



**US Army Corps
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San Francisco District

Appendix F Civil Design



**Colma and San Bruno Creek
Flood Risk Management Section 203 Feasibility Study
South San Francisco, California**

Civil Design Appendix



**U.S. Army Corps of Engineers
San Francisco District**

June 2022

**COLMA AND SAN BRUNO CREEK
FLOOD RISK MANAGEMENT SECTION 203 FEASIBILITY STUDY
SOUTH SAN FRANCISCO, CALIFORNIA**

CIVIL DESIGN APPENDIX

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1 INTRODUCTION

This appendix documents the civil design for improving flood risk management (FRM) along San Bruno and Colma Creek in South San Francisco, CA. The purpose of the Lower Colma Creek Flood Risk Management Feasibility Study is to reduce flood damages to the wastewater treatment plant, City of South San Francisco and infrastructure due to fluvial flooding and sea level rise in Lower Colma Creek. The study area includes the reach of the wastewater treatment plant and nearby Pumpstation #4. This appendix summarizes the design and site considerations required for construction of project features, floodwalls, staging areas, real estate requirements, relocations and quantities developed for the alternatives analyzed for the Lower Colma Creek Flood Risk Management Feasibility Study. Design consideration information includes floodwalls and floodgates guidance, EM-1110-2-2000 Standard Practice for Concrete for Civil Works Structures and ER 1110-2-1150 Engineering and Design for Civil Works Projects.

1.1 PROJECT LOCATION AND BACKGROUND

Colma Creek drains roughly 16 square miles as it flows from San Bruno Mountain down through the heavily urbanized cities of Colma, South San Francisco, San Bruno, and Daly City on its way to San Francisco Bay (Figure 1). The creek is bordered by the San Andreas Fault to the west and San Bruno Mountain to the north. As it approaches San Francisco Bay, the Colma Creek channel once included historical salt marsh wetlands, most of which have been filled due to development. Limited wetland areas remain at the mouth of Colma Creek. Today, the creek serves as the City's stormwater infrastructure.

San Bruno Creek also starts in San Bruno Mountain, and it flows to San Francisco Bay through a tide gate structure roughly 1,400 feet south of where Colma Creek meets San Francisco Bay (Figure 2). San Bruno Creek drains an area of roughly 4.5 square miles, collecting runoff from the City of San Bruno.

The lower reaches of Colma and San Bruno Creeks are heavily tidally influenced. During King or extreme tides on San Francisco Bay, drainage of the creeks is impeded, causing water levels to back up in the channels, potentially leading to overtopping the banks. With sea level change (SLC) increasing San Francisco Bay water levels, it is likely that San Bruno and Colma Creeks will more frequently overflow their banks and inundate surrounding areas due to more frequent high-water events on the Bay.

Flooding along the lower reaches of the Colma Creek and San Bruno Creek Project Area threatens critical public infrastructure and residential areas in South San Francisco and nearby San Bruno. As both creeks drain to San Francisco Bay, extreme tides on the Bay can exacerbate fluvial flooding in these areas. Sea level change on San Francisco Bay is therefore expected to increase the frequency with which Colma and San Bruno Creeks inundate surrounding areas and infrastructure. Erosion and in-channel sedimentation in Colma Creek Channel are also concerns that reduce capacity of the channel, which can increase the likeliness of overbank flooding.

Colma Creek is hydraulically connected to San Bruno Creek, Navigable Slough, and San Francisco Bay. Therefore, implementing flood risk management (FRM) measures in one part of this system will affect water levels in another part of the system and these effects must be considered during plan formulation.

The Belle Air, Lindenville, and Tanforan neighborhoods are some of the most low-lying and neighborhoods in the project area and are vulnerable to flooding from the creeks. The South San Francisco Bay Area Rapid Transit (BART) station is immediately adjacent to the Colma Creek flood control channel and overtopping of the channel is likely to significantly disrupt regional transportation. Other vulnerable transportation assets include the South San Francisco Caltrain station, US Highway 101, and a regional bus depot operated by SamTrans. Other non-transportation assets that could be affected by flooding from San Bruno and Colma Creeks, exacerbated by SLC, include PG &E electrical substations, fire stations, a number of outpatient health care facilities, and a homeless shelter.

Project purpose: The purpose of this feasibility study in this project area is to explore flood risk management (FRM) measures to reduce present and future flood risk associated with sea-level change along San Bruno and Colma Creeks. The City will consider structural FRM measures that include (but are not limited to) traditional levees, seawalls, floodwalls, horizontal levees, and wetlands restoration. The feasibility study will also explore nonstructural FRM Measures, including elevation, flood proofing, and acquisition and relocation of critical infrastructure, land use planning policies, enhanced crisis management efforts, and flood insurance. In the development and selection of alternatives, the feasibility study will evaluate the potential for integrating natural and nature-based FRM measures to reduce flood risk and preserve or enhance environmental quality.

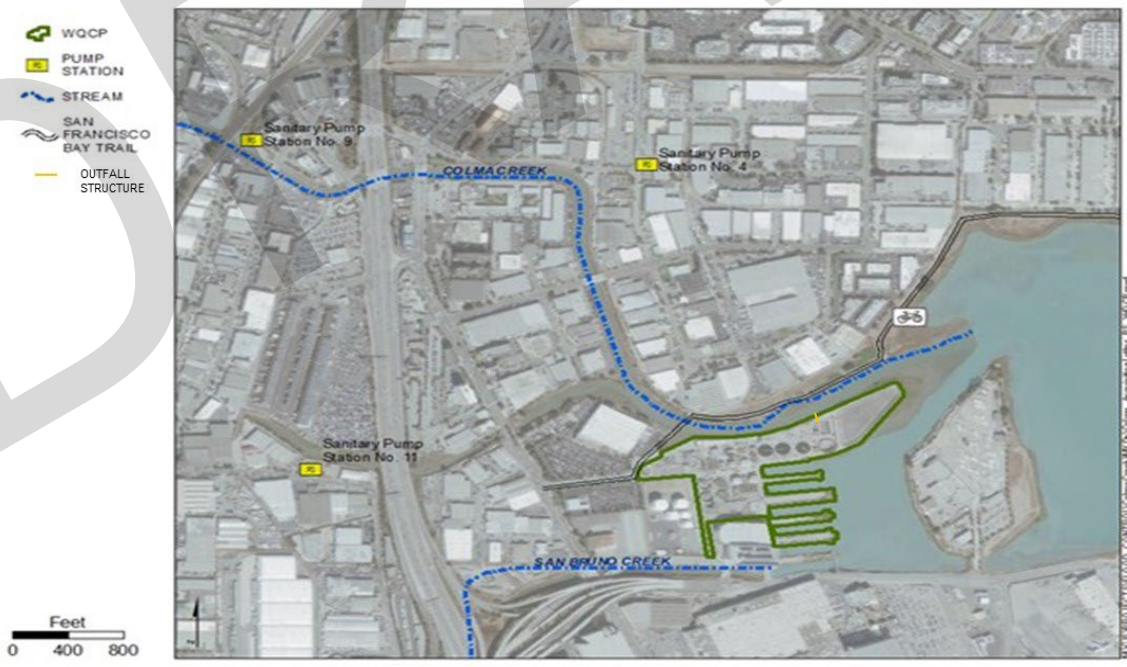
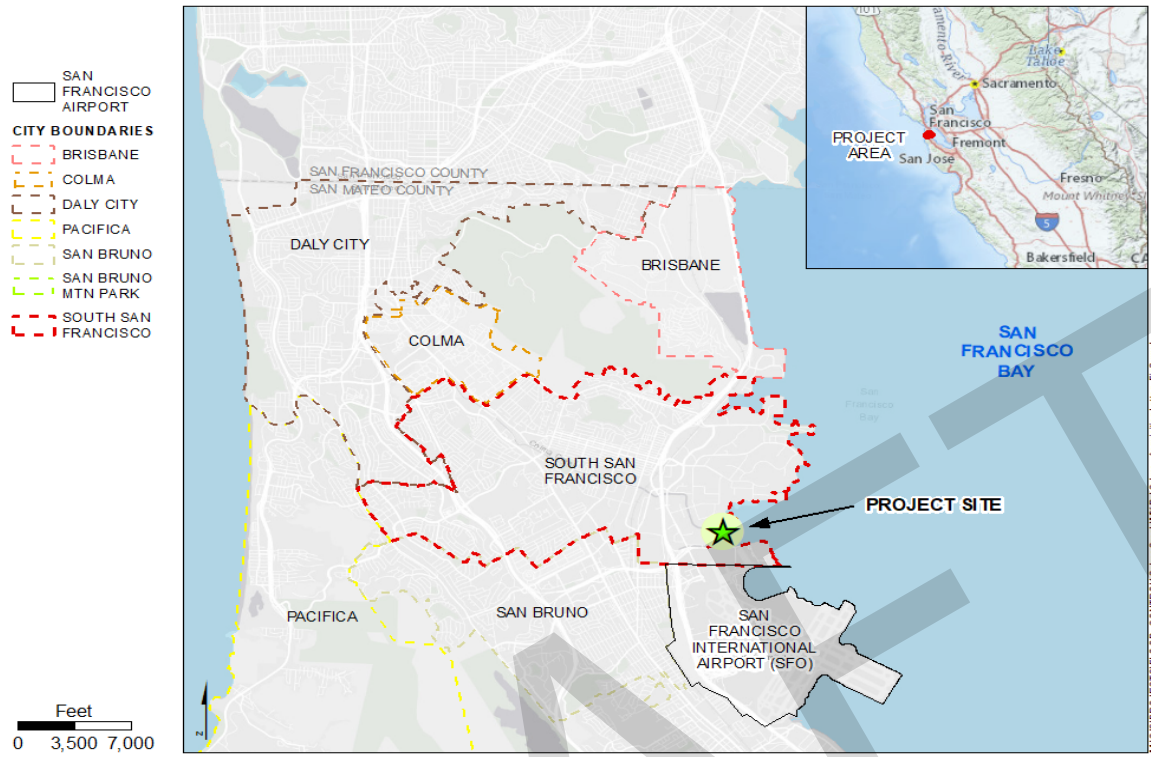


Figure 1.1: Study Area

1.2 PROJECT LIMIT AND COORDINATION

The project limit covers the footprint of the South San Francisco Water Quality Control Plant (WQCP) and Pump Station #4 (see Fig 1.1). The project delivery team (PDT) consisted of USACE San Francisco. Non-USACE team members include the City of South San Francisco and City of San Bruno.

2 GENERAL CONSIDERATIONS

2.1 TOPOGRAPHIC DATA

The topographic survey will be done in the PED phase. The elevations recorded will be in feet and referenced to the North American Vertical Datum of 1988 (NAVD88) and the horizontal datum is referenced to the North American Datum of 1983 (NAD83), and California State Plane Coordinate Zone III.

2.2 CLEARING, GRUBBING, AND STRIPPING

All areas, 4 feet wide along the floodwall alignment to either be excavated or native soil areas to be prepared to receive fill will be stripped of topsoil. This included the levee slopes. Other areas will be cleared and grubbed, including tree removal in the park and along the existing rock slopes. Stripping consists of the removal of weeds, grasses, and other vegetative materials, and the removal of surface soils.

2.3 SHEETPILE WALLS AND CONCRETE FLOODWALLS

The proposed sheetpile walls will include the concrete reinforced cap on top of sheetpile. According to the Geo-tech analysis, the walls are constructed by driving approximately 13' of prefabricated sections below the grades and extend approximately 4' of concrete cap above the grades. Depends on the soil conditions which may allow for the sections to be vibrated into ground instead of it being hammer driven. The full sheet pile wall is formed by connecting the joints of adjacent sheet pile sections in sequential installation. Foundations and detailed information on sheetpile floodwall and ring concrete floodwall can be found in the Geo-tech appendix.

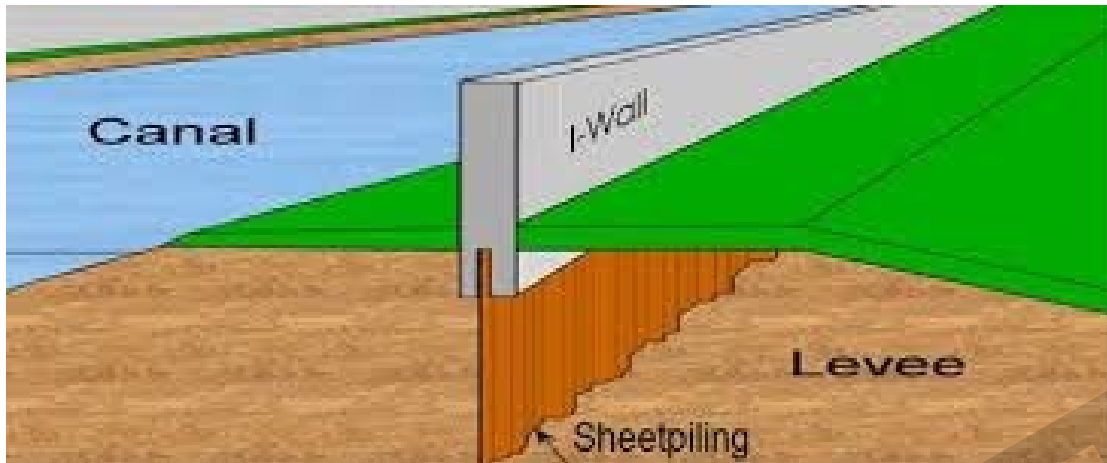


Figure 2.1: Sheetpile Floodwall

2.4 ALIGNMENT AND STATIONING

The stations will be set at 100-foot intervals along the centerline of the floodwall following standardized notation norms and procedures.

2.5 UTILITIES

There are several known utilities in the wastewater treatment plant that will need to be modified during the north and south floodwall construction (See Plate 2).

Table 2.1: Utilities affected by the Floodwalls

| Item | Known Utility | Location | Owner |
|------|---------------------------|-----------------|--------------------------|
| 1 | 48"-D Storm Drain outfall | North wall, N1A | City of S. San Francisco |
| 2 | 30"-D Storm Drain culvert | North wall, N1A | City of S. San Francisco |
| 3 | High voltage Cable | South wall, 2S | City of S. San Francisco |
| | | | |

2.6 KNOWN LOWER COLMA CREEK FLOOD EVENTS

Periodic flooding occurs in South San Francisco but is generally confined to certain areas along Colma Creek north of the project site. The water levels in Colma Creek are highly influenced by both tidal action and storm events. The project site is located within a 1% annual exceedance probability (AEP) floodplain, colloquially referred to as the 100-year floodplain, designated by the Federal Emergency Management Agency (FEMA; 2012). The FEMA maps reviewed in a recent flood study (Carollo Engineers, 2010) indicate that the 1% AEP event occurring at high

tide would raise water levels to 9.7 feet above mean sea level. The Maintenance Building at the project site lies at an elevation of approximately 12.82 feet (Carollo Engineers, 2010). While the water level is not regularly monitored in the stretch of the creek bordering the project site, near-flooding conditions have been observed outside the Maintenance Building (Carollo Engineers, 2010). As recently as October 13, 2009, the water level was measured to be 1.6 feet above the 1% AEP flood level (11.3 feet above mean sea level), which is approximately 1.5 feet below the Maintenance Building's foundation elevation. The project site is not substantially higher than potential flooding events.

2.7 CONSTRUCTION ACCESS – HAUL ROUTES, ACCESS RAMPS AND STAGING AREAS

The PDT has identified a staging area and access haul route (See Figure 3.2) throughout the project that are strategically positioned.

2.8 REAL ESTATE REQUIREMENTS

The Non-Federal Sponsor is responsible for the procurement of all lands, easements, relocations, rights-of-way, and disposal areas (LERRD) necessary for the construction, operation, and maintenance of the project.

Temporary construction easements and staging / stockpiling areas will also be required for this project. Materials to be disposed of will be hauled to a landfill or other areas to be identified during the design phase of the project.

Maps and detailed information on easements and affected properties can be found in the Real Estate appendix.

2.9 OPERATION AND MAINTENANCE

The Inspection of Completed Works (ICW) program is an O&M program that provides for USACE inspections of federally constructed flood risk management projects. A draft O&M manual will be developed preceding a project's final design state and used by the counties and the USACE to ensure that the project is maintained to USACE standards. Annual and periodic 5-year ICW inspections will be performed for the Lower Colma Creek Project which will be based on the O&M manual requirements and current USACE maintenance standards. The O&M manual will provide a detailed description of the management activities for the floodwall, channel, vegetation, sediment, debris, bank erosion, concrete surfaces, and other activities to provide the design flood conveyance of the TSP.

3 PROJECT DESIGN ALTERNATIVES AND SELECTED PLAN

3.1 FINAL ARRAY OF ALTERNATIVES

A wide range of features were considered and evaluated to reduce flood risk in the project area. Below is the final array of alternatives that were analyzed:

Alternative Plan 1: 1% Annual Chance Exceedance (ACE) protection with floodwall installation consisting of approximately 1,996 feet of the sheetpile wall with reinforced concrete cap along the north perimeter of the wastewater treatment plant plus ring floodwall at pump station 4, with flood warning system.

LOWER COLMA CREEK ALT - FLOODWALL 1A & B (N)



Figure 3.1: Alternative Plan 1

Alternative Plan 2: 0.2% Annual Chance Exceedance protection with floodwall installation consisting of approximately 2,660 feet of the sheetpile wall with reinforced concrete cap along the north and south perimeter of the wastewater treatment plant plus ring floodwall at pump station 4, with flood warning system.

Alternative Plan 3 (Nonstructural only): Floodproofing 23 buildings at the main WQCP and ring floodwall at pump station 4, with flood warning system, plus raising critical access in place, and providing elevated emergency exits for plant operator.

3.2 TENTATIVELY SELECTED PLAN

The Tentatively Selected Plan (TSP) milestone was held in March 2022, where it was determined that Alternative 2 was the TSP. Alternative 2 was found to have a higher benefit to cost ratio than Alternative 1. However, both alternatives were found to have positive benefit to

cost ratios. Alternative 2 is the locally preferred plan (LPP). At the request of the Sponsor, the LPP was recommended as the TSP.

LOWER COLMA CREEK TSP – LOCATION MAP FOR NORTH FLOODWALL, SOUTH FLOODWALL, AND PUMPSTATION #4



LOWER COLMA CREEK TSP - FLOODWALLS 1A, 1B (N) & 2(S)



LOWER COLMA CREEK TSP – FLOODWALL AT PUMPSTATION #4

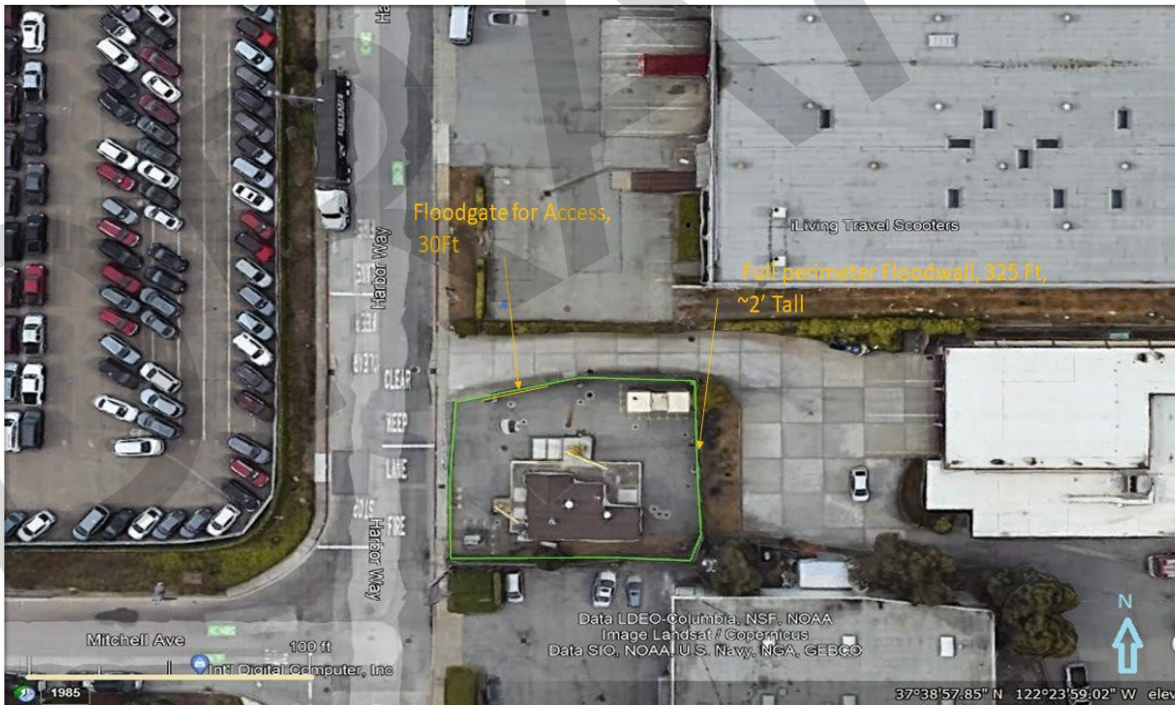


Figure 3.2: Tentatively Selected Plan

3.3 CIVIL QUANTITY ESTIMATES

Construction quantity estimates for excavation, stockpiling and backfill were calculated utilizing the average end area method, which were based on the topo survey (see paragraph 2.1 Topographic Data). Additional construction quantity estimates included reinforcing steel rebar tonnage for floodwall construction, concrete caps, traffic control, and construction fencing.

Table 3.1: Estimated Quantities of Floodwall Construction

| | Task | Estimated Quantity | Unit of Measure |
|----|---|---------------------------|------------------------|
| 1 | MOBILIZATION AND DEMOBILIZATION | 1 | Job |
| 2 | STORM WATER POLLUTION PREVENTION PLAN | 1 | Job |
| 3 | PRE-AND-POST CONSTRUCTION SURVEY | 1 | Job |
| 4 | CLEARING AND GRUBBING | 1 | Job |
| 5 | CONTROL OF WATER | 1 | Job |
| 6 | TRAFFIC CONTROL | 1 | Job |
| 7 | CONSTRUCTION TRAILER | 1 | EA |
| 8 | CONCRETE REMOVAL & SITE DEMOLITION | 1 | Job |
| 9 | TRENCH EXCAVATION | 121 | CY |
| 10 | SAWCUTTING | 650 | LF |
| 11 | CONCRETE T-WALL AT PUMPSTATION 4 | 115 | CY |
| 12 | FLOODGATE & STOPLOGS | 30 | LF |
| 13 | CONCRETE FORMING AT PUMPSTATION 4 | 325 | LF |
| 14 | #4 REBAR FOR PUMPSTATION 4 | 4,343 | LB |
| 15 | 6' TALL CHAIN LINK FENCE AND STREET-END-BARRICADE | 1 | Job |
| 16 | 6' TALL TEMPORARY CONSTRUCTION FENCE AND RAIL | 400 | LF |
| 17 | SHEETPILE WALL (S) | 9,960 | SF |
| 18 | CONCRETE CAP (S) | 222 | CY |
| 19 | #4 REBAR FOR SOUTH WALL | 7,097 | LB |
| 20 | CONCRETE FORMING (S) | 7,968 | SF |

| | | | |
|----|-------------------------|--------|-----|
| 21 | SHEETPILE WALL (N) | 29,925 | SF |
| 22 | CONCRETE CAP (N) | 665 | CY |
| 23 | #4 REBAR FOR NORTH WALL | 21,323 | LB |
| 24 | CONCRETE FORMING (N) | 23,940 | SF |
| 25 | Utility Modification | 1 | Job |

3.4 CONSTRUCTION DURATION ESTIMATES

The estimated duration of the construction for the floodwall and utility modification is 12 months. The daily production rate of the sheetpile wall construction is approximately 30 feet. The following assumptions should be considered as far as the construction schedules are concerned.

- Construction activities must be scheduled according to project phase narrative.
- Single crews will be mobilized for each independent activity.
- Utility construction in plans set is not included in these rates.
- Weather delays are not accounted for in these rates.

However, due to environmental restrictions, work in the creek will be allowed for 6 months in a year. Therefore, it is expected that the construction would occur during two construction seasons.

3.5 CONSTRUCTION EQUIPMENT AND SEQUENCE

The construction equipment will include, but not limited to, concrete saw cutter, front-end loader with 2 CY bucket, 10 CY dump truck, hydraulic excavator with 1.5 CY bucket, sheepsfoot soil compactor, 3,000-gallon water tank and hydraulic hammers.

The proposed construction sequence is as follows:

1. A loader will remove vegetation and rock from the top of the bank and will stockpile materials in the staging area or load directly into a dump truck. Start work at South floodwall 2, begin removing vegetation from the 4' wide work zone along the alignment and use hydraulic hammers drive sheet piles to its final elevations.
2. Move the same equipment to Floodwall 1 N and Floodwall 2-N; repeat the same process as Item 1. The hydraulic excavator excavates the trench to gain an access at Floodwall 1-N for manually seal the intersection of the floodwall and storm drainpipe.
3. At the low spots near the bridge location, excavate slope toe and prep soil sub-base prior to placing imported clay. Import clay from staging area to the site. Dump truck will unload clay at the top of bank and the loader will move clay into the low spots adjacent to the bridge. Final placement of the clay will be placed by the excavator. The remaining slope above the levee will be compacted using compaction equipment or a dozer if the slope isn't very steep.
4. Hydroseed slope.

- This activity might be done last when all construction is nearly complete.
 - Additional measures could be needed if the final slope is steep. May need to use an erosion control netting/blanket. Wire netting could be used if the slope is steeper than or equal to 1.5H:1V slope.
5. Move excavator and loader over to Pump station #4. Excavator will start construction from the top and will remove sawcut concrete slab and excess soil along the alignment. A loader will remove concrete out of the sawcut areas. Dump trucks will remove concrete/excess soil to the staging area or to the landfill.

3.6 TRAFFIC CONTROL

The Belle Air Rd Lane right next to the Costco Gas station is expected to need traffic control when the construction equipment goes in and out of the plant through the access roads. During the floodwall construction, a concrete truck is expected to be parked on the Belle Air Rd Lane or Costco parking lot right next to the creek while concrete is pumped to the creek.

3.7 ACRONYMS AND ABBREVIATIONS

ACE - Annual Chance Exceedance
 CFS – Cubic Feet per Second
 CY – Cubic Yard
 FRM – Flood Risk Management
 ICW – Inspection of Completed Works
 LF – Linear Feet
 LB - Pound
 LERRD – Lands, Easements, Relocations, Rights-of-way, and Disposal Area
 NAD – North American Datum
 NAVD – North American Vertical Datum
 O&M – Operation and Maintenance
 PDT – Project Delivery Team
 PED – Preconstruction Engineering and Design
 NED – National Economic Development
 RW – Retaining Wall
 SF – Square Feet
 STA – Station
 TSP – Tentatively Selected Plan
 USACE – U.S. Army Corps of Engineers
 WQCP – Water Quality Control Plant

3.8 REFERENCES

- Lower Colma creek H&C engineering appendix, Detail project report, March 2022
- Staff Summary sheet – Lower Colma CAP 103 RP Execution sheet

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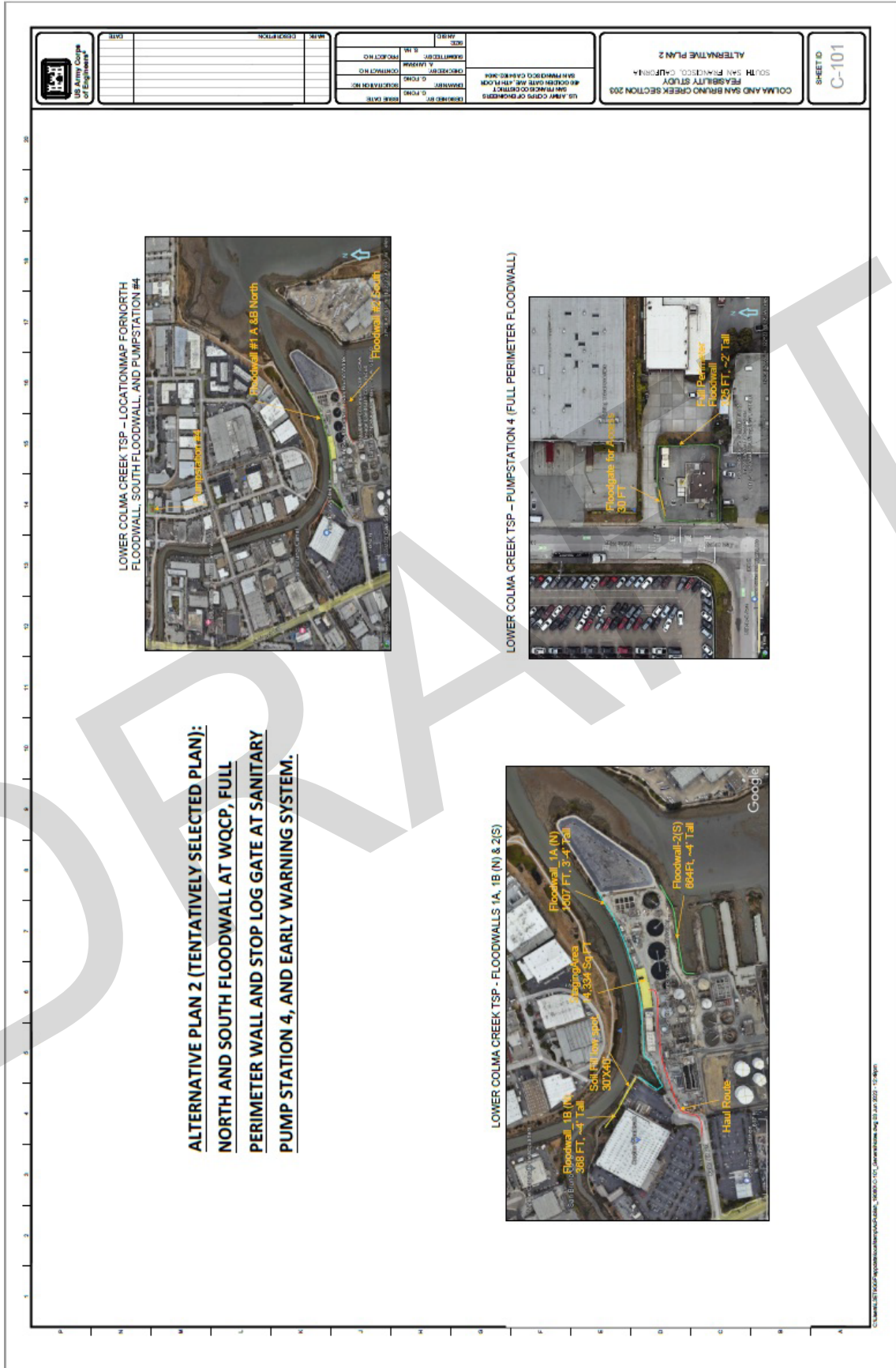


Plate 1

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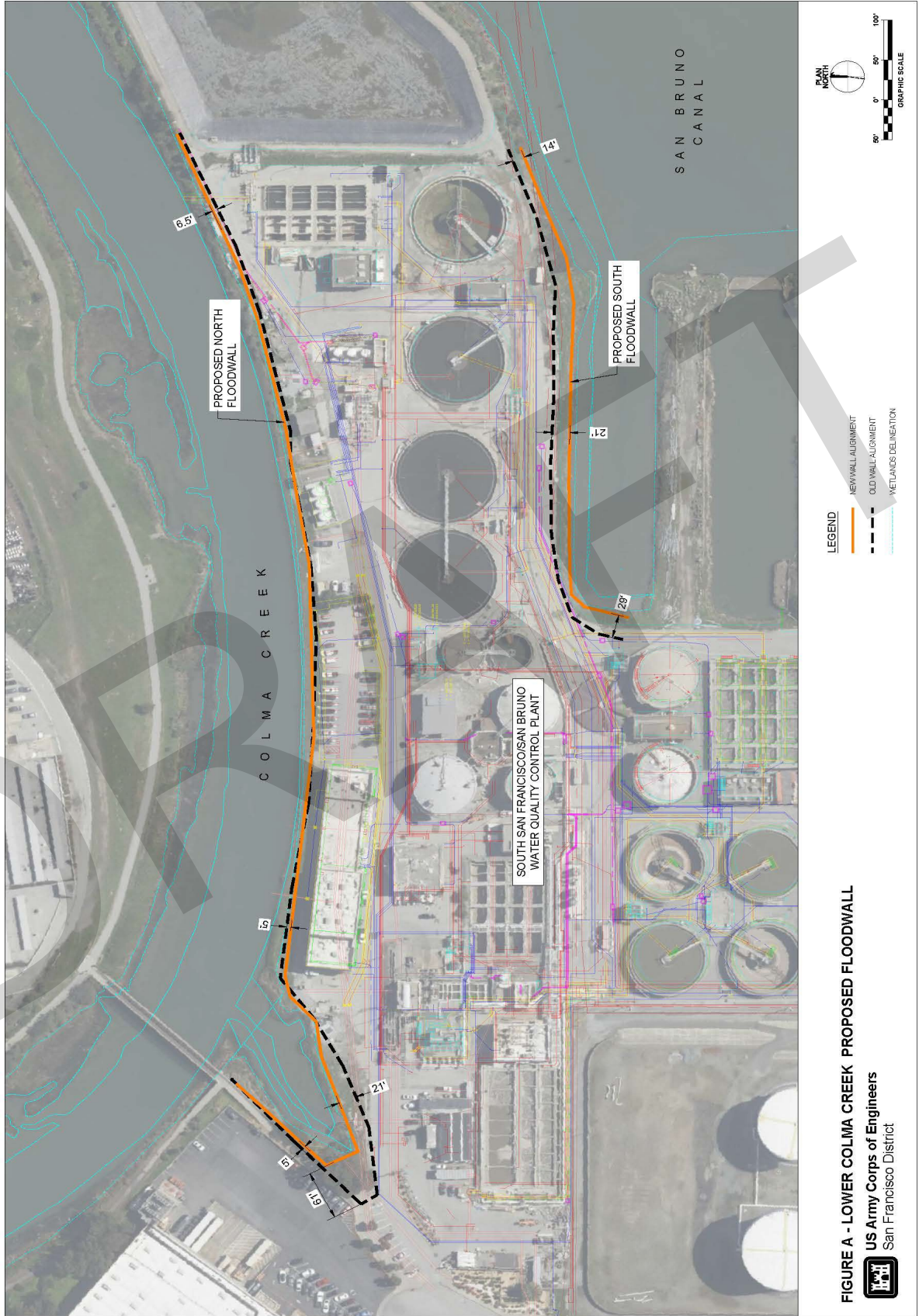


FIGURE A - LOWER COLIMA CREEK PROPOSED FLOODWALL


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Plate 2

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