based on the persistence of a dry beach for each of the alternatives. As shown in **Table 3**, the analyses indicate that the alternatives would perform similarly for changes to the annual average beach width, but would respond differently to short-term, episodic erosion events caused by storms. Over time, however, as the bluff material erodes away, alternatives with a hardened back beach would experience increased erosion and scour, resulting in accelerated narrowing of the beach. This is evident in the overall scores shown in Table 3; the alternatives that harden the back beach scored lower (Score of 3) than the alternatives without a hardened back beach (Score of 4).

Table 3. Ecological and Recreation Impacts

Alt. No.	Alternative	Long-Term Beach Width (Average)	Short-Term Beach Width (Episodic)	Criteria Raw Score
A	Protect LMT with exterior low-profile wall	4	3	3
B	Protect LMT with interior reinforcement + new storage	4	3	3
C	Remove LMT + new tunnel alignment	4	4	4
D	Remove LMT + new pump station, pipeline & storage	4	4	4

References

City and County of San Francisco, 2015, Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco: Assessing Vulnerability and Risk to Support Adaptation, Prepare by the City and County of San Francisco, Sea Level Rise Committee for the San Francisco Capital Planning Committee, Adopted September 22, 2014, Revision Adopted December 14, 2015, Available online: http://onesanfrancisco.org/sites/default/files/inline-files/Guidance-for-Incorporating-Sea-Level-Rise-into-Capital-Planning1.pdf.

Ocean Protection Council (OPC), 2011, Resolution of the California Ocean Protection Council on Sea-Level Rise, Adopted on March 11, 2011, Available online: http://www.opc.ca.gov/webmaster/ftp/pdf/docs/OPC_SeaLevelRise_Resolution_Adopted031111.pdf.

[3] A portion of the dredged sand would be allocated for mid Ocean Beach (MOB); while the OBMP originally recommended 0.5 MCY of sand every 10-30 years at SOB, MOB would receive about 1.5 MCY every 10-30 years.

SPUR, AECOM, ESA PWA, Nelson\Nygaard, Sherwood Design Engineers, Phil D. King, PhD, 2012, Ocean Beach Master Plan, Prepared for State of California Coastal Conservancy, San Francisco Public Utilities Commission, and the National Park Service.

SPUR, ESA PWA, Moffatt & Nichol, McMillen Jacobs Associates, AGS, 2015, Coastal Protection Measures and Management Strategy for South Ocean Beach, Ocean Beach Master Plan: Coastal Management Framework, Prepared for San Francisco Public Utilities Commission, April 24, 2015, Available online: http://default.sfplanning.org/plans-and-programs/local_coastal_prgm/Coastal__Mgmt_Framework.pdf

APPENDIX C
TECHNICAL MEMORANDUM:
SEA LEVEL RISE RESILIENCE ASSESSMENT

South Ocean Beach AAR: Technical Memorandum

Evaluation Criterion – Sea Level Rise Resilience

Louis White, PE and James Jackson, PE
Environmental Science Associates (ESA)

Prepared for the San Francisco Public Utilities Commission

February 15, 2018

Introduction

This memorandum presents an overview of the technical analysis conducted by ESA to assess the resilience of the South Ocean Beach Wastewater System to sea level rise for several Lake Merced Tunnel (LMT) treatment alternatives. In general, sea level rise will increase the risk of coastal flooding and erosion of the shore, resulting in potential impacts to the natural and built environment. The alternatives include the option to either protect or remove the LMT, which is located farther seaward than other assets. Therefore, the erosion of the shore above and behind the LMT may impact other critical assets at varying times in the future.

We assessed the degree of resilience of each alternative by estimating the timing of the exposure of these assets to future erosion hazards. Erosion was modeled using a profile-based geomorphic response model originally developed during the Ocean Beach Master Plan (OBMP). The methods and results of the model were reviewed by a technical advisory committee (TAC), a select group of technical experts in a range of relevant disciplines, including coastal management, littoral and climate science, infrastructure, and regulatory processes (SPUR et al. 2015). The assets located landward of the LMT, for which timing of the erosion hazard was estimated, include the 48-inch Force Main, 84-inch Overflow to Southwest Ocean Outfall (SWOO), the West Side Pump Station, and the Oceanside Treatment Plant.

Overall, the results suggest that the wastewater system is more resilient to coastal hazards under the alternatives that include structural protection of the LMT, while removal of the LMT could allow the erosion to impact other critical wastewater assets within the project's planning horizon (2060). It was conducted to support the comparison of relative erosion hazards and resilience among conceptual alternatives and planning-level decision making. The analysis does not represent a detailed vulnerability assessment of the assets for any particular alternative.

Sea Level Rise Resilience of Wastewater System

The resilience of the wastewater system to sea level rise impacts was analyzed by considering the timing that various critical assets located landward of the LMT are exposed to the future potential erosion hazards. The sections below describe the alternative LMT treatments that would affect the shore, a definition of the criteria and a description of the technical analysis, and the alternatives evaluation and scoring.

Alternatives

The alternatives we assessed include options to either protect the LMT in place using a low-profile wall or structural modification, or removal of the LMT:

- **Alternative A. Protect LMT with low-profile wall** – Under this alternative, a wall would be constructed approximately 10 feet seaward of the existing LMT springline (outer edge). The top of cap would be approximately 5.5 feet above the top of LMT, providing vertical cover above the tunnel. Thus, the wall (and cap) would rise to approximately 14 to 18 feet North American Vertical Datum (NAVD); the LMT's top elevation ranges from approximately 8.5 feet NAVD in the north to 12.3 feet NAVD in the south.[1] Bluff erosion would ultimately intersect the wall, fixing the backshore and limiting the amount of sand and other bluff material from being eroded onto the beach. Limitations on the landward extent and elevation of erosion were applied to the model to reflect the constructed wall geometry for this alternative.

- **Alternatives B. Fortify LMT in place via structural modification** – For this alternative, the LMT would remain in its current location and undergo structural modification. No exterior wall is included in this alternative. Bluff erosion would intersect the LMT later in time relative to the wall option (Alternative A). Because the LMT is round and lower in elevation relative to the wall in Alternative A, Alternative B would be less effective at limiting erosion of the material above the LMT. The extent and elevation limits of backshore erosion were set to reflect the current LMT geometry.

- **Alternative C& D. Remove LMT** – With these alternatives, the LMT would be completely removed and bluff erosion would proceed naturally. No additional limitations or constraints on backshore erosion were applied to the model.

Criteria Definition and Analysis

The timing of the exposure of critical wastewater assets to the potential erosion hazard zone is used as a measure of sea level rise resilience value for each alternative. The timing of the exposure of the asset to the erosion hazard was determined when the eroded future profile intersected a 25-foot buffer zone seaward of one of the four wastewater assets listed below:

- 48-inch Force Main
- 84-inch Overflow to SWOO
- West Side Pump Station
- Oceanside Treatment Plant

The 25-foot safety buffer is an allowance for erosion from an episodic bluff erosion event with a 15- to 20-year return period. This buffer would protect the assets while mitigating interventions are developed and implemented, which requires lead-time. The safety buffer concept used here is based on the analysis and recommendations made in the *Coastal Protection Measures & Management Strategy for South Ocean Beach* (SPUR et al. 2015).

[1] Mean sea level at Ocean Beach is approximately 3.2 feet NAVD (NOAA/Co-ops station 9414290).

Figures 1 and **2** present a plan-view diagram of the wastewater assets overlaid on an aerial image[2] at the northern and southern halves of South Ocean Beach, respectively. As shown in the figures, the relative locations of the assets vary along the shore. Two cross-shore profiles were selected to best represent the locations that pose the greatest risk to the different wastewater system assets:

- Profile A in the north includes
  - LMT
  - 84-inch Overflow to SWOO
  - 48-inch Force Main
  - Westside Pump Station

- Profile B in the south includes
  - LMT
  - 84-inch Overflow to SWOO
  - 48-inch Force Main
  - Oceanside Treatment Plant
  - SWOO

We did not consider erosion impacts to the LMT and SWOO assets in the exposure analysis. Because the alternatives would either protect the LMT in-place or remove it entirely, impacts of erosion were not factored into the performance of each alternative. The SWOO was not considered because it is lower in elevation than the LMT, and its landward components are not expected to be impacted by sea level rise within the planning horizon of the project. The analysis conducted represents a high-level assessment of potential erosion hazards to be used in comparing alternatives, and does not include a detailed vulnerability assessment of the assets. More detailed analysis is needed for design of alternatives and further understanding of potential impacts.

The proximity of the erosion hazard to the assets were measured over time for each alternative using a model previously developed by ESA for the Ocean Beach Master Plan (OBMP). The model is a profile-based geomorphic response model. The model uses the modified Bruun rule, which accounts for the rate of shoreline erosion over time based on the historic shoreline erosion rate, the overall slope of the shore, and sea level rise. This approach yields a conservatively high amount of erosion due to the assumptions that all of the shoreline protection structures would be removed, the bluff material is composed of sand, and an initial adjustment of the shore by 40 feet to account for immediate erosion after armor removal.

Sea level rise amounts used in this analysis are consistent with the approach used in the OBMP, and based on the March 2011 resolution of the Ocean Protection Council (OPC 2011). The sea level rise amounts used are:

- 2030: 0.6 feet sea level rise
- 2050: 1.2 feet sea level rise
- 2100: 4.6 feet sea level rise

The above-listed sea level rise amounts are also consistent with the sea level rise projections in the City and County of San Francisco's *Guidance for Incorporating Sea Level Rise into Capital Planning in*

[2] Aerial image of South Ocean Beach was collected by Sierra Overhead Analytics in March 2017

San Francisco (City and County of San Francisco 2015), which are based on the sea level rise projections from the National Research Council (NRC 2012). It is important to note that the model was used to compare the relative resiliency of the alternatives to sea level rise erosion hazards, rather than to identify sites for the placement of infrastructure. The sea level rise amounts used in the model (OPC estimates) are: 0.6 feet by 2030, 1.2 feet by 2050, and 4.6 feet by 2100. The CCSF sea level rise guidance recommends using projections of 6 in. by 2030, 11 in. by 2050, and 36 in. by 2100; with adaptive capacity to accommodate upper end ranges of 12 in., 24 in., and 66 in. for these years, respectively. While not identical, the OPC and CCSF estimates are sufficiently similar to inform an analysis of the relative differences between alternatives.

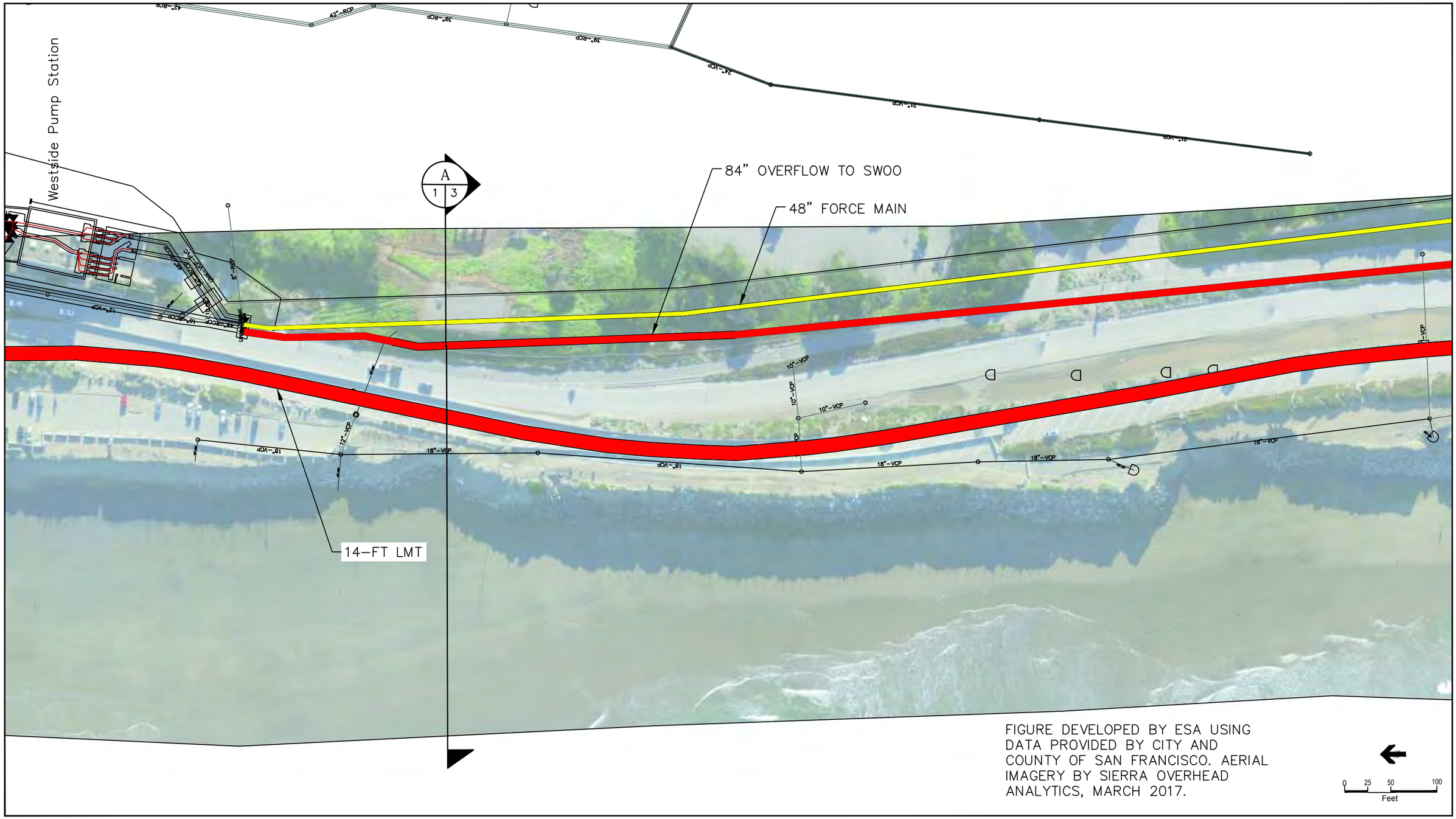
Figures 3 and **4** present the profile analysis for the two SOB locations A and B, respectively. The three panels in each figure represent the analysis for the different alternatives. The solid line represents the existing grade profile, and dashed lines represent the future eroded profiles. The red, blue and green dashed lines represent the eroded future profiles at 2030, 2050 and 2100, respectively. Additional black dashed lines were included for years 2060, 2070, 2080, and 2090. When one of the dashed lines came within approximately 25 feet of one of the critical assets, the associated time of exposure was tabulated into the results. **Table 1** presents a summary of the estimated year that the erosion hazard would intersect the asset safety buffer.

TABLE 1
ESTIMATED YEAR OF EROSION HAZARD INTERSECTION WITH ASSET SAFETY BUFFER

Alt. No.	Alternative	48-inch Force Main	84-inch Overflow to SWOO	Westside Pump Station	Oceanside Treatment Plant
A	Protect LMT with exterior low-profile wall	2060	2065	2085	2090
B	Protect LMT with interior reinforcement + new storage	2050	2055	2075	2070
C	Remove LMT + new tunnel alignment	2045	2050	2070	2065
D	Remove LMT + new pump station, pipeline & storage	2045	2050	2070	2065

These results represent the approximate year that the different assets would be exposed to the future erosion hazard. The year values presented in Table 1 represent the earliest time that the shore would be expected to intersect an asset buffer in either profile (A or B). This analysis is coarse, and sufficient only for comparison of alternatives and not detailed design.

As indicated in Figure 1, shoreline profile A was established at the location where the 84-inch Overflow to SWOO and the 48” Force Main are closest to the existing erosion hazard, located immediately north of the existing sand bag structure. While the Westside Pump Station is not physically located within Profile A, its relative location is included in Profile A for reference (Figure 3). As shown in Figure 2, the shoreline profile B was established at a location in front of the Wastewater Treatment Plant (Figure 4).



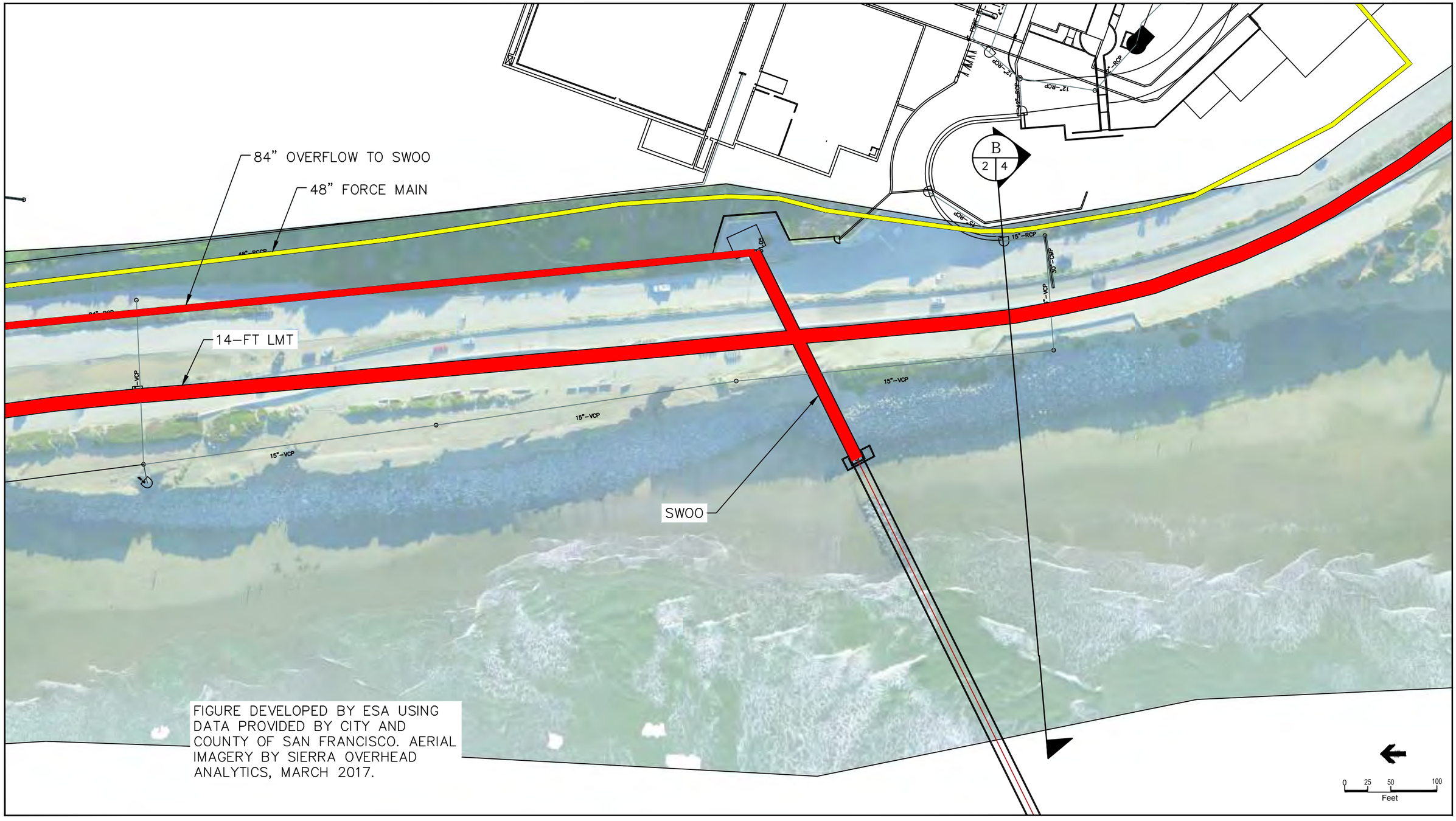
SOURCE:

ESA

Ocean Beach AAR - Alternatives Evaluation . 120468.10

FIGURE 1

South Ocean Beach - North
Plan View



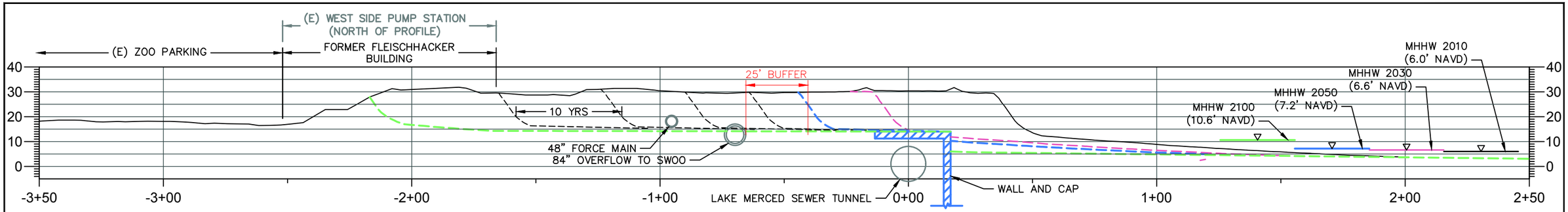
SOURCE:

ESA

Ocean Beach AAR - Alternatives Evaluation . 120468.10

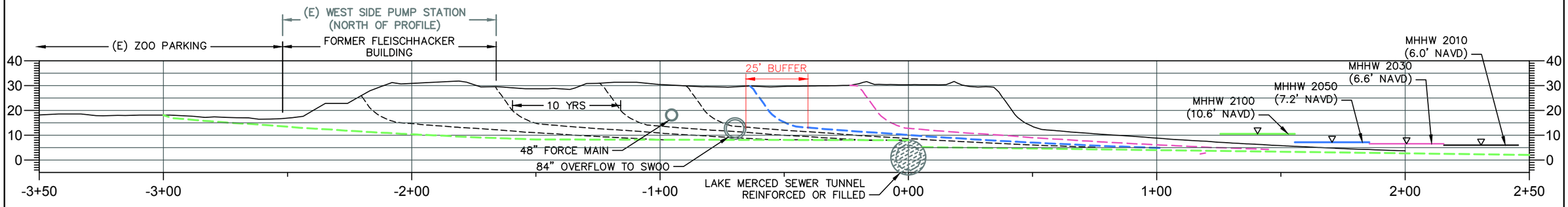
FIGURE 2

South Ocean Beach - South
Plan View



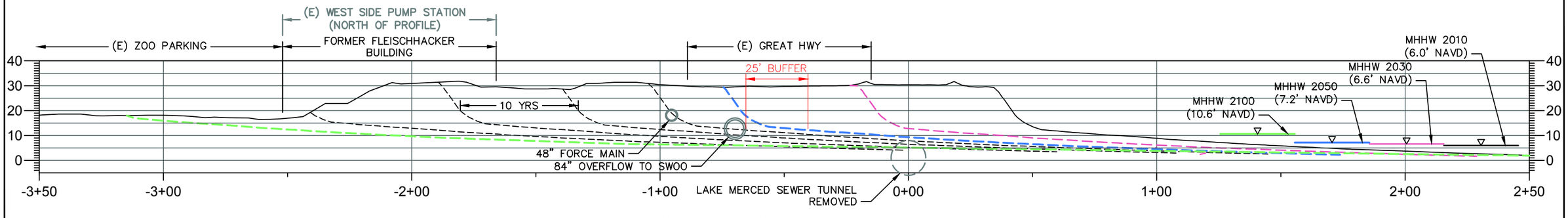
PROFILE A - WALL AND CAP

SOB 1" = 40'



PROFILE A - REINFORCED/FILLED LMT

SOB 1" = 40'



PROFILE A - REMOVE LMT

SOB 1" = 40'

0 20 40

SCALE (FEET)

SOURCE:

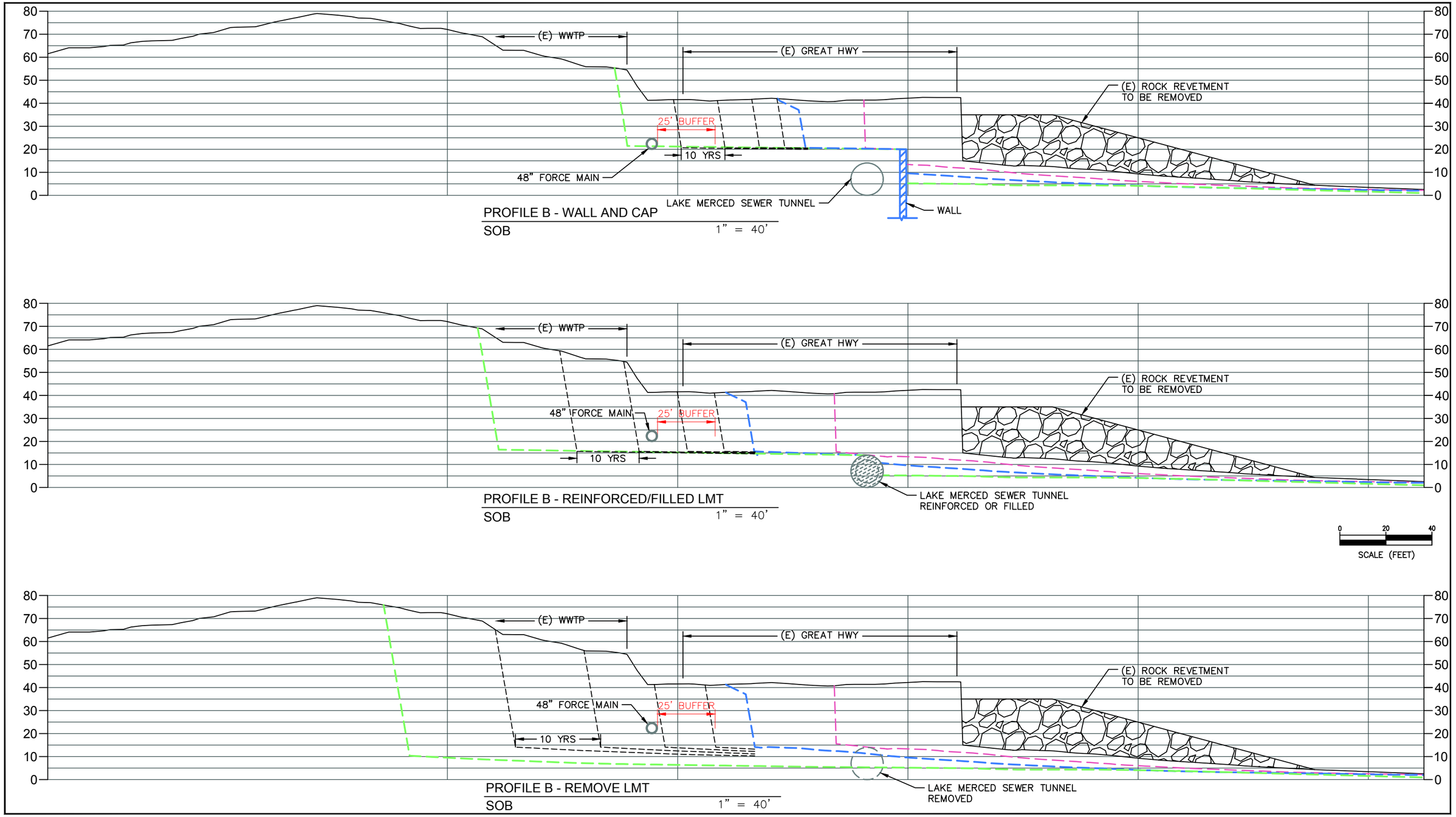
ESA

2010 PROFILE
2030 PROFILE
2050 PROFILE
2060–2090 PROFILES
2100 PROFILE

NOTES:
1. VERTICAL GRID 5' INTERVALS IN NAVD. HORIZONTAL GRID 100' INTERVALS.
2. 2017 PROFILES SHOW GROUND SURVEY BY ESA FROM SOB MONITORING.
3. SURFACE FEATURES LOCATED WITH GEO-REFERENCED DIGITAL AERIAL PHOTOGRAPHY.
4. SEWER FACILITIES LOCATIONS PROVIDED BY SFPUC.
5. FUTURE PROFILES ESTIMATED USING LONG TERM EROSION RATES AND ACCELERATED SEA LEVEL RISE PROJECTIONS (OPC, 2010).

FIGURE 3

Profile A - Erosion with SLR
Where Bluff is closest to 84" Overflow to SWOO ("Decant Pipe")



SOURCE:

ESA

- 2010 PROFILE
- 2030 PROFILE
- 2050 PROFILE
- 2060–2090 PROFILES
- 2100 PROFILE

NOTES:
1. VERTICAL GRID 5' INTERVALS IN NAVD. HORIZONTAL GRID 100' INTERVALS.
2. 2017 PROFILES SHOW GROUND SURVEY BY ESA FROM SOB MONITORING.
3. SURFACE FEATURES LOCATED WITH GEO-REFERENCED DIGITAL AERIAL PHOTOGRAPHY.
4. SEWER FACILITIES LOCATIONS PROVIDED BY SFPUC.
5. FUTURE PROFILES ESTIMATED USING LONG TERM EROSION RATES AND ACCELERATED SEA LEVEL RISE PROJECTIONS (OPC, 2010).

FIGURE 4

Profile B - Erosion with SLR
At WWTP

Alternatives Evaluation and Scoring

Performance of the alternatives is based upon consideration of the relative time that the assets would be exposed to the erosion hazard. An index for the resilience metric was developed based on the relative timing described above, and each of the alternatives was evaluated under this index. A score from 1 to 4 was assigned to each alternative, where 1 is the worst performing and 4 is the best performing. The relative performance is based on the duration that the assets are operable without being exposed to the erosion hazard. **Table 2** presents a summary of scores assigned to each asset for the various alternatives, where the index value is assigned based on whether the estimated time of impact is within the planning horizon (score 1,2 or 3), or beyond the planning horizon (score 4). The index is then averaged to yield the criteria raw score.

TABLE 2
SCORES FOR ASSET EXPOSURE FOR VARIOUS ALTERNATIVES

Alt. No.	Alternative	48-inch Force Main	84-inch Overflow to SWOO	Westside Pump Station	Oceanside Treatment Plant	Criteria Raw Score
A	Protect LMT with exterior low-profile wall	4	4	4	4	4
B	Protect LMT with interior reinforcement + new storage	3	3	3	3	3
C	Remove LMT + new tunnel alignment	2	2	2	2	2
D	Remove LMT + new pump station, pipeline & storage	2	2	2	2	2

As indicated by the scores presented in Table 2, the Alternative A provides the greatest amount of resilience to the wastewater system, in that the critical assets located landward of the LMT are at lower risk of erosion impacts than the alternatives to use structural modification (no wall) and removal of the LMT. The analysis is in agreement with the recommendations of the OBMP that even with the low-profile wall, additional protection of other assets may be required in the future.

References

City and County of San Francisco, 2015, Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco: Assessing Vulnerability and Risk to Support Adaptation, Prepare by the City and County of San Francisco, Sea Level Rise Committee for the San Francisco Capital Planning Committee, Adopted September 22, 2014, Revision Adopted December 14, 2015, Available online: http://onesanfrancisco.org/sites/default/files/inline-files/Guidance-for-Incorporating-Sea-Level-Rise-into-Capital-Planning1.pdf.

National Research Council (NRC), 2012, Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future, the National Academies Press, Washington DC.

Ocean Protection Council (OPC), 2011, Resolution of the California Ocean Protection Council on Sea-Level Rise, Adopted on March 11, 2011, Available online: http://www.opc.ca.gov/webmaster/ftp/pdf/docs/OPC_SeaLevelRise_Resolution_Adopted031111.pdf.

SPUR, ESA PWA, Moffatt & Nichol, McMillen Jacobs Associates, AGS, 2015, Coastal Protection Measures and Management Strategy for South Ocean Beach, Ocean Beach Master Plan: Coastal

Management Framework, Prepared for San Francisco Public Utilities Commission, April 24, 2015, Available online: http://default.sfplanning.org/plans-and-programs/local_coastal_prgm/Coastal__Mgmt_Framework.pdf